Fertility Response to Business Cycles: "Gender Asymmetry in Industries"*

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Abstract

Fertility rate in the US declined sharply after the Great Recession (from 2.12 to 1.84 children per women). We argue that fertility response to business cycles is shaped by the gender properties of the labor market as well as cyclical properties of industries. We find that men predominantly work in heavily procyclical industries whereas women work in acyclical industries. Hence, employment and income losses are significant among working men whereas women are not affected as much from recessions. In a joint household fertility choice model with partial specialization, we show that stable (or better) female labor market outcomes contribute to the decline in fertility as well as worse outcomes for males. We argue that procyclicality of fertility is due to gender biased industry employment and cyclicality of industries, which amplifies fertility changes during recessions. In a quantitative framework, we find that 28% to 44% of the decline in fertility is due to gender asymmetric industry employment.

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1 Introduction

This paper studies cyclical as well as gender asymmetric properties of industries to understand the relationship between fertility trends and economic conditions. The fertility rate in the US had an increasing trend in the beginning of 2000s until the start of the Great Recession. In 2007, total fertility rate was 2.12, the highest number since 1971, then it declined sharply to 1.84 by 2015. We find that 28% to 44% of fertility decline can be attributed to gender asymmetric industry employment and different cyclical properties of industries.

Industries have different cyclical properties (Abraham and Katz [1984]). A great majority of women (41%) are employed in industries such as education, health services and government which are acyclical (or even countercyclical) industries. On the other hand, a great majority of men are employed in industries such as construction and manufacturing which are heavily procyclical industries. It is still the women who mostly bear the time cost of a child (Kleven et al. [2018], hence the opportunity cost of having a child is foregone earnings in employment for females. Then, increase in male income increases fertility through income effect, while female income increase has ambiguous effect because it produces both income and substitution effects. However, many evidences show that the substitution effect is dominant and higher female income both at cross section and in time series is correlated with lower fertility rates (Heckman and Walker [1990]). In times of economic downturns, since males are employed in heavily procyclical industries, they lose their jobs which decreases household income and it has a negative impact on fertility. On the other hand, female employment is either not affected or affected positively due to acyclical properties of female dominant industries, better economic prospects of women also have a negative impact on fertility. Hence, we argue that fertility decline is amplified in economic downturns because of these two properties of the economy: 1- gender asymmetric industry employment, 2- cyclical properties of industries.

Our empirical analysis shows that state level birth rates are correlated negatively with the changes in female dominant industry employment (and industry compensation) and positively with the changes in male dominant industry employment (and industry compensation) for the whole sample period of 2002-2016. The correlations are even stronger at post-recession period. We also show that employment (or compensation) changes in gender symmetric industries do not have any effect on fertility rates since the positive effect from men is canceling out by the negative effect from women.

In order to understand the effect of the structural properties of the economy in shaping fertility trends with business cycles, we build a model with the following features: 1-Joint household consumption, saving and fertility decision. 2- Partial specialization. 3-Timing of birth. In our model, male income is positively related to fertility through income effect and female income is negatively related to fertility through substitution effect. We calibrate the model to match pre-recession fertility rates for younger and older women. We compute the changes in industry level total compensation between 2007-2011. Using industry gender composition, we build a measure of gender compensation levels for different age groups. We then apply the observed compensation changes to our model. Our model is able to predict the fertility in response to the changes in industry compensation both qualitatively and quantitatively. We then ask the question of "what would have happened to fertility if industry employment was not gender-biased and/or industries display the same cyclical properties?'. In all the counterfactual scenarios, we predict the fertility changes to be milder.

Fertility decline is becoming an important problem in the developed world. Although, the US did not suffer from this problem as much compared to Europe, the recent data shows that it will in the near future as the current fertility rate is well below the replacement level. We highlight a different aspect of labor market structure and its relation to fertility. Gender asymmetry in labor market affects fertility in an adverse manner. Obviously, it is unfortunate that better labor market outcomes for women worsens fertility. However, one reason why we obtain such a conclusion is that women still incur majority of childbearing and another reason is that women have to sacrifice hours worked when they have children. Hence, other than gender symmetric labor market conditions, policies which may potentially reduce the opportunity cost of child to mothers may help in rising fertility.

2 Related Literature

In his seminal paper, Becker [1960] analyzes fertility as en economic choice where families have utility from both the number of children they have and quality they invest to them. Later, in Becker and Barro [1988], Becker et al. [1990], fertility has been analyzed in the context of economic growth by introducing altruism of parents, hence as an outcome affecting macro economic outcomes. Doepke [2015a] summarizes the quality-quantity trade-off literature by Gary Becker and points the importance of quality perspective in fertility choice as the income elasticity is stronger for quality by also noting that the desired fertility is still positively correlated with income levels which is an evidence for children being normal goods.

The first attempt to analyze the cyclicality of fertility is by [Butz and Ward, 1979]. In their paper, they argue that fertility in the US fertility becomes countercyclical in 60s, after the baby boom period. However, there are other studies later on, which argues that the decrease in fertility in the 60s was due to increase in female labor force participation rate as well as the introduction of "the pill". [Macunovich, 1995] argues that in recession periods, the negative effect of unemployment surpasses the positive effect of lower opportunity cost. There is also evidence about procyclicality of fertility in a multiple country study by [Sobotka et al., 2011]. Finally, [Jones and Schoonbroodt, 2016] proves that fertility is procyclical in a study by incorporating dynastic altruism and productivity shocks.

