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Beyond the Great Recession: Labor Market Polarization and Ongoing Fertility Decline in the United States

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Abstract

In the years since the Great Recession, social scientists have anticipated that economic recovery in the U.S., characterized by gains in employment and median household income, would augur a reversal of declining fertility trends. However, the expected post-recession rebound in fertility rates has yet to materialize. In this study, I propose an economic explanation for why fertility rates have continued to decline regardless of improvements in conventional economic indicators. I argue that ongoing *structural* changes in U.S. labor markets have prolonged the financial uncertainty that leads women and couples to delay or forego childbearing. Combining statistical and survey data with restricted use vital registration records, I examine how cyclical and structural changes in metropolitan-area labor markets were associated with changes in total fertility rates (TFR) across racial/ethnic groups from the early 1990s to the present day, with a particular focus on the period between 2006–2014. The findings suggest that changes in industry composition – specifically, the loss of manufacturing and construction businesses – have a larger effect on TFR than changes in the unemployment rate for all racial/ethnic groups. Since structural changes in labor markets are more likely to be sustained over time, in contrast to unemployment rates which fluctuate with economic cycles, further reductions in unemployment are unlikely to reverse declining fertility trends.

Keywords

Fertility; Great Recession; Labor Market Polarization; Unemployment

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The United States experienced an economic recession from December 2007 to June 2009 that had manifold negative consequences on the national and global economy (Bureau of Labor Statistics 2012). Approximately 8.8 million U.S. jobs disappeared and the U.S. unemployment rate rose to a peak of 9.5 percent in 2009 (Bureau of Labor Statistics 2012; Goodman and Mance 2011). All told, the economic damage wrought by the Great Recession resulted in the loss of 19.2 trillion dollars in U.S. household wealth (Department of the Treasury 2012).

In the decade since, demographers have leveraged the Great Recession's adverse economic consequences to examine how economic conditions influence aggregate fertility trends

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(Sobotka, Skirbekk, and Philipov 2011). These studies have examined economic and labor market variation at the national- and state-level and have found differential outcomes in fertility behavior based on characteristics such as race and ethnicity, socioeconomic status, marital status, and educational attainment (Cherlin et al. 2013; Currie and Schwandt 2014; Percheski and Kimbro 2014; Schneider and Hastings 2015). Researchers interpret these results as indications that women and couples temporarily postpone childbearing as a result of financial uncertainty induced by job loss and decreases in income (Balbo, Billari, and Mills 2013; Brauner-Otto and Geist 2018). Delays in childbearing – even for a couple of years – can reduce lifetime fertility rates for cohorts of women (Bongaarts and Feeney 1998; Currie and Schwandt 2014; Morgan 2003; Ryder 1980). As a result, both brief and sustained changes in macroeconomic conditions have long term implications for population change and renewal.

Despite the importance of these previous studies, a puzzle remains concerning trends in post-recession fertility: while unemployment rates and median household income have returned to pre-recession levels, fertility rates continue to decline and have recently fallen to record lows in the United States (Hamilton et al. 2017; Martin et al. 2018). The total fertility rate for the United States remained below replacement at about 1.77 births per woman in 2017 (Hamilton and Kirmeyer 2017; Martin, Hamilton, and Osterman 2018), down from 2.12 births per woman in 2007. Meanwhile, the national unemployment rate returned to its pre-recession level of 4.7% in May 2016 (Bureau of Labor Statistics 2017) and median household income surpassed pre-recession levels in 2015 (Semega, Fontenot, and Kollar 2017). These patterns raise questions about the relative importance of cyclical economic conditions on fertility behavior and decision-making. If employment and earnings have improved, why do fertility rates continue to decline? Answering this question not only helps explain the contemporary puzzle of why fertility rates have deviated from their historically cyclical trend, but also contributes insight into how longer-term economic processes shape U.S. fertility.

In this study, I propose a structural economic explanation for why fertility rates continue to decline in the United States regardless of improvements in conventional economic indicators since the Great Recession. I argue that ongoing structural changes in the industry composition of U.S. labor markets have prolonged the financial uncertainty that leads women and couples to delay or forego childbearing. Since the 1980s, the U.S. labor market has experienced declines in middle-skill, middle-income jobs in manufacturing and construction as a result of improvements in assembly line automation and the displacement of routine production jobs offshore, among other explanations (Acemoglu and Autor 2011; Autor, Katz, and Kearney 2006; Kalleberg 2009). This process of "labor market polarization" has reduced employment demand for jobs in the middle of the occupational skills distribution while increasing employment demand for lower-paid, low-skill service sector positions. Figure 1 displays the declining share of employment, total annual payroll, and business establishments concentrated in goods-producing industries between 1987 to 2014. The graph shows that the share of workers employed in goods-producing industries declined from 29% in 1987 to 14.7% in 2014. This trend parallels the disappearance of goods-producing business establishments from U.S. labor markets. Economic explanations of demographic behavior should account for structural changes of this magnitude.

Combining statistical and survey data with restricted-use vital registration records, I comparatively examine how cyclical and structural changes in metropolitan-area labor markets were associated with changes in total fertility rates (TFR) across racial/ethnic groups from the early 1990s to the present day, with a particular emphasis on the period between 2006–2014. I focus on variation in TFR across racial/ethnic groups for two reasons. First, the variation in fertility trends across racial/ethnic groups over this period is particularly striking and may reflect the differential economic impacts of the Great Recession in domains ranging from job loss, wealth loss, and housing foreclosure (Hall, Crowder, and Spring 2015; Hout and Cumberworth 2012; Pfeffer et al. 2016). Second, historical inequalities fundamentally shape the distribution of contemporary labor market opportunities (Browne 2000; Jaret, Williams Reid, and Adelman 2003). Since occupational distributions vary by race and ethnicity, we should expect labor market polarization to influence fertility behavior more for groups with larger shares of workers in goods-producing industries.

I focus this analysis on local geographic areas, specifically all 381 metropolitan statistical areas (MSAs) in the United States, since the distribution of labor market outcomes vary considerably across geographic areas (Levine 2012; United States Department of Labor 2012). Past studies on how economic conditions influence fertility behavior in the U.S. mostly focus on state- or national-level trends. However, within states, economic conditions and labor markets vary substantially across metropolitan areas. Furthermore, family formation and fertility are processes that occur primarily at the local level. Social networks, which are mostly concentrated within local geographic areas, are influential in setting the norms of family and fertility decision-making decisions (Arai 2007; Balbo and Barban 2014; Bernardi and Klärner 2014).

The findings of the present study suggest that structural changes in U.S. labor markets have a larger effect on TFR than changes in unemployment rates for all racial/ethnic groups during the 2006–2014 period. Since changes in labor market polarization are more likely to be sustained over time – in contrast to unemployment rates which fluctuate with economic cycles – the results indicate that structural characteristics of U.S. labor markets are as important, if not more important, than short-term swings in unemployment in predicting decreased levels of TFR in recent years. The findings also indicate that Hispanic fertility is substantially more responsive to the loss of goods-producing businesses than white, black, and Asian fertility. Importantly, the findings from this study help explain why fertility rates continues to decline in the United States despite the presence of indicators of employment and income that would otherwise predict a return to pre-recession fertility levels. In addition to making a theoretical contribution to the demographic literature on macroeconomic change and aggregate fertility behavior, the results of this study indicate that further reductions in unemployment are unlikely to reverse declining fertility trends.

CYCLICAL TRENDS IN ECONOMIC CONDITIONS AND FERTILITY BEHAVIOR

The 2007–2009 financial crisis led to immediate reductions in fertility in the United States and Europe (Hamilton and Sutton 2012; Matysiak, Sobotka, and Vignoli 2014). Researchers theorize a pro-cyclical relationship between economic conditions and fertility behavior: fertility rates increase during economic expansions and decrease during economic recessions. As economic prosperity diminishes during cyclical downturns and financial uncertainty and distress increases, women and couples postpone childbearing (Balbo et al. 2013; Buckles, Hungerman, and Lugauer 2018; Currie and Schwandt 2014). Such a perspective is consistent with classical economic theory on fertility that regards children as investments in either future income or future satisfaction (Becker 1960). In economically developed contexts where satisfaction is the primary aim of having children, parents are more likely to afford the costs of bearing and raising children as incomes rise (Sawhill 1977). Other theoretical perspectives posit a counter-cyclical relationship between unemployment and fertility (Butz and Ward 1979; Ermisch 1988). As female unemployment rises during economic recessions, researchers theorize an increase in fertility because women's time out of the labor force lowers the opportunity costs associated with having a child. However, few empirical studies support this theoretical perspective in contemporary U.S. or European contexts (Cherlin et al. 2013; Morgan, Cumberworth, and Wimer 2011).

Most of the literature on how economic conditions influence fertility behavior use measures of unemployment and median household income to proxy changes in economic conditions. Morgan and colleagues' (2011) analysis of state-level economic and fertility trends during the Great Recession suggests that larger increases in unemployment are associated with larger decreases in fertility rates. Similarly, Schneider's (2015) analysis of county- and state-level fertility trends throughout the Great Recession suggests that both national and state trends in unemployment were negatively associated with general fertility rates (GFR).

Two other studies of the Great Recession find similar pro-cyclical patterns pertaining to changes in unemployment and income. First, Currie and Schwandt's (2014) comprehensive analysis of state-level fertility trends between 1975–2010 suggests that increased unemployment during economic recessions was associated with short-term and long-term reductions in fertility for women in their early 20s. Second, a study by Cherlin and colleagues (2013) likewise finds variation across age groups during the Great Recession: while younger women experienced decreases in age-specific GFR, women in their 40s continued having children at the same pre-recession age-specific GFR levels. As a result, the authors argue that economic cycles differentially influence fertility behavior across age groups.