Understanding the baby boom in 50s and its consequences on the labor market is a prominent feature of the literature. [Greenwood et al., 2000] argue that baby boom in 50s is caused by an atypical burst in technological progress in household sector which lowers the opportunity cost of child. On the other hand, [Doepke et al., 2015] argue that after war baby boom was caused by increased female labor market participation by older generations during the war which persisted and competed out younger generation of women from the labor market in after-war period.

The effects of female and male wages on fertility have been studied empirically by identifying the effects through the panel data. [Heckman and Walker, 1990] identify the effect of an increase in female's wage on fertility by analyzing Swedish panel data and find that higher female wage leads to delaying childbirth and lower fertility as a result. In order to identify the effect of male income on fertility, unexpected job displacement has been used as an exogeneous shock. Both [Lindo, 2010] and [Amialchuk, 2013] find that an unexpected shock to male income (job displacement) decreases fertility. [Schaller, 2016] attempts to find both effects by using exogenous labor demand shocks and gender employment indices in industries. Consistent with the literature, she finds positive effect for male wage and negative effect of female wage. [Dettling and Kearney, 2014] also shows that house prices (hence business cycles) have a positive impact on fertility.

Not only wage changes but also the effect of unemployment on fertility has been studied in the literature and the results are similar to those of wage changes. [Schmitt, 2011] and [Özcan et al., 2010] find that male unemployment affects fertility negatively whereas female unemployment affects positively.

Until recently, the literature tries to identify the wage effects on fertility and tried to explain long term cycles with economic conditions. Following the papers which study the occupation riskiness by looking at the wage and unemployment volatility ([Saks and Shore, 2005]), [Sommer, 2016] studies the effect of unexpected earnings risk on fertility and finds that higher earnings risk is associated with delay in fertility and lower fertility. A comprehensive study by [Adda et al., 2017] endogenize all life time choices and argue that career choices are made along with fertility choices, hence there is sorting in occupations according to fertility choices during life time.

3 Facts

3.1 Facts on Fertility

The US has relatively high fertility rates but experienced sharpest decline in the Great Recession

Fertility rates have been declining in the 20th century and there is negative correlation between GDP per capita and fertility rates all over the world ([Doepke, 2015b], Doepke and Tertilt [2016]). Increase in female labor participation rate, pill revolution certainly have an impact on this long run decreasing trend. There is however, large baby boom and bust periods in the 20th century driven by economic conditions ([Doepke et al., 2015, Jones and Schoonbroodt, 2016]). Since 80s on, fertility rates become more stable, large baby boom and baby bust periods do not exist anymore as it occurred in the middle of the century. However, there are still cycles correlated with economic conditions.

In the US, fertility had an increasing trend during late 90's and early 2000s with the housing boom. Then, a sharp declining trend started with the Great Recession. OECD countries have been also affected by global conditions and European countries by the Euro Crisis. However, the decline in the US fertility rate was very sharp and lasted long (Figure 3.1). Only after 2011, it converged to a plateau.

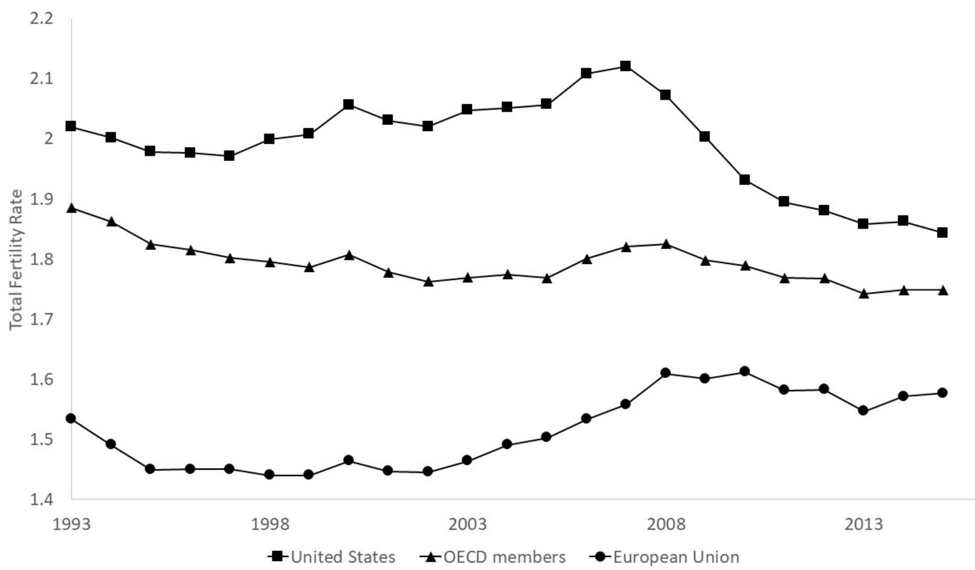

Figure 1: Total Fertility Rate in Developed World
Source: World Bank

Fertility declines in recession times

Figure 3.1 shows the fertility trend in the US starting from 1975 and the recession periods. For all the recession periods since 80s, fertility drops with the start of the recession and usually recovers by the end of the recession and follows an increasing trend afterwords. There are two recessions in which fertility continued to drop even after the recession, which are 1990 recession and the Great Recession. One common characteristic of these recessions is that we experience "jobless recoveries" in both (Gordon [1993],Doepke and Tertilt [2016]). Our analysis also shows that fertility is more responsive to employment changes than income changes at aggregate level. Hence, jobless recoveries imply that fertility recovery also takes time.

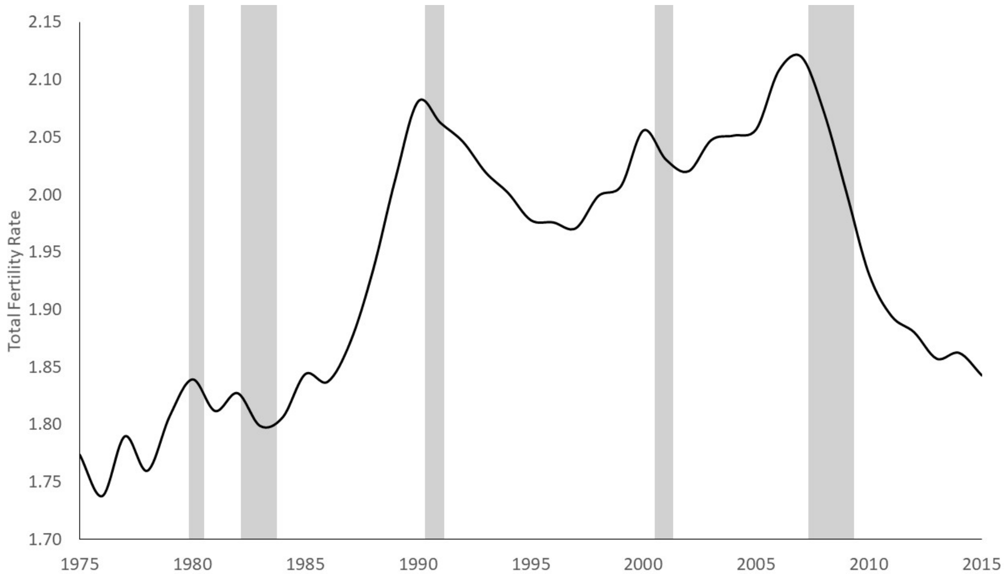

Figure 2: Fertility and Recessions in the US
Note: Shaded areas areas are recession periods. The data is taken from Fred.

Fertility change and real GDP per capita change are correlated at state level

Figure 12 shows that the states which experienced the largest GDP decline also experienced the largest fertility decline and vice versa. Hence, not only at time series but also at cross-section, fertility is positively correlated with income changes. For instance, in California and Florida, during the recession, income declined significantly, so as the fertility.

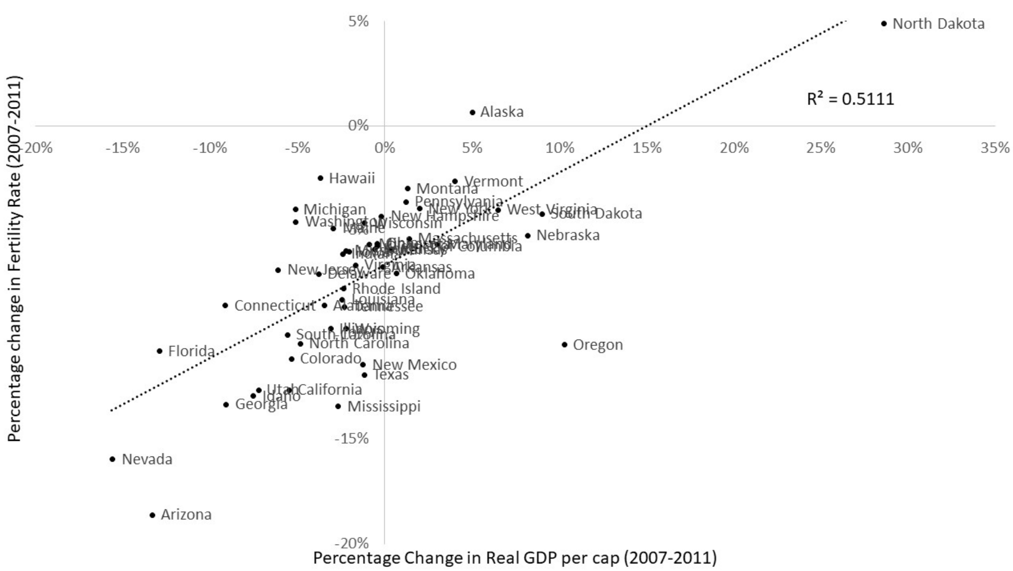

Figure 3: Fertility vs. Real GDP per capita Change
Note: Fertility data has been taken from National Health Statistics. State level real GDP per capita data has been taken from Bureau of Economic Analysis

Fertility decline was the sharpest among women of age group 20-30

Figure 3.1 shows that women of age 25-29 and 20-24 had the highest birth rates. However, they experienced the largest decline after the recession possibly due to delaying motive, hence fertility decline in 20-30 age group has been translated into increase in birth rates of women of age 30-39. As reported by [Kleven et al., 2018], even in Denmark where social system towards families is more powerful with maternity leaves, there is a child penalty in hours worked and earned wages among women. Hence, among younger ages there is a career cost of children ([Adda et al., 2017]), which makes fertility among young more responsive. Moreover, women of age 40-44 have a stable fertility trend. In our model section, we are going to incorporate different trends across age groups.