If the fertility response to the Great Recession was in fact pro-cyclical, then the post-recession recovery period should have predicted increased fertility rates in the same way that the recessionary period predicted decreased fertility rates. However, fertility rates have yet to return to pre-recession levels. Cherlin and colleagues' (2013) analysis indicated an 11 percent decrease in TFR between 2007 and 2011 – a drop from a 2.1 to 1.9. By 2013, six years after the onset of the Great Recession, the national TFR remained below the level of population replacement (Martin et al. 2015). Only in 2014 did the TFR briefly reverse course and increase before decreasing yet more through 2017 (Hamilton and Kirmeyer 2017; Martin et al. 2018). This ongoing fertility decline in the U.S. is at odds with slow, yet steady improvements in economic conditions. Nationally, median household income returned to pre-recession levels in 2015 while the unemployment rate returned to pre-recession levels in 2016.

STRUCTURAL CHANGE IN U.S. LABOR MARKETS

While theories on economic uncertainty and fertility behavior focus almost exclusively on changes in cyclical economic indicators, broader structural changes in U.S. labor markets might help explain the persistence of low fertility in the past decade. Critically, the United States has experienced an economic restructuring that has reshaped the composition of industries that provide jobs to American workers (Kalleberg 2009). Since the 1980s, middle-skill, middle-income jobs in manufacturing and construction have steadily disappeared while service sector positions have rapidly expanded. Although there are many explanations for this labor market restructuring (Janoski, Luke, and Oliver 2014), researchers have identified technological advances in assembly line automation and the offshoring of routine production jobs as major causes (Autor 2011; Autor et al. 2006). This process of "labor market polarization" has reshaped the economic opportunities available for workers, especially those who have less than a college education, by shifting the types of jobs available to workers away from stable middle-class positions (Kalleberg 2009). At the same time, employment demand has grown for low-wage positions which require little education or training as well as for high-wage positions which require a college degree. However, middle-skill, middle-income jobs, long a pathway to middle class economic stability for workers with only a high school degree, have steadily declined (Newman and Winston 2016).

My theoretical argument is motivated in part by recent empirical findings by Autor and colleagues (2017) and Kearney and Wilson (2018) who link long- and short-term industrial changes in U.S. labor markets to changes in fertility rates. Examining the rise of manufacturing import penetration from China between two time periods, 1990–2000 and 2000–2014, Autor et al. (2017) find that commuting zone-level import shocks were associated with decreased fertility rates for U.S. women in their 20s and 30s. In contrast to negative economic shocks, Kearney and Wilson (2018) find that the growth in local-area hydraulic fracturing production between 19972012, a positive economic shock, was associated with increases in birth rates for women between the ages of 18–34. These two studies emphasize how the gain and loss of specific industries, in contrast to overall levels of employment, in local labor markets are associated with substantive changes in fertility rates. The findings from these studies also suggest that structural economic changes impact fertility behavior at the community level, influencing perceptions of anticipated growth or decline of industrial sectors.

I focus this analysis on the decade surrounding the Great Recession because economic downturns have historically played a critical role in accelerating the displacement of middle-skill jobs and goods-producing businesses from U.S. labor markets. However, the modeling strategy also accounts for long-term structural change with an additional analysis that extends back to the early 1990s. Importantly, once manufacturing and other goods-producing jobs disappear, they rarely return during post-recessional recovery periods (Abel and Deitz 2012). For instance, Jaimovich and Siu (2012), examining rebounds in job loss across occupational categories after every economic recession in the U.S. since the 1970s, find that an overwhelming proportion of permanent job loss in middle-skill positions since the 1980s occurred during periods of economic recession rather than periods between economic recessions. The Great Recession was no exception to this trend: between 2007–2009, employment in occupational categories of production, craft, and repair decreased by 17% and employment in occupational categories of operators, fabricators, and laborers decreased by 15% (Autor 2010). The data used in the present analysis indicate that the average percentage of goods-producing businesses in metropolitan statistical areas decreased from 16.66% in 2006 to 14.24% in 2014, a 2.42 percentage point decline (Figure 1). Overall, economic recessions have hastened permanent structural changes in U.S. labor markets and have reduced the demand for middle-wage, middle-income jobs.

The present analysis relies on population-level data and cannot test how individual-level factors influence fertility decision-making. One plausible mechanism through which this macroeconomic relationship may operate is individual-level financial uncertainty, initiated by job displacement from manufacturing, construction, and other goods-producing industries. Workers displaced from positions in goods-producing industries must find new work in service-providing industries which often provide fewer hours, lower pay, and scarcer benefits (Bureau of Labor Statistics and U.S. Department of Labor 2016; Janoski et al. 2014; Kalleberg 2009).[1] Valletta and van der List (2015), for instance, find structural changes in industry composition to contribute to involuntary part-time work in the years following the Great Recession. Reemployment for many who lost jobs during the Great Recession did not necessarily return economic security and stability to pre-recession levels (Janoski et al. 2014; Moretti 2012). This mechanism is consistent with findings on the association between work precarity and fertility and family formation (Brauner-Otto and Geist 2018; Lim 2017; Modena and Sabatini 2012; Piotrowski, Kalleberg, and Rindfuss 2015; White and Rogers 2000; Yu and Sun 2018).

RACIAL/ETHNIC DIFFERENCES IN OUTCOMES DURING THE GREAT RECESSION

The aggregate trend of decreased fertility in the U.S. during the Great Recession conceals substantial variation across racial/ethnic subgroups. First, Hispanic women experienced large decreases in fertility following the start of the Great Recession (Martin et al. 2014). Cherlin and colleagues (2013), for instance, find larger decreases in past-year births for Hispanic women than non-Hispanic women between 2008–2011. Second, black and Asian/Pacific Islander fertility rates decreased more sharply than white fertility rates, but less than Hispanic fertility rates. According to national vital statistics records on fertility between

[1]Alternatively, displaced workers often exit the labor force entirely, enroll in workforce retraining programs, or pursue additional educational degrees and certifications (Janoski et al. 2014; McConnell et al. 2016)

2007 to 2015 (Hamilton et al. 2017), GFR decreased 3% for non-Hispanic whites, 10% for non-Hispanic blacks, 10% for Asian/Pacific Islanders, and 36% for Hispanics.

The variation in fertility trends across race and ethnicity throughout this period is particularly striking and may reflect differential economic impacts experienced in domains such as housing foreclosure (Hall et al. 2015; Rugh 2015), wealth loss (McKernan et al. 2014; Pfeffer et al. 2016), and job loss (Holder 2017, 2015; Hout and Cumberworth 2012). McKernan et al. (2014), for instance, find that while white families experienced an average decrease in family wealth of approximately 26.2% following the Great Recession, black and Hispanic families lost 47.6% and 44.3%, respectively.

These differential economic consequences of the Great Recession across race/ethnicity also reflect a broader history of labor market stratification. Although black occupational and socioeconomic mobility increased throughout the middle of the 20th century, the economic downturn of the late 1970s largely constrained upward occupational mobility in the years to follow (Bound, Dresser, and Browne 1999; Pattillo 2013). This constrained upward mobility is reflected in the structure of educational and occupational networks which act as barriers to high-level professions for black and Latino workers (Catanzarite and Aguilera 2002; Cohen and Huffman 2007; Kmec 2003; Royster 2003). Racial differences in labor market occupational distributions are also attributed to employer discrimination (Pager and Pedulla 2015). Indeed, research on occupational shifts of African American men during the Great Recession by Holder (2015) indicates that black men experienced declines in representation in high-wage and middle-wage occupational categories between 2005–2006 and 2010–2011, while non-Hispanic white men experienced only minor shifts in their representation in the same occupational categories.

Since occupational distributions vary across race and ethnicity, we should expect labor market polarization to influence fertility behavior more for groups with larger shares of workers in goods-producing industries. Figure 2 displays the percentage of workers age 15–64 employed in goods-producing industries by racial/ethnic group between the years 2006–2014. Throughout this nine-year period, Hispanics had the highest percentage of workers employed in goods-producing industries, followed by whites. Black and Asian workers had the smallest percentage of workers in goods-producing industries.

The statistical approach used in the present study estimates separate regression models for racial/ethnic subgroups and tests for differences across these racial/ethnic subgroups. I expect macroeconomic conditions, both cyclical and structural, will differentially influence fertility behavior across race and ethnicity. Given the variation in the level of employment in goods-producing industries across racial/ethnic groups, we should expect the loss of goods-producing businesses following the Great Recession to have a disproportionate impact on racial/ethnic groups with larger shares of workers in goods-producing industries.

DATA and METHODS

Data

The present study is based on 31.5 million county-level birth certificate records between 2006–2014 from the restricted-use natality detail file from the National Vital Statistics System (NVSS).[2] The restricted-use NVSS natality detail file provides a full enumeration of county-level births in the United States, and includes information on mother's age, race, and Hispanic origin, which allow for the calculation of stratified racial/ethnic total fertility rate (TFR) values (NCHS 2016). County-level birth certificate records were aggregated up to the metropolitan area to match MSA designations defined by the Office of Management and Budget in 2013 (Office of Management and Budget 2013). MSA-level population counts were obtained for each year of the analysis from the National Center for Health Statistics' bridged-race population estimates, which are derived from U.S. Census Bureau population estimates. Female population counts, stratified by 5-year age groups, racial/ethnic group, and county, were aggregated up to the MSA-level.

Data on MSA-level business establishments were accessed from the U.S. Census Bureau's County Business Patterns (CBP) program. Business establishments are physical locations with (1) paid employees and (2) where business activity is conducted. Companies can have multiple business establishments with different numbers of employees. The CBP data provides a complete enumeration of business establishments in the U.S. by industry classification codes which are primarily derived from Internal Revenue Service administrative records. Business establishments are coded according to the Standard Industrial Classification System (SIC) between 1990–1997, and according to the North American Industry Classification System (NAICS) between 1998–2014. I used the Bureau of Labor Statistics' designations of NAICS "domains" to code businesses as either "goods-producing" or "service-providing" (Appendix Table 1).[3] The domain level consists of aggregated industry "supersectors." Industry supersectors within the goods-producing domain include natural resources extraction and mining, construction, and manufacturing.

MSA-level unemployment data were accessed from the Bureau of Labor Statistics' Local Area Unemployment Statistics program (LAUS) and MSA-level Per Capita GDP was accessed from the Bureau of Economic Analysis (BEA). Table 1 displays a full summary of measures and corresponding data sources.