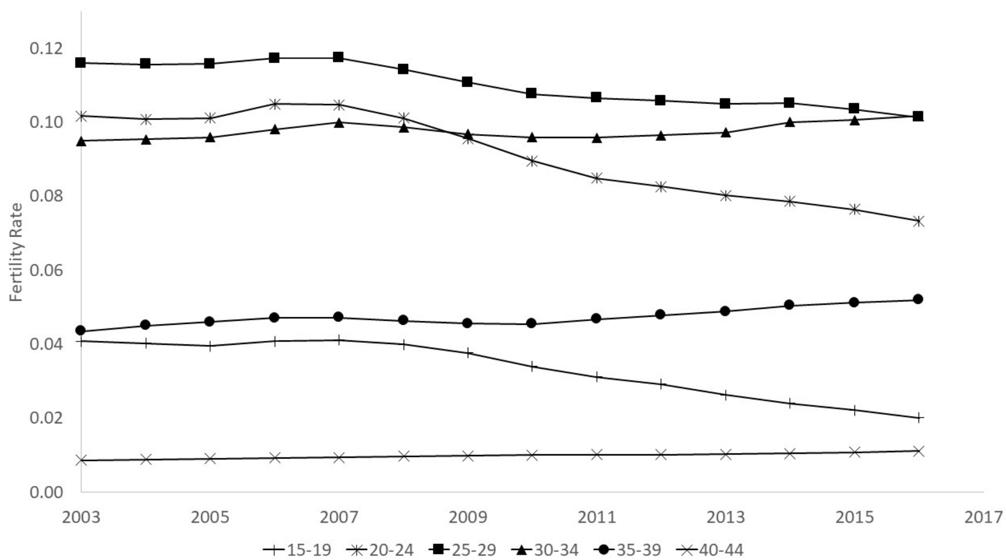

Figure 4: Fertility Across Age
Source: National Health Statistics

Tempo vs. Quantum Effects

Sobotka [2004] discusses tempo and quantum effects in fertility for Europe. In the developed world, there is a trend towards postponing childbirth to later years of adulthood, which is called "tempo effect". On the other hand, the overall decrease in fertility is called "quantum effect". Figure 5 shows these effects for the US. In 2007, both tempo and quantum effects are positive relative to 2003. In 2011, there is a significant quantum effect, however we do not observe a tempo effect as there is no right shift in age profile of fertility. In 2015 though, there is a tempo effect as the whole distribution shifts to the right relative to 2011. It means that younger females have lower fertility rates but older females have higher fertility rates. Hence, between 2007-2011, we do observe the pure effect of the recession as there is an overall decline which is mostly pronounced among young females. In 2015, we start observing the recovery of fertility rate among older women who postponed fertility during the recession.

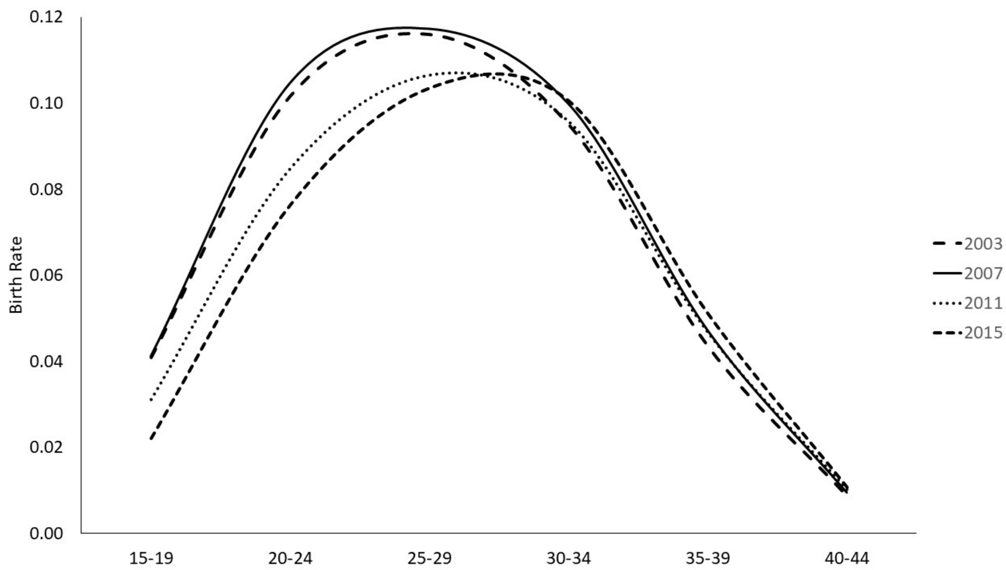

Figure 5: Tempo vs. Quantum Effects

Fertility decline vary across races

In order to understand the heterogeneity across individuals, we do present the outcomes for different race groups in Figure 3.1. All the race groups had an increase in fertility until 2007 and decline afterwords but Hispanic women experienced the largest decline in fertility. The convergence in fertility rates of Hispanic vs. non-Hispanic women over time may have contributed to the decline. However, Hispanic fertility also starts declining after the Great Recession.

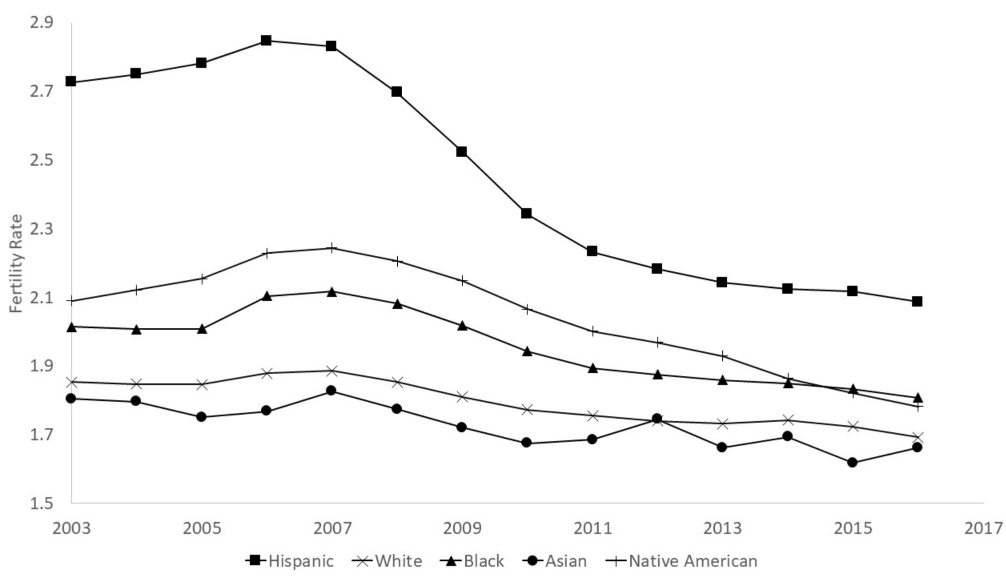

Figure 6: Fertility Across Races
Source: National Health Statistics

3.2 Facts on Labor Market

Female employment share within industry ranges from 13% to 77%

Figure 3.2 shows that female versus male employment within each industry vary significantly. Some industries such as education and health services, financial activities and government are female dominant where construction, manufacturing and mining industries are heavily male dominant. Especially education and health services industry is the most female dominant industry where 77% percent of industry employment is female. On the other hand, construction and mining industries are most male dominant industries where 87% of employment is male. Furthermore, these changes do not change over time (see Appendix Figure 13).

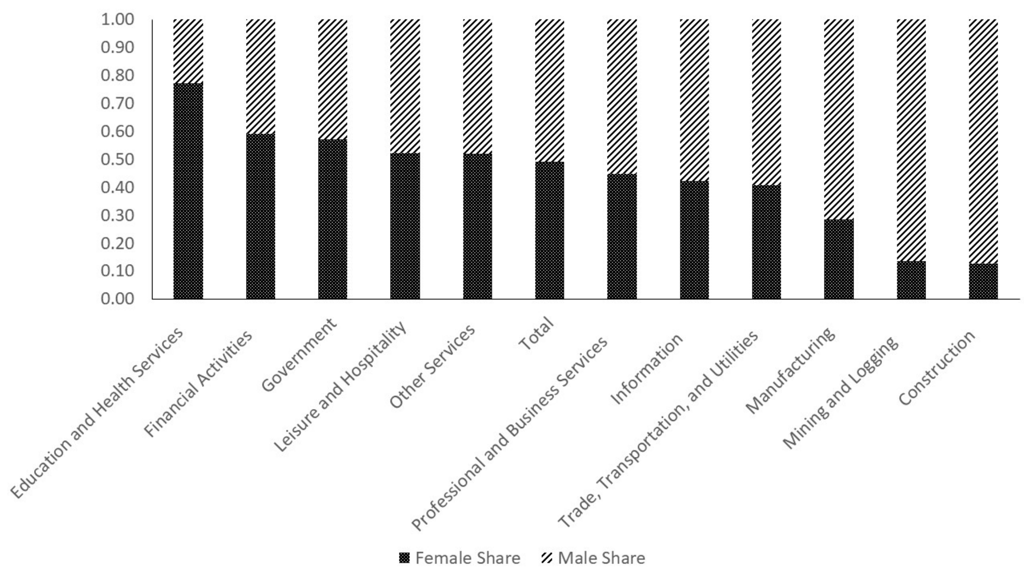

Figure 7: Gender Bias in Industries

Note: The data is taken from Bureau of Labor Statistics. Women shares are averages across years 2002-2015.

Half of women are employed in education, health and government industries

Not only education and health services industry is female dominant but also a large fraction (22%) of females are working in that industry. Figure 3.2 shows that almost half of employed women are working in two major industries; education and health services and government. Also, industry trends in female employment is stable over time (see Appendix Figure A).