Finally, I calculated metropolitan area statistics for education, past-year migration, homeownership, and marital status from the 1-year American Community Survey (ACS) between 2006–2014 for the overall MSA-level population as well as for racial/ethnic subgroups. ACS data were accessed through the IPUMS-USA database at the University of Minnesota (Ruggles et al. 2017). The smallest identifiable geographic unit in the 1-year public release ACS estimates are public use microdata areas (PUMAs) which have a

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[2]I additionally estimate models using a dataset that extends from 1991–2014, which relies on 82.3 million birth certificate records.
[3]To account for comparability issues between SIC and NAICS industry classification codes in the extended period analysis (1991–2014), I construct analogous "domain"-level grouping of SIC codes for CBP data between 19911997.

minimum of 100,000 residents. As a result, ACS estimates used to generate covariates are only available for MSAs with greater than 100,000 residents.[4]

Measures

Dependent Variable—I measure population fertility behavior by calculating racial and ethnic-specific total fertility rates (TFR) at the MSA-level for non-Hispanic white women, non-Hispanic black women, Hispanic women, and non-Hispanic Asian women. The TFR measure describes *period* fertility: it provides an aggregate summary of annual age-specific fertility rates for women between the ages of 15–49 in a specific population, thereby generating a measure that can be used for comparisons across populations (Preston et al. 2000). Period TFR is a synthetic measure that describes the number of births a woman could expect to have if she were to experience every current age-specific fertility rate throughout her reproductive life course. To create the TFR measure, I retrieved racial/ethnic-specific and MSA-specific birth counts from the NVSS natality detail file as well as equivalent stratified racial/ethnic- and MSA-specific population counts from the NCHS bridged-race population estimates. I then generated stratified year-, race-, and metropolitan area-specific TFR values according to Eq. 1:

$$\text{TFR}_{tmr} = 5 \times \sum_{x = 15 \ldots 45} \frac{B^{xtmr}}{N^{xtmr}} \qquad \text{(Eq. 1)}$$

where x represents birth counts to women age x to x+5, t represents the year of analysis, m represents the metropolitan statistical area, and r represents the racial/ethnic category.

The use of local-area population estimates in conjunction with birth records to calculate TFR generates a few implausible TFR values. Online Appendix Figure S1 displays a histogram with all TFR values generated through Eq. 1. Of 13,709 total TFR observations, 159 exceed 4.0. I remove these cases from the analytic sample to ensure that outliers are not influencing the regression results. The inclusion of these values in the models, however, does not substantively change the results.

Independent Variables

Labor Market Polarization.: I operationalize labor market polarization as a relative measure: the percentage of goods-producing business establishments in a MSA. Past research on labor market polarization has established that the goods-producing business sector contains a disproportionate share of middle-skill, middle-income jobs and therefore represents an appropriate measure of local labor market polarization (Abel and Deitz 2012). Additionally, because the availability of goods-producing jobs in a local area is a matter of supply, the distribution of business establishments, rather than the distribution of workers across occupations, is the preferred measurement of structural labor market conditions. In

[4]Since PUMAs are nested within states rather than counties, MSA-level estimates have errors of commission and omission in which areas outside of the MSA are included or areas within the MSA are not included, respectively. Most MSAs have a combined error of less than 0.1% or less than 4.9%, but 44 MSAs have an error of 5.0–9.9% and 40 have an error of 10–14.9%. Or in other words, 296 MSAs have less than a 5% geographic boundary error. In this analysis, I make the plausible assumptions that (1) the outlying geographic areas of MSAs are not excessively biasing the overall MSA population averages, and that (2) sub-population averages in outlying areas of MSAs are similar whether they happen to be immediately inside or outside the MSA boundary.

Online Appendix Text S1, I further discuss the conceptual and data limitations of substituting a worker-based measure for the business establishment measure used in the present study.

I calculate the percentage of goods-producing businesses for each MSA by aggregating CBP business establishment data by "domain" classification codes for each year – either goods-producing industries or service-providing industries. I then lag this measure by one year to approximate labor market structure at the time of conception each year rather than the time of birth. As an additional robustness check, I test an absolute measure of labor market polarization: the number of goods-producing businesses in a MSA, log transformed to address its non-normal distribution.

Unemployment.: I measure MSA-level unemployment using a one-year lagged annual measure of the unemployment rate from the LAUS dataset. The unemployment rate is calculated by dividing the number of people seeking employment by the total number of people in the civilian labor force. I test the sensitivity of this measure by estimating models which substitute the unemployment rate for (a) the employment-to-population ratio for workers ages 15–64 using ACS data, and (b) *sex-specific* measures of the unemployment rate and employment-to-population ratio for workers ages 15–64 using ACS data.

Control variables

The analytic method used in the present analysis, fixed-effects, controls for time-invariant unobserved heterogeneity that enters the specifications linearly and additively (Allison 2009). Accordingly, fixed characteristics of a metropolitan area are inherently controlled for in this analysis.[5] Fixed-effects analyses, however, do not account for *time-varying* sources of unobserved heterogeneity. To minimize threats to causal inference, I include a set of theoretically relevant covariates that are lagged one year (Table 1).

In the full MSA analysis, covariates include year fixed-effects, a logged measure of population size to adjust for annual changes in metro population size, and per capita gross domestic product (GDP) to adjust for economic growth.

In robustness models using data from the ACS, I additionally adjust for aggregate measures of educational attainment (the percentage with more than a high school diploma), past-year MSA in-migration (the percentage who have in-migrated to the MSA in the past year), homeownership (the percentage who own a home), and marital status (the percentage who have never been married). These covariates are first calculated at the MSA-level for adults age 15–64, and in a further sensitivity check, re-calculated for adults age 15–64 for each racial/ethnic group.

These time-varying covariates have theoretical importance for considering how MSA-level economic and noneconomic indicators might influence racial- and ethnic-specific fertility

[5]I conceptualize these fixed characteristics as aspects of geography, climate, city-specific cultural norms and mores, shared history, and place-specific socioeconomic and class distributions. To be sure, these metropolitan area characteristics do change over time; but given the relatively brief period of analysis, I make the plausible assumption that metropolitan areas maintain a fixed set of social, cultural, and built-environment characteristics.

rates. First, educational attainment is a well-documented determinant of fertility (Rindfuss, Morgan, and Offutt 1996); college attendance for women is associated with lower fertility levels (e.g. Brand and Davis 2012). I account for educational attainment by adjusting for the percentage with more than a high school education. Second, births in an MSA are composed of women residing in the area both prior to and after conception. Consequently, the TFR of a population is partially influenced by births to women which were conceived prior to entering the population. This makes adjusting for MSA in-migration important.[6] I define this measure as the percentage of people in a MSA who have in-migrated to the MSA in the past year.

Third, the Great Recession followed the burst of a housing bubble in the U.S. which reversed a seven-decade trend of increasing homeownership rates. Metropolitan areas experienced sizeable declines in homeownership throughout the 2006–2014 period, although the extent of decline varied across metropolitan areas (Flanagan and Wilson 2013). I account for these changes by including a covariate for the homeownership rate, defined as the percentage of people who own a housing unit, either with or without a mortgage, in a MSA.

Fourth, in addition to impacting population fertility behavior directly, economic conditions might influence fertility behavior indirectly vis-à-vis changes in marriage and partnership trends, which are important proximate determinants of fertility (Bongaarts 1978; Sawhill and Venator 2015; Stevenson and Wolfers 2007). Specifically, economic downturns might alter patterns in union formation and dissolution (for a more detailed discussion, see Morgan et al. 2012). While marriage rates declined and cohabitation rates increased throughout the years of the Great Recession, researchers mostly attribute these changes to continuations of pre-existing trends (Cherlin et al. 2013; Kennedy and Fitch 2012; Morgan et al. 2012; Schneider 2017). In regard to marital union dissolution, research by Cohen (2014) suggests no association between state-level unemployment rates and increases in divorce rates.

To be thorough in the present analysis, I include a covariate in the robustness models for the percentage of people who are single, never-married in a MSA to adjust for changes in marital status over time. Additionally, I estimate a supplemental model in Online Appendix Table S2 which adjusts for MSA-level divorce rates for the population age 15–64. Limitations in the ACS dataset preclude the inclusion of cohabitation measures throughout the entire 2006–2014 period (U.S. Department of Health and Human Services 2008).

In a final set of robustness checks, I test how (a) compositional changes of the Hispanic population throughout the 2006–2014 period and (b) the differential impact of the Great Recession on women and men might influence the results.

Compositional Changes of the Hispanic Population.—Declines in Hispanic TFR in the 2006–2014 period attributable to cyclical or structural economic changes might be partially explained by compositional changes of the Hispanic population throughout this

[6]Kothari et al. (2013) note that geographic mobility declined throughout the years of the Great Recession. For the geographic mobility that did occur, labor migration during the Great Recession varied for low- and high-skilled workers as well as across foreign-born and non-foreign-born workers (Cadena and Kovak 2016). In-migration from Mexico, for instance, decreased as a result of economic disruption to the construction and manufacturing sectors in the United States (Calnan and Painter 2017; Villarreal 2014).

period – primarily a drop in Mexico-U.S. migration throughout the 2000s and 2010s (Choi 2014; Parrado 2011; Villarreal 2014). In the present analysis, I am unable to calculate TFR values separately for U.S.-born and foreign-born Hispanics because annual disaggregated county- or metro-level population estimates for these groups are not available. Instead, I conduct a robustness check for the estimates of Hispanic fertility that adjusts for the percentage of reproductive age women who are Mexican immigrants. The inclusion of this measure into the statistical analysis, which captures a form of Recession-driven compositional change in the Hispanic population, does little to alter the results.