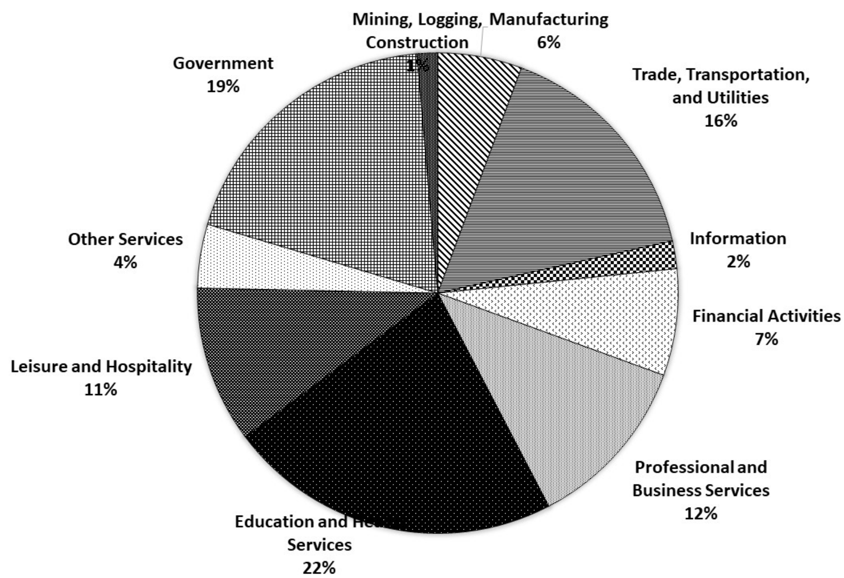

Figure 8: Female Employment

Note: The data is taken from Bureau of Labor Statistics. Industry shares are averages across years 2002-2015.

Employment share vary across races

Figure 9 documents the variation of construction industry share in male employment. Hispanic men are predominantly employed in construction industry. Previously, we documented that Hispanic fertility decline was the sharpest relative to other races. The fact about Hispanic men's high employment share in construction gives additional evidence why Hispanic fertility might have been declined much.

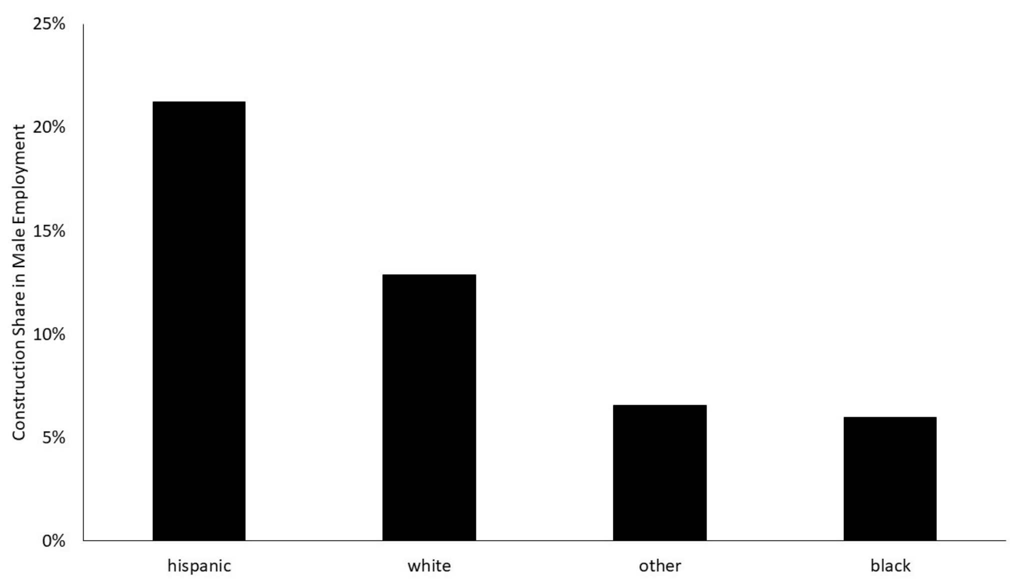

Figure 9: Construction Share in Male Employment

Male dominated industries are procyclical and female dominated industries are acyclical

In terms of number of people each industry employs, male dominated industries experience a large employment decline during recessions where female dominated industries do not deviate from the long term trend. Hence, Figure 3.2 shows that construction and manufacturing industries are procyclical whereas education, health services and government industries are acyclical. Employment changes for all industries are shown in Figure A.

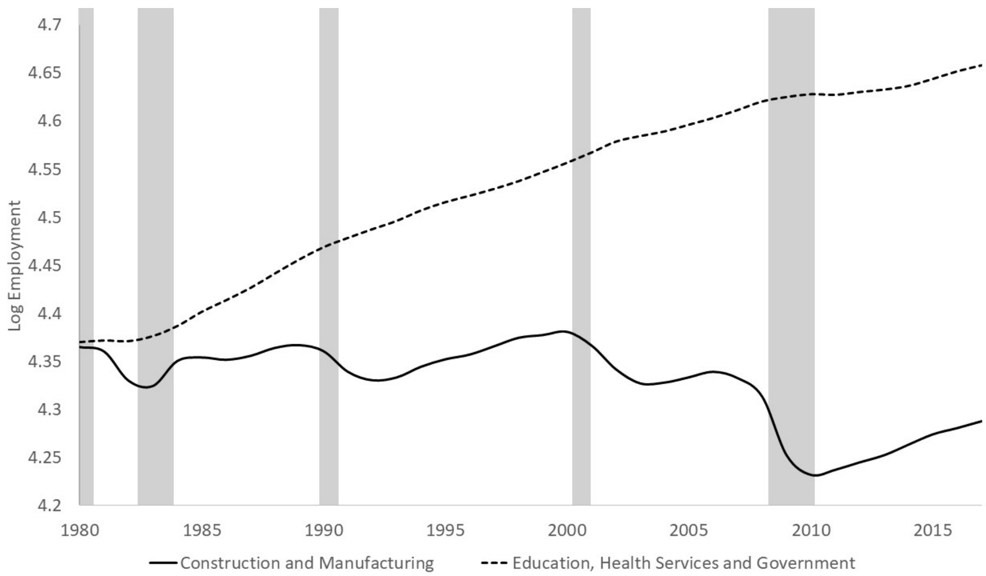

Figure 10: Male vs. Female Dominated Industries
Note: Data is taken from Bureau of Labor Statistics.