Differential Impact of the Great Recession on Women and Men.—The timing and magnitude of job loss during the Great Recession varied substantially for men and women (Hartmann, English, and Hayes 2010). Male unemployment increased more rapidly and remained at higher levels than female unemployment between 2007–2009 (Sahin, Song, and Hobijn 2010). Female labor force participation rates were initially unaffected by the recession, whereas male labor force participation rates experienced immediate declines in early 2008 (Cunningham 2018). These differential trends are explained by a larger concentration of men employed in goods-producing industries which were more vulnerable to recessionary impacts (Cunningham 2018; Hout and Cumberworth 2012; Wood 2014). Although women's earnings slightly outpaced men's earnings into the post-recession period (Goodman and Mance 2011), the recovery period (2010–2011) was more financially difficult for women, who began to experience job loss at higher rates than men. In fact, gains during the recovery period in male employment displaced existing female employment in certain service-providing industries (Taylor et al. 2011). To account for these gender-specific trends throughout the years of the Great Recession which might impact fertility behavior, I substitute the overall unemployment rate for gender-specific (a) unemployment rates and (b) labor force participation rates in sensitivity analyses.

Model Specification—The statistical models are estimated as follows. First, I estimate separate two-way fixed-effects regression models for four racial/ethnic subgroups of mothers: non-Hispanic black, non-Hispanic white, Hispanic, and non-Hispanic Asian (Eq. 2):

$$TFR_{mt} = \boldsymbol{\beta} \boldsymbol{x}_{mt} + \alpha_m + \mu_{mt} \quad \text{(Eq. 2)}$$

where TFR_{mt} refers to the total fertility rate TFR for MSA m during year t; $\boldsymbol{x}_{mt}$ refers to a set of vectors that includes measures of the two independent variables – labor market polarization and unemployment – as well additional covariates and binary-coded year vectors; $\boldsymbol{\beta}$ refers to a vector of estimated coefficients; α_m refers to a vector of MSA-specific intercepts; and μ_{mt} refers to MSA- and year-specific error terms.

Next, I test for significant differences in coefficients across each racial/ethnic group by (a) pooling observations from the previously separate racial/ethnic subset regressions, and then (b) estimating a model that estimates $\boldsymbol{\beta}$ coefficient values as in Eq. 2, but additionally interacting a set of binary-coded vectors for three of the four racial/ethnic groups $\boldsymbol{g}_r$, using non-Hispanic whites ($\boldsymbol{g}_{white}$) as the reference group, with vectors $\boldsymbol{x}_{mt}$ (Eq. 3). This model is estimated as follows:

$$TFR_{mrt} = \boldsymbol{\beta x}_{mt} + \boldsymbol{\gamma}(\boldsymbol{x}_{mt} * \boldsymbol{g}_{mrt}) + \alpha_{mr} + \mu_{mrt} \quad \text{(Eq. 3)}$$

where $\boldsymbol{\gamma}(\boldsymbol{x}_{mt} * \boldsymbol{g}_{mrt})$ represents the interaction coefficients that test for significant differences across racial and ethnic groups. In this equation, $\boldsymbol{\beta}$ coefficients represent the average value for non-Hispanic white women ($\boldsymbol{g}_{white}$), while the $\boldsymbol{\gamma}$ coefficients represent the average difference between each racial/ethnic group and the non-Hispanic white reference group. Critically, Eq. 2 and Eq. 3 are functionally equivalent, but Eq. 3 tests for statistical differences across racial/ethnic-specific coefficients. In the results section, I present regression tables for Eq. 2 and summarize the results from Eq. 3 in the text.

Finally, I estimate a period interaction model that tests whether the coefficient for labor market polarization and the unemployment rate persisted throughout both the pre-recession/recession (2006–2010) and post-recession (2011–2014) time periods.[7] To this end, I re-estimate the racial and ethnic-specific subgroup model (Eq. 2) with an interacted set of binary-coded vectors for the post-recession period $\boldsymbol{p}_{postrecesssion}$ with vectors $\boldsymbol{x}_{mt}$ (Eq. 4). The model is estimated as follows:

$$TFR_{mrt} = \boldsymbol{\beta x}_{mt} + \boldsymbol{\gamma}(\boldsymbol{x}_{mt} * \boldsymbol{p}_{mt}) + \alpha_{m} + \mu_{mt} \quad \text{(Eq. 4)}$$

where the $\boldsymbol{\beta}$ coefficients represent the average value for the post-recession period ($\boldsymbol{p}_{postrecession}$), while the $\boldsymbol{\gamma}$ coefficients represent the average difference in coefficients for the pre-recession/recession and post-recession periods.

RESULTS

Table 2 presents the means and standard deviations of all variables over the entire period of analysis, 2006–2014. Figure 3 displays the average MSA-level TFR values for each racial/ethnic group by year. For all racial/ethnic groups, TFR began to decline in 2008, although at different rates. Hispanic women experienced the largest decline in TFR, from approximately 2.9 in 2006 to 2.2 in 2014, a 24 percent drop. By the end of the period, Hispanic TFR had dropped below black TFR. All other groups experienced declines in TFR between the beginning and end of the period: white TFR declined 7.7%, black TFR declined 7%, and Asian TFR declined 7.8% between 2006–2014.

Figure 4 displays changes in unemployment and goods-producing businesses for all 381 MSAs between 1991–2014. In Panel A, the average MSA unemployment rate increased sharply at the start of the Great Recession in 2008 and then slowly declined after 2011. In contrast to this cyclical trend, Panel B displays a sharp decline in the average share of goods-producing businesses in MSAs at the start of the Great Recession. The rate of decline decreased and leveled off towards the end of the period in 2014. Online Appendix Figure S3 disaggregates the average trend for the share of goods-producing businesses and displays the 2006–2014 drop for each MSA.

[7]Because of the lag time between economic conditions during the time of conception and economic conditions at the time birth, the start of the post-recession period aligns with an approximate 1-year lag time.

Table 3 displays the results of the separate two-way fixed-effects regressions predicting racial- and ethnic-specific TFR for all 381 OMB-designated MSAs in the United States between 2006–2014. (Online Appendix Table S1 displays the full results). All four models include time fixed effects and MSA-level covariates. In 2014, the population residing in these 381 MSAs represented approximately 85% of the U.S. population.

In Model 1, I estimate an equation that aims to reproduce previous findings in family and fertility research that demonstrates a negative association between unemployment and fertility. The results indicate a significant, negative association between the unemployment rate and TFR for non-Hispanic white women (β = −.007 S.E. = .001), non-Hispanic black women (β = −.012; S.E. = .005), non-Hispanic Asian women (β = −.016; S.E. = .007), and Hispanic women (β = .036; S.E. = .005).

In Model 2, I estimate the effect of labor market polarization, measured as the percentage of goods-producing businesses in a metropolitan area, on TFR without the inclusion of the unemployment rate parameter. In these models, the coefficients are positively and significantly associated with TFR for white, black, Asian, and Hispanic women. A one percentage point increase in goods-producing businesses in a MSA is associated with a .021 increase in TFR for white women (S.E. = .002), a .022 increase in TFR for black women (S.E. = .008), a .027 increase for Asian women (S.E. = .010), and a .058 increase for Hispanic women. (S.E. = .008). Comparing coefficients across racial and ethnic groups (Eq. 3), the results indicate that the effect size for the goods-producing businesses parameters is significantly larger for Hispanics than for whites, blacks, and Asians. There is no significant difference between the coefficients for the latter three groups.

The percentage of goods-producing businesses in all MSAs declined an average of 2.42 percentage points between 2006 and 2014 (Figure 4, Panel B). The estimates in Model 2 suggest that a decline of this magnitude predicts an average decline in TFR of .051 for white women, .053 for black women, .066 for Asian women, and .141 for Hispanic women throughout the entire period. To contextualize these findings, the overall decline in TFR between 2006–2014 was .136 for white women, .139 for black women, .143 for Asian women, .547 for Hispanic women. Altogether, this indicates that declines in the percentage of goods-producing businesses on average account for 37% of overall TFR declines for white women, 38% of overall TFR declines for black women, 46% of overall TFR declines for Asian women, and 26% of overall TFR declines for Hispanic women. These calculations illustrate the average relative differential impact of metropolitan area labor market polarization on fertility rates across population subgroups.

Because parameter estimates of the percentage of goods-producing businesses might be explained by changes in the unemployment rate, Model 3 includes both variables. In this set of models, the effect size of the percentage of goods-producing businesses coefficients remain similar to those estimated in Model 2 for all racial/ethnic groups, although their magnitude slightly diminishes. In contrast, the coefficients for the unemployment rate attenuate in both size and significance in comparison to the coefficients estimated in Model 1. For Hispanic women, the coefficient for the unemployment rate remains sizeable and precisely estimated. Overall, however, these results provide evidence that structural changes in labor markets (i.e. the loss of goods-producing businesses) are more predictive of fertility decline than cyclical changes (i.e. unemployment), at least when examining fertility across racial and ethnic groups at the metropolitan level.

To examine whether labor market polarization and unemployment continued to influence fertility behavior in the recovery period, Model 4 tests whether these two variables maintained their effect sizes during the post-recession period. To estimate the post-recession parameters, I interacted a post-recession dummy variable (2011–2014) with all independent and control variables. I then calculated the pre-recession/recession parameters (2006–2010) in a comparable manner. Both columns of Model 4 estimate the same equation, the only difference is whether the interacted dummy indicator was set as the pre-recession/recession period or the post-recession period.

The results from Model 4 indicate that the effect size of the percentage of goods-producing businesses coefficient remain similar and statistically significant during the post-recession period as they did for the pre-recession/recession period for white, Asian, and Hispanic women. While the coefficient for the percentage of goods-producing businesses does not change across time periods for white women, it slightly increases for Asian women and slightly decreases for Hispanic women. In regard to the unemployment rate, the coefficients remain non-significant for black and Asian women, and close to zero for white women. However, for Hispanic women, the unemployment rate coefficient slightly diminishes between the 2006–2010 period ($\beta = -.033$) and the 2011–2014 period ($\beta = -.026$). To summarize, the results from Model 4 demonstrate how reductions in the percentage of goods-producing businesses in a MSA contributed not only to declines in TFR throughout the recession, but also during the post-recession recovery period.

Robustness Checks

Since the specifications presented above do not account for several unmeasured, time-varying metropolitan area characteristics that might influence the results, I conduct a series of robustness checks which test alternate specifications of these models.