4 Data

4.1 National Health Statistics

Fertility data; ratio of number of births to total population and to female population of 15-44 age for every state between years 2003-2016 is taken from National Health Statistics. Age and race specific fertility rates are also taken from National Health Statistics database.

4.2 Bureau of Labor Statistics

Industry employment numbers at state level between years 2002-2015 as well as female and male employment at industry level are taken from Bureau of Labor Statistics database. Monthly data has been used to calculate the correlation between total employment changes and industry level employment changes. To calculate female employment share in each industry and industry share in total female employment, the annual data has been used. To form the birth rate-employment matched data set between years 2002-2016, state level annual industry employment levels have been used.

4.3 Bureau of Economic Analysis

Regional Statistics from Bureau of Economic Analysis has been used to get the total employee compensation at industry and state level. CPI index has been used to get real employee compensation to be consistent in yearly changes. The data is matched to state level birth rate data.

4.4 Current Population Survey

Current Population Survey has been used to estimate earnings gap between female and male, as well as between young and old workers. These estimates have been used as model inputs when constructing compensation of four different agents. Moreover, industry employment composition for different race and education groups have been also estimated as robustness check.

5 Empirical Analysis

5.1 Cyclical Properties

The first step of the empirical analysis is to identify the cyclical properties of industries. To do that, we use monthly employment data from BLS and look at the percentage changes in industry employment and calculate the correlation of industry employment changes to the total employment changes between years 2002-2015. Table 5.1 shows that the correlation between industry employment changes to the total employment changes ranges from 0.18 to 0.86. Moreover, procyclical industries have lower female share and vice versa. The exceptions are trade, transportation and utilities and professional and business services industries where the procyclicality is the highest and gender bias does not exist. However, construction and manufacturing industries have the correlation 0.84 and 0.85 respectively and they have the lowest female share in employment. Furthermore, industries with the highest female share are education, health services and government, with shares 77% and 57% respectively and those are the industries with the lowest correlation between industry employment and total employment (0.18 and 0.21)[1]. There is another exception to this, which is financial activities industry with relatively high female share (59%) and high correlation (0.72).

[1][Charles et al.] find that college attendance decreased during boom times and increased in recession times. This finding can be also thought as a reason why education, health services are acyclical, and even countercyclical sometimes.

Industry	Correlation	Within Industry Women Share	Industry Share in Women Employment
Trade, Transportation, and Utilities	0.86	0.41	0.16
Professional and Business Services	0.86	0.45	0.12
Manufacturing	0.85	0.28	0.06
Construction	0.84	0.13	0.01
Financial Activities	0.72	0.59	0.07
Leisure and Hospitality	0.71	0.52	0.11
Other Services	0.56	0.52	0.04
Information	0.48	0.42	0.02
Mining and Logging	0.41	0.13	0.00
Government	**0.21**	**0.57**	**0.19**
Education and Health Services	**0.18**	**0.77**	**0.22**

Table 1: Correlation of Industry Employment Changes and Total Employment Changes

Note: Monthly employment data is taken from Bureau of Labor Statistics. The first column represents the correlation between monthly employment changes at industry level to the national employment changes. The second column is the average within industry female share over the years of 2002-2015. The third column is the average industry share of women over the years 2002-2015.

5.2 Gender Asymmetry and Cyclicality: How to decide?

The hypothesis that we are arguing in this paper is that female dominated industries are acyclical and male dominated industries are heavily procyclical. As described in the previous part, there are some exceptions to this rule. Hence, we are going to analyze how important these irregularities are. First exception is that two heavily procyclical industries; "Trade, Transportation, and Utilities" and "Professional and Business Services" are relatively gender balanced; i.e. displays 41% to 45% women share respectively. Hence, we think negative effect on fertility from male side and positive effect of fertility from female side will cancel out each other[2]. Another exception is "Financial Activities" industry which has relatively high cyclicality (0.72) and relatively high female share (0.59). However, Figure 3.2 shows that this industry captures only 7% of total female employment. Therefore, it is a relatively small industry and excluding that from the analysis does not change the analysis qualitatively[3].

As a result, major industries which are significantly procyclical and male dominant and significantly acyclical and female dominant are the ones which also employ a large majority of labor force. Hence, in our empirical analysis, we are going to focus on these industries; Construction and Manufacturing to represent male income effects, Education, Health and Government to represent female income effects. However, results including all the industries will be shown as well. Employment changes in gender equal industries do not have a significant impact on fertility as male and female effects cancel out each other. In our model, we incorporate employment and cyclicality of all industries when constructing the measure for men and women wages.

[2] Robustness checks are done and presented in Table 11

[3] Robustness checks are done and presented in Table 11

5.3 Regression Analysis

The classical assumption of time cost of childbearing is only on female side implies that male income changes produce income effect, female income changes produce both income and substitution effects. However, previous studies and cross sectional evidences show that substitution effect is dominant for female as high wage earner women have lower fertility rates. To test this hypothesis, we construct a dataset which includes birth rates and industry employment at state level. For male income effects, we use employment of male dominant industries (construction, manufacturing) as a proxy and for female income, we use employment of female dominant industries (education, health services and government). Table 2 shows that employment changes in female dominant industries have negative impact on fertility changes, whereas employment changes of male dominant industries have positive impact as we argued. In other words, 1% employment increase in male dominant industries leads to 0.22 ppt increase in fertility and 1% employment increase in female dominant industries leads to 0.33 ppt decrease in fertility at state level.

If we think that employment changes may not be a good proxy for income changes, we have also used total industry compensation changes as it captures both the changes in employment and changes in earnings. Table 11 shows the results for different specifications. Coefficients for male and female income effects remains qualitatively same and significant. Moreover, regression results for post-recession period give larger effects.

Finally, in order to rule out potential problem which may arise from excluding industries other than the ones we defined as female and male dominant industries, we have included all the industry compensation changes in our analysis. Consistent with our hypothesis, compensation changes of gender equal industries do not have significant effect on fertility as positive male effect and negative female effect cancel out each other. Nevertheless, male dominant and female dominant industry compensation changes still have significant effect on fertility outcomes, where the signs are the same as in the baseline specification (Table 11).

Baseline Specification		
Dependent Variable: $\Delta Fertility\ Rate_{t,t-1,s}$		
$\%\Delta Employment\ Female\ Dominant\ Industries_{t-1,t-2,s}$	-0.31***	-0.50***
	(0.108)	(0.098)
$\%\Delta Employment\ Male\ Dominant\ Industries_{t-1,t-2,s}$	0.22***	0.19***
	(0.015)	(0.021)
Year Fixed Effects	No	Yes
R^2	0.35	0.73
n	576	576

Table 2: Birth Rate and Gender Biased Industry Employment

Note: The data includes state level industry employment and birth rates for years 2002-2016. Female dominant industries are education, health services and government, male dominant industries are construction and manufacturing. Birth data is from NHS and industry employment data is from BLS. The regression is weighted by state employment level.

6 Model

We formalize the idea of heterogeneous impact of female and male earnings in fertility and we conduct counterfactual scenarios such as "What would have happened if industry employment was gender balanced?" or "What would have happened if different industrial cyclical properties did not exist?". To address these issues, we build a household fertility choice model with partial specialization[Jones et al., 2010]. Partial specialization feature allows both genders to work in the market, however only female incur the time cost of childbearing. We first derive the static model and we build a 3-period model in order to address the fertility gap between younger and older women, but more importantly larger fertility decline among younger women in recession times.

6.1 Static Model

A representative household solve the maximization problem in (1) by choosing how much to consume (c) and how many kids to have (n). σ_c is curvature of the utility function with respect to consumption, σ_n is curvature of the utility function with respect to fertility. α_n represents preference towards children with respect to consumption. Household has income from male (w_m) and from female (w_f). However, female has to sacrifice her time from working when they have a kid by a factor γ. There is no labor force participation decision. Both genders work full time, female works less when they have a kid.

$$\max_{c,n} \frac{c^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{n^{1-\sigma_n}}{1-\sigma_n} \quad s.t.\ c \leq w_m + (1-\gamma n)w_f$$

Optimality Condition:

$$\left(\frac{[w_m + (1-\gamma n*)w_f]}{n*^{\sigma_n/\sigma_c}}\right) = \left(\frac{\gamma w_f}{\alpha_n}\right)^{1/\sigma_c}$$

Special Case $\sigma_c = \sigma_n = 1$:

$$n* = \frac{w_m + w_f}{\left(\gamma w_f + \left(\frac{\gamma w_f}{\alpha_n}\right)\right)} \tag{1}$$

$$\partial n^*/\partial w_m = \frac{\alpha_n}{\gamma w_f(\alpha_n + 1)} > 0 \tag{2}$$

$$\partial n^*/\partial w_f = \frac{-w_m \alpha_n}{\gamma(\alpha_n + 1)w_f^2} < 0 \tag{3}$$

$$\partial n^*/\partial w_m \partial w_f = \frac{-\alpha_n}{\gamma w_f^2(\alpha_n + 1)} < 0 \tag{4}$$

$$\partial n^*/\partial^2 w_f = \frac{2 w_m \alpha_n}{\gamma(\alpha_n + 1) w_f^3} > 0 \tag{5}$$

Fertility is an increasing function of male income and decreasing function of female income. Moreover, female income has a negative impact on the response of fertility to the male income changes. It means that fertility changes less to a shock to the male income if female income is high. On the other hand, fertility responds more to a shock to the female income if male income is high and less if female income is high.

6.2 3-Period Model

Representative household lives 3 periods. In the first period she is young, in the second period she is old and in the last period she is retired. Having a kid is only possible in the first 2 periods. In the third period, the agent consumes her savings. Female incur the time cost of the kid only when the kid is young. The young agent face borrowing constraints