Table 4 displays a set of models which incorporate a set of theoretically-relevant MSA-level covariates, including educational attainment, past-year in-migration, homeownership rates, and marital status. The number of MSAs included in this analysis for each racial/ethnic group is reduced because of ACS 1-year microdata availability. Upon adding these additional covariates, the coefficients and standard errors for the percentage of goods-producing businesses and the unemployment rate remain approximately comparable to those in the previous full 381 MSA analysis for all models estimated above, with several important exceptions. First, the goods-producing businesses coefficients diminish in size and significance for black and Asian women in all models. Second, the unemployment rate coefficient for white women diminishes in size and significance.

In Online Appendix Table S2, I substitute the rate of single/never-married in an MSA for the MSA divorce rate for the population age 15–64. The results from these ACS models are likewise comparable to the previous ACS subset models.

To account for changes in the composition of the Hispanic population, I re-estimate the ACS subset robustness model for Hispanics by swapping past-year in-migration for a measure of Mexican composition: the percentage of reproductive age Hispanic women who are Mexican immigrants (Online Appendix Table S3). The inclusion of this measure into the statistical analysis, which adjusts for compositional changes in the Hispanic population, does little to alter the main results for the goods-producing and unemployment parameter estimates.

Online Appendix Table S4a and S4b displays the results of a further series of robustness and sensitivity checks. I re-estimate the full model, Model 3, using (a) labor market polarization measured as the logged number of goods-producing businesses, (b) MSA-level racial/ethnic-specific covariates in place of MSA-level covariates, (c) labor market polarization measured as the percentage of mid-march workers employed in goods-producing industries, (d) sex-specific unemployment rates in place of the overall unemployment rate, (e) employment-to-population ratios – both overall and sex-specific – in place of the overall unemployment rate, and (f) labor force participation rates – both overall and sex-specific – in place of the overall unemployment rate.

The results from these alternate specifications yield comparable results to those in Table 3. When operationalized as the logged *number* of goods-producing businesses (Models 1–2, Online Appendix Table S4a), labor market polarization similarly explains more variation than the unemployment rate for three out of the four racial/ethnic groups. Substituting racial/ethnic-specific covariates for MSA-specific covariates (Models 4, Online appendix Table S4a) does not substantively change the results of the ACS subset analysis in Table 4 (Model 3). Moreover, accounting for gender-specific trends in unemployment and labor force participation, the results from these models suggest little change from the main results. In total, this battery of alternate specifications yields comparable results to the previously estimated models in Table 3 and Table 4, suggesting that the findings are largely robust.

Long-Term Structural Change, 1991–2014

The prior results indicate that the annual loss of goods-producing business establishments in metropolitan areas throughout the decade spanning the Great Recession was associated with declines in TFR for white, black, Asian, and Hispanic women in the full 381 MSA analysis and for white and Hispanic women in the ACS subset analysis. However, these models do not account for the longer span of time since the 1980s when U.S. labor markets initially began to transition away from the production of goods and towards the provision of services. To evaluate whether these effects have been present over the past several decades, I extend the annual dataset back to the early 1990s to estimate a set of two-way fixed-effects models that cover the years 1991–2014.[8] At the beginning of the period, 1991, goods-producing businesses comprised an average of 18.28% of all businesses in MSAs; by the end of the period, 2014, goods-producing businesses comprised an average of 14.24% of all businesses in MSAs, an overall 4.04 percentage point decrease (Figure 1). Throughout this 24-year period, the average unemployment rate was 6.2%, although cyclical economic expansions and contractions resulted in an average low of 4.2 % in 2001 and an average high of 9.6% in

[8]County-level CBP data on industry composition is available from 1986 and onwards; however, county-level LAU data is available from 1990 and onwards.

2011. Online Appendix Table S5 displays the means and standard deviations of variables in the 1991–2014 analysis.

In Table 5, I present the results of these extended period models. The results are substantively comparable to the results from the 2006–2014 analysis for the percentage goods-producing coefficients (Table 3), although the effect size is largest for black women. In Model 3, a one-point increase in the percentage of goods-producing businesses in a MSA is associated with a .020 increase in TFR for white women (S.E. = .001), a .051 increase in TFR for black women (S.E. = .004), a .023 increase for Asian women (S.E. = .005), and a .035 increase for Hispanic women. (S.E. = .005). Since the percentage of goods-producing businesses in metropolitan areas declined by an average of 4.04 percentage points over this 24-year period, the estimates from model 3 predict that changes in industry composition accounted for an average decline in TFR of .081 for white women, .206 for black women, .093 for Asian women, and .141 for Hispanic women. For MSA-level unemployment, the coefficients suggest that the relationship between the unemployment rate and racial/ethnic total fertility rate remained pro-cyclical throughout the entire period for white and Asian women, but not for black and Hispanic women.

Overall, the empirical results from this extended period analysis bolster the theoretical argument that ongoing structural trends in the labor market have contributed to fertility decline over the past several decades.

DISCUSSION and CONCLUSION

In the years since the Great Recession, social scientists have anticipated that economic recovery in the U.S., characterized by gains in employment and median household income, would augur a reversal of declining fertility trends. However, the expected post-recession rebound in fertility rates has yet to materialize. In fact, fertility rates continue to decline, with 2017 reaching an unprecedented national low for general fertility rates (Hamilton et al. 2018). The analysis presented here demonstrates how structural changes in U.S. labor markets help explain trends in declining fertility rates. Overlooked in past research on fertility behavior, labor market polarization signifies a permanent change in the financial outlook of American workers, especially for those without a college degree. As businesses, and therefore jobs, in goods-producing industries disappear, displaced workers who wish to remain in the labor force must find employment in the lower paid, lower-skill service sector that provides jobs with fewer hours, lower pay, and scarcer benefits (Bureau of Labor Statistics and U.S. Department of Labor 2016; Janoski et al. 2014; Kalleberg 2009). The “hollowing out” of the middle of the occupational income distribution results in decreased financial security for American workers as they seek to start or expand families. Importantly, once goods-producing businesses disappear from American cities – either as a result of offshoring or improvements in assembly line automation – they tend to not return (Autor and Dorn 2013).

The present analysis suggests that labor market polarization contributed to the decline in fertility rates throughout the entire decade spanning the Great Recession, including the post-recession period between 2011–2014. These findings held even upon adjusting for the unemployment rate and additional economic and noneconomic covariates. As long as goods-producing businesses remain a smaller share of the overall industry composition of U.S. metropolitan areas, the models presented here indicate that fertility rates will remain below their pre-recession levels.

While labor market polarization was found to influence TFR for all racial/ethnic groups throughout the extended period analysis, the effect size is substantially larger in magnitude for women of color than for whites, particularly black and Hispanic women. Job loss in goods-producing industries is more devastating for non-white workers since racial disparities in employment exist even during economically prosperous times (Janoski et al. 2014; Moore 2010). Discrimination in hiring practices by employers has played a significant role in perpetuating these racial disparities, constructing social barriers towards stable and long-term employment (Fryer, Pager, and Spenkuch 2013; Pager, Bonikowski, and Western 2009). Consequently, the search for re-employment for non-white workers after economic recessions has been more drawn out than for whites, entailing lengthier spells of unemployment and therefore increased periods of financial precarity (Couch and Fairlie 2010; Hout and Cumberworth 2012).

The results also suggest a more heterogenous picture regarding the pro-cyclicity of economic cycles and fertility rates during the Great Recession. With exception of the Hispanic models, the unemployment rate parameter estimates were mostly small in size and non-significant once labor market polarization was included in the models. These results were robust to alternative measures of employment, including sex-specific unemployment rates, sex-specific employment-to-population ratios, and the overall employment-to-population ratio. Although this finding contrasts with earlier studies on the Great Recession which find considerable evidence of pro-cyclicality (e.g. Currie and Schwandt 2014; Morgan et al. 2011; Schneider 2015), this discrepancy might be explained by the extended time period of the present study and the geographic level examined.

The magnitude of the coefficient estimates of labor market polarization on fertility rates was nearly three times larger for Hispanic women than for white women. Differences in occupational distributions across racial and ethnic groups might partially explain this finding because groups with a larger share of workers in goods-producing industries would be disproportionately affected by the disappearance of these businesses. In fact, 33% of the Hispanic labor force was employed in goods-producing industries prior to the recession in 2007, whereas only 22.5% of whites, 20% of Asians, and 18% of blacks were employed in goods-producing industries at that time (Figure 2). In absolute terms, as well, there were more Hispanic workers in manufacturing, construction, and mining/extraction industries than there are black and Asian workers combined in 2007 (U.S. Bureau of Labor Statistics 2008). It is therefore likely that compositional differences account for some of the differential impact. The large share of Hispanic workers in the goods-producing sector might also explain why the unemployment rate coefficient remained sizeable and significant for Hispanic fertility.

During the post-recession period, availability and usage of long acting reversible contraceptives (LARCs) increased substantially (Branum and Jones 2015; Finer, Jerman, and

Kavanaugh 2012). At the same time, rates of unintended pregnancy declined considerably (Finer and Zolna 2016). Past research suggests that these trends contributed to post-recession fertility declines (Fletcher and Polos 2017; Schneider and Gemmill 2016). Schneider and Gemmill (2016) find that increases in regional LARC usage between 2003–2014 partially accounted for state-level declines in the non-marital fertility rate, especially for Hispanic women. To the extent that labor market restructuring changed the demand for children and the attendant demand for contraception with lower failure rates, LARC take-up is an explanation of post-recession fertility decline that is consistent with the findings presented here. However, the association between structural labor market changes and fertility dates at least to the early 1990s (Table 5) before major increases in LARC availability and usage (Branum and Jones 2015), suggesting that LARCs may be part of but not the entire story of the present findings.

An important question that follows from this analysis is whether declines in fertility rates from labor market polarization are an indicator of delayed or foregone births. One way to approach this question is to identify which age groups were more responsive to declines in goods-producing businesses. In Online Appendix Table S6, I estimate the effect of structural and cyclical economic changes on age-specific fertility rates, binned at five-year age intervals, between 2006–2014. For all racial/ethnic groups, the largest effect sizes for the goods-producing businesses coefficients are concentrated towards women in their 20s. Since the effect size is small and mostly non-significant for women in their 30s and 40s, the results suggest that births are likely being delayed rather than entirely foregone. At the same time, the cohort of women in their 20s at the beginning of the 2006–2014 period might have different birth histories than the cohort of women who began the period in their 30s. Future research will need to determine over the next decade whether increases in fertility rates for women in their 30s are large enough to offset decreases in fertility rates for women who were in their 20s over the past decade.

The age-specific fertility rate models also suggest that fertility rates for teenage women ages 15–19 were significantly responsive to changes in structural economic conditions for both white and Hispanic women and changes in cyclical economic conditions for white women. There was no significant effect of structural or cyclical economic conditions on age-specific fertility rates for black or Asian women. Most research examining the influence of the Great Recession on teenage fertility rates finds little empirical evidence of a significant relationship with unemployment rates (Boonstra 2014; Lindberg, Santelli, and Desai 2016; Percheski and Kimbro 2014).

The findings presented here should be interpreted with an understanding of several limitations of the data and analytic method used. First, the present analysis uses aggregate data and is susceptible to ecologically fallacious inference; the findings should only be interpreted in terms of population-level behavior patterns, not individual-level choices. Accordingly, I cannot directly test how individual-level financial uncertainty influences fertility decision-making. Future research should examine how fertility preferences, intentions, and demand are influenced by both individual-level labor market experiences and aggregate labor market conditions. Second, the TFR measure relies on both administrative data and population estimates. While the numerators of the equation, birth counts, represent a full enumeration of all new births in U.S. metropolitan statistical areas between 1991–2014, the denominators of the equation, population counts, draw on bridged-race population *estimates*. However, the bridged-race population estimates used in the present analysis are the same source of population estimates used by the NCHS when they generate and distribute public release vital statistics figures, including fertility rates, and are regarded as the best source of population data for this task.

Despite these limitations, this study offers an innovative economic explanation for why fertility rates in the United States continue to decline. Prevailing theoretical perspectives on how economic conditions influence fertility have primarily relied on cyclical measures of economic change. Researchers have overlooked important long-term structural changes in U.S. labor markets, particularly the decline of manufacturing and construction industries, and the coincident rise of low-paid jobs in service industries. While the present analysis focuses on the impact of economic restructuring in U.S. metropolitan areas on fertility rates, future research should account for whether this relationship is similar in nonmetropolitan and rural areas, which have also experienced considerable declines in goods-producing industries (Low 2017). By proposing a structural economic explanation for why fertility rates continues to decline, this study contributes to the understanding of how macroeconomic conditions influence fertility behavior and decision-making.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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APP

Appendix Table 1.

BLS definitions of Industries by Domains, Super-Sectors, and NAICS-Sectors

Domain	Super-Sector	NAICS-Sector (2-Digit Codes)
Goods-Producing	Natural Resources and Mining	11 Agriculture, Forestry, Fishing, and Hunting
		21 Mining
	Construction	23 Construction
	Manufacturing	31–33 Manufacturing
Service-Providing	Trade, Transportation, and Utilities	42 Wholesale Trade
		44–45 Retail Trade
		48–49 Transportation and Warehousing
		22 Utilities
	Information	51 Information
	Financial Activities	52 Finance and Insurance

Domain	Super-Sector	NAICS-Sector (2-Digit Codes)
		53 Real Estate and Rental and Leasing
	Professional and Business Services	54 Professional, Scientific and Technical Services
		55 Management of Companies and Enterprises
		56 Administrative and Waste Services
	Education and Health Services	61 Educational Services
		62 Health Care and Social Assistance
	Leisure and Hospitality	71 Arts, Entertainment, and recreation
		72 Accommodation and Food Services
	Other Services	81 Other Services (Except Public Administration)

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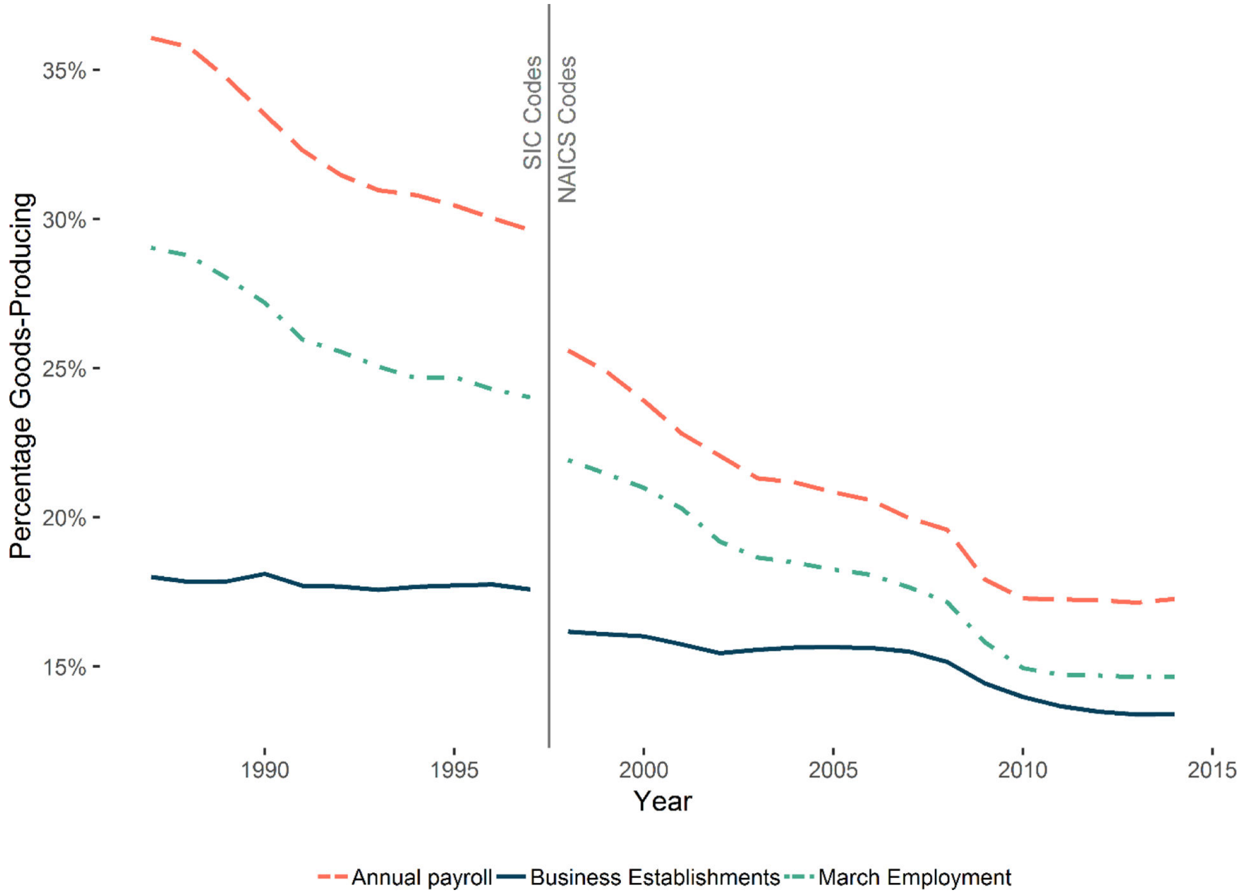

Figure 1. Share of Employment, Payroll, and Business Establishments in Goods-Producing Industries between 1987–2014

Notes: Data from U.S. Census Bureau's County Business Pattern (CBP) program. Industry classification codes changed in 1998. Dashed lines (1987–1997) are based on Standard Industry Codes (SIC) goods-producing industries; Solid lines (1998–2014) based on North American Industry Classification System (NAICS) goods-producing industries. Calculations are for all metropolitan statistical areas.

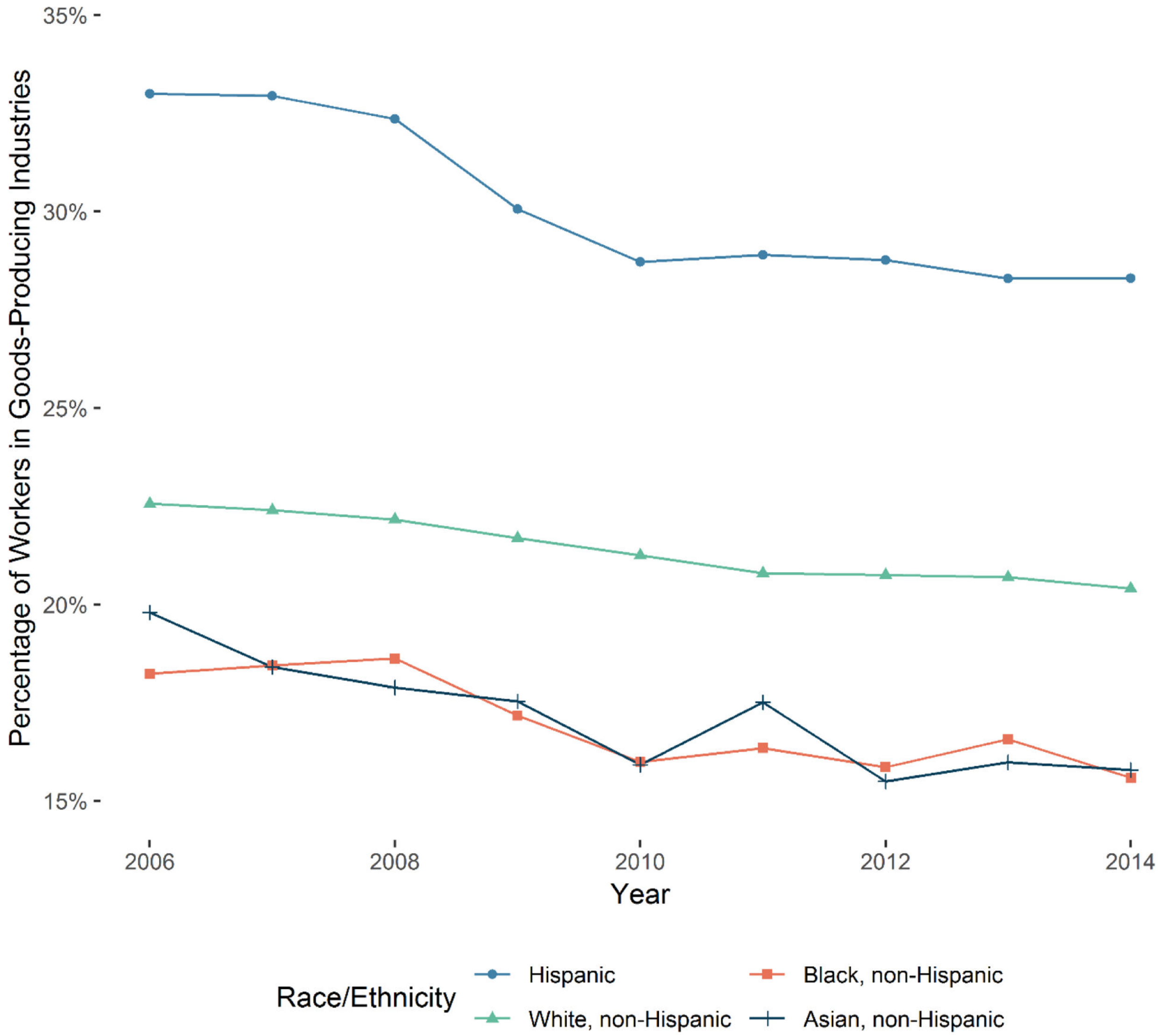

Figure 2. Percentage of Workers Ages 15–64 in Goods-Producing Industries by Race/Ethnicity

Notes: (a) Goods-producing industries include manufacturing, construction, and extraction/ mining, and were classified using NAICS domain codes (b) data from the American Community Survey between 2006–2014 for Metropolitan Statistical Areas with core urban populations larger than 100,000.

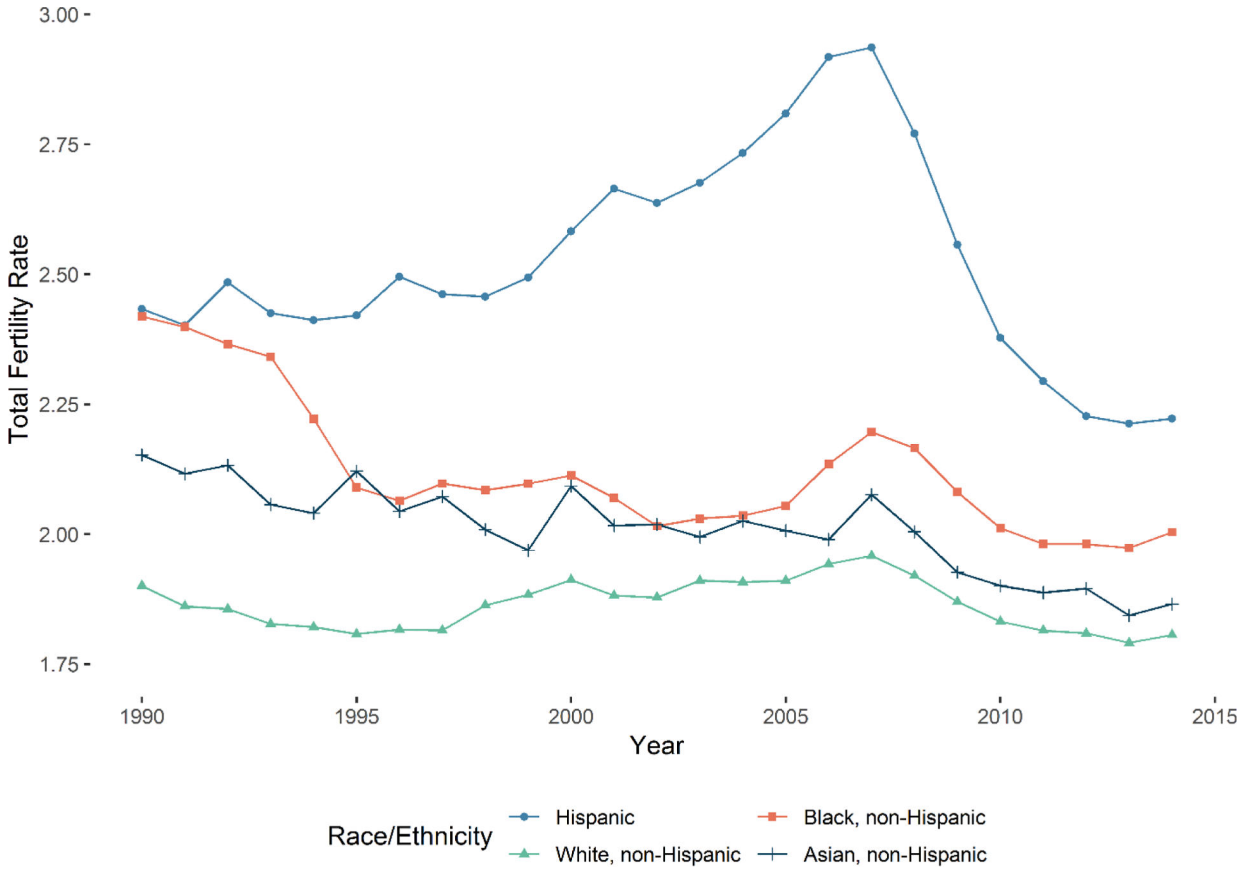

Figure 3. Average Total Fertility Rate (TFR) for all 381 Metropolitan Statistical Areas between 1990–2014 by Race/Ethnicity

Notes: Calculated using birth data from restricted-use NCHS Natality Detail Files (1990–2014) and female population data from NCHS bridged-race population estimates. See Online Appendix Figure S2 for TFR by race/ethnicity for entire U.S. metro population.

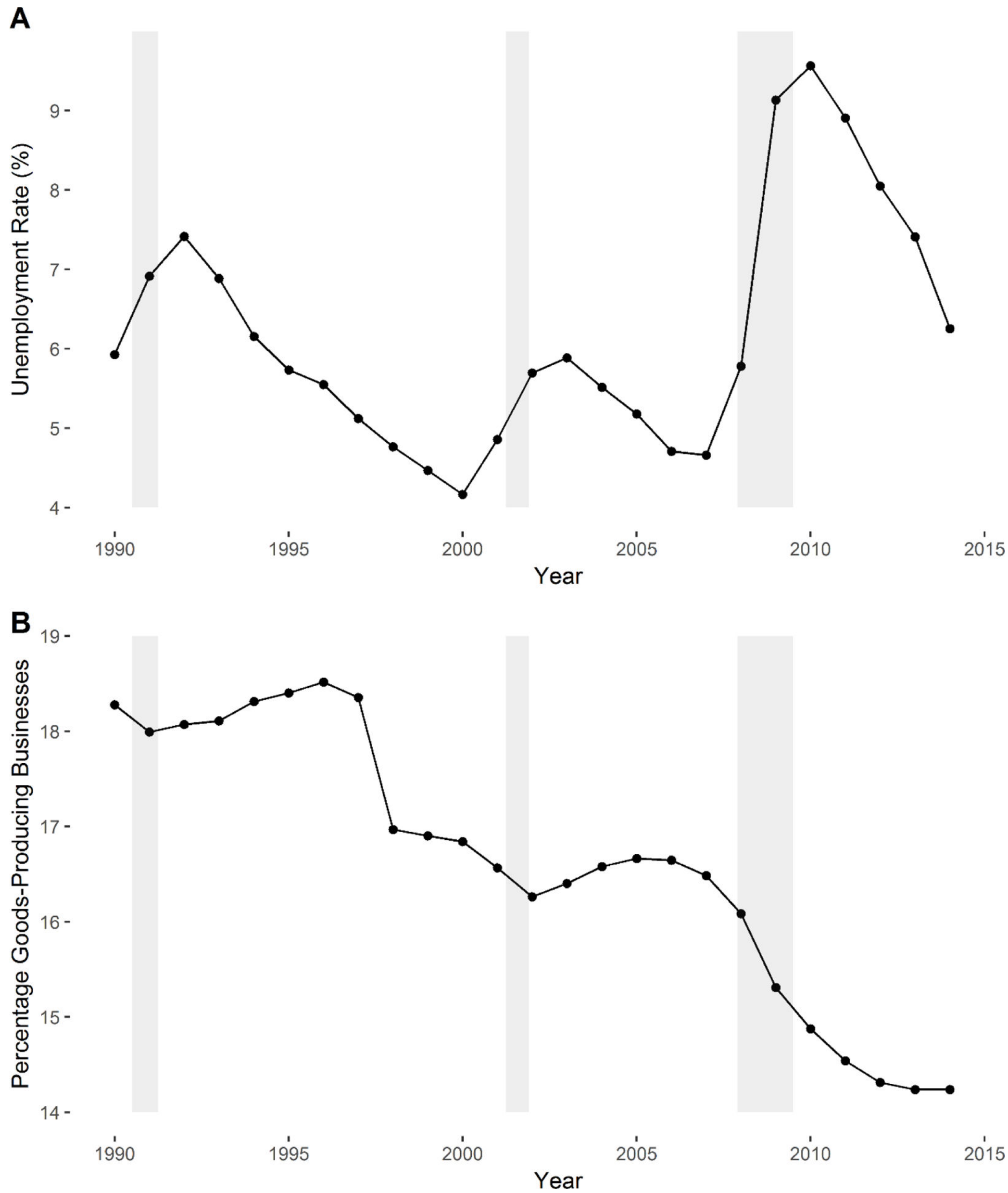

Figure 4. Average (A) Unemployment Rate and (B) Percentage of Goods-Producing Businesses for all 381 Metropolitan Statistical Areas between 1990–2014.

Note: Shaded areas represent NBER designated recessionary periods (http://www.nber.org/cycles.html): (1) July 1990-March 1991, (2) March 2001-November 2001, and (3) December 2007-June 2009.

Table 1.

Metropolitan Statistical Area Variables and their corresponding Data Sources

Variable	Data Source(s)
Total Fertility Rate	Restricted-use birth data from the NVSS; population data from the bridged-race population estimates from the NCHS
Unemployment Rate	Bureau of Labor Statistics' Local Area Unemployment Statistics (LAU)
% Goods-Producing Businesses Logged # Goods-Producing Businesses	U.S. Census Bureau's County Business Patterns (CBP)
Per Capita GDP	Bureau of Economic Analysis (BEA)
Never Married Status	1-Year American Community Survey (ACS) via IPUMS-USA
Education Level	
Past Year In-Migration[9]	
Homeownership Rate	
Unemployment Rate (Male and Female) Share of Hispanic population who are Mexican-origin	
Labor Force Participation Rate (Overall, Male, and Female)	
Employment-to-Population Ratio (Overall, Male, and Female)	
Divorce Rate	

[9]While the ACS includes data for moves within states, these measures do not specify moves between MSAs or from a non-MSA area to a MSA. Measuring MSA in-migration specifically for reproductive-age women would be the ideal measure. However, the ACS has systemic issues in undercounting births to women, especially younger women who are in the first 15 years of their reproductive life-span (O'Hare, Jensen, and O'Hare 2013; U.S. Census Bureau 2016).

Table 2.

Descriptive Statistics

	2006–2014		
Variables	**Mean**	**S.D.**	**Number of MSAs**
Total Fertility Rate			
White TFR	1.86	0.3	381
Black TFR	2.03	0.5	381
Asian TFR	1.90	0.5	381
Hispanic TFR	2.45	0.6	381
MSA-level Covariates			
Unemployment Rate (%)	7.0	2.9	381
Percentage Goods-Producing Businesses	15.5	3.0	381
Number Goods-Producing Businesses (logged)	7.0	1.1	381
Percentage Goods-Producing Workers	18.4	6.7	381
Total Population (logged)	13.6	1.1	381
Per Capita GDP (10,000s)	3.7	0.7	381
MSA-Specific Covariates			
Greater than a HS Degree (%)	54.7	8.1	290
Never Married (%)	36.3	5.3	290
Past Year In-Migration (%)	3.7	2.2	290
Home Ownership (%)	67.5	6.9	290
Divorce Rate 15–64 (%)	11.3	2.2	290
Female Unemployment Rate (%)	8.3	3.1	290
Male Unemployment Rate (%)	8.9	3.5	290
Labor Force Participation Rate 15–64 (%)	73.9	4.3	290
Female Labor Force Participation Rate 15–64 (%)	69.4	5.0	290
Male Labor Force Participation Rate 15–64 (%)	78.4	5.0	290
Employment-to-Population Ratio 15–64 (%)	67.7	5.1	290
Female Employment-to-Population Ratio 15–64 (%)	63.7	5.5	290
Male Employment-to-Population Ratio 15–64 (%)	71.6	6.0	290
Race/Ethnicity-Specific Covariates			
Greater than a HS Degree (%)			
White	60.6	8.7	290
Black	48.0	14.5	260
Asian	66.3	17.2	254
Hispanic	36.7	14.1	277
Never Married (%)			
White	32.3	5.5	290
Black	52.1	13.0	260
Asian	33.1	15.2	254
Hispanic	42.7	10.9	277
Past Year In-Migration (%)			

	2006–2014		
Variables	**Mean**	**S.D.**	**Number of MSAs**
White	3.7	2.5	290
Black	5.3	8.9	260
Asian	9.3	10.2	254
Hispanic	6.0	6.9	277
Home Ownership (%)			
White	73.0	7.1	290
Black	44.4	16.2	260
Asian	63.9	19.2	254
Hispanic	50.5	15.3	277
Mexican-Origin Composition (%)			
Hispanic Women Ages 15–49	29.5	18.3	282

Notes: (1) All covariates lagged 1-year (2) Different number of MSAs for TFR values reflects removal of TFR values over 4.0 (3) Different number of MSAs for MSA-specific and Race/Ethnicity-specific covariates reflects differential availability of ACS microdata (4) Because yearly sampling variation is assumed to be normally distributed in the ACS, I do not exclude observations that have implausible values. However, I do remove observations with ACS covariate values that indicate the total presence or total lack of a specific social/economic characteristic (e.g. 100% of the population is married). These values are indicative of a very small number of sampled of respondents in a local geography sharing the same characteristic in an annual survey.

Table 3.

Fixed-Effects Regression Models of Total Fertility Rate by Race/Ethnicity between 2006–2014 for All MSAs

		2006–2014		2006–2010	2011–2014
Dependent Variable: Total Fertility Rate	**Model 1**	**Model 2**	**Model 3**	**Model 4a**	**Model 4b**
White, Non-Hispanic (381 MSAs; N=3429)					
% Goods-Producing Businesses		0.021***	0.020***	0.019***	0.017***
		(0.002)	(0.002)	(0.002)	(0.002)
Unemployment Rate (%)	−0.007***		−0.003*	−0.004*	−0.003*
	(0.001)		(0.001)	(0.002)	(0.001)
Black, Non-Hispanic (380 MSAs; N=3394)					
% Goods-Producing Businesses		0.022**	0.019*	0.019*	0.015
		(0.008)	(0.008)	(0.008)	(0.010)
Unemployment Rate (%)	−0.012*		−0.008	−0.005	−0.009
	(0.005)		(0.006)	(0.007)	(0.006)
Asian, Non-Hispanic (381 MSAs; N=3394)					
% Goods-Producing Businesses		0.027**	0.022*	0.022*	0.027*
		(0.010)	(0.011)	(0.011)	(0.012)
Unemployment Rate (%)	−0.016*		−0.012	−0.011	−0.012
	(0.007)		(0.007)	(0.009)	(0.007)
Hispanic (381 MSAs; N=3333)					
% Goods-Producing Businesses		0.058***	0.046***	0.046***	0.037***
		(0.008)	(0.008)	(0.008)	(0.009)
Unemployment Rate (%)	−0.036***		−0.027***	−0.033***	−0.026***
	(0.005)		(0.006)	(0.007)	(0.006)
MSA Controls	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	No	No

* p<.05,

** p<.01,

*** p<.001 (two-tailed tests)

Notes: (a) MSA-level covariates included in all models. Year fixed-effects included only in Model 1 through Model 3. Covariates include annual measures of logged population and per capita GDP. (b) All covariates are lagged one year. (c) Standard errors in parentheses.

Table 4.

Fixed-Effects Regression Models of Total Fertility Rate by Race/Ethnicity between 2006–2014 for ACS Subset Sample

		2006–2014		2006–2010	2011–2014
Dependent Variable: Total Fertility Rate	**Model 1**	**Model 2**	**Model 3**	**Model 4a**	**Model 4b**
White, Non-Hispanic (290 MSAs; N = 2375)					
% Goods-Producing Businesses		0.022 ***	0.022 ***	0.022 ***	0.022 ***
		(0.002)	(0.002)	(0.002)	(0.003)
Unemployment Rate (%)	−0.005 **		−0.001	−0.003	−0.001
	(0.001)		(0.001)	(0.002)	(0.002)
Black, Non-Hispanic (289 MSAs; N = 2354)					
% Goods-Producing Businesses		0.016	0.013	0.015	0.005
		(0.008)	(0.009)	(0.009)	(0.010)
Unemployment Rate (%)	−0.009		−0.007	−0.006	−0.004
	(0.005)		(0.005)	(0.007)	(0.006)
Asian, Non-Hispanic (290 MSAs; N = 2360)					
% Goods-Producing Businesses		0.013	0.007	0.008	0.025
		(0.011)	(0.012)	(0.012)	(0.014)
Unemployment Rate (%)	−0.016 *		−0.014 *	−0.012	−0.013
	(0.007)		(0.007)	(0.009)	(0.008)
Hispanic (290 MSAs; N = 2319)					
% Goods-Producing Businesses		0.077 ***	0.062 ***	0.064 ***	0.063 ***
		(0.009)	(0.009)	(0.009)	(0.010)
Unemployment Rate (%)	−0.042 ***		−0.031 ***	−0.038 ***	−0.024 ***
	(0.005)		(0.006)	(0.007)	(0.006)
MSA Controls	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes

* p<.05,

** p<.01,

*** p<.001 (two-tailed tests)

Notes: (a) Year fixed effects and MSA-level covariates included in all models. Covariates include annual measures of logged population, per capita GDP, percentage of homeowners, percentage of one-year in-migration, percentage with more than a high school education, and percentage never married. (b) All covariates are lagged one year. (c) Standard errors in parentheses

Table 5.

Fixed-Effects Regression Models of Total Fertility Rate by Race/Ethnicity between 1991–2014 for All MSAs

	1991–2014		
Dependent Variable: Total Fertility Rate	**Model 1**	**Model 2**	**Model 3**
White, Non-Hispanic (381 MSAs; N=9138)			
% Goods-Producing Businesses		0.020***	0.020***
		(0.001)	(0.001)
Unemployment Rate (%)	−0.004***		−0.00000124
	(0.001)		(0.001)
Black, Non-Hispanic (381 MSAs; N=9004)			
% Goods-Producing Businesses		0.045***	0.051***
		(0.004)	(0.004)
Unemployment Rate (%)	−0.011***		0.020***
	(0.003)		(0.003)
Asian, Non-Hispanic (381 MSAs; N=8909)			
% Goods-Producing Businesses		0.026***	0.023***
		(0.005)	(0.005)
Unemployment Rate (%)	−0.015***		−0.010*
	(0.004)		(0.004)
Hispanic (381 MSAs; N=8764)			
% Goods-Producing Businesses		0.027***	0.035***
		(0.005)	(0.005)
Unemployment Rate (%)	0.019***		0.025***
	(0.004)		(0.004)
MSA Controls	No	No	No
Year Fixed Effects	Yes	Yes	Yes

* p<.05,

** p<.01,

*** p<.001 (two-tailed tests)

Notes: (a) Variables are lagged one year. (b) Standard errors in parentheses. (c) Due to data limitations, these models cannot be adjusted for the covariates included in the full 381 MSA 2006–2014 analysis (i.e. per capita GDP, etc.). Models are adjusted for logged population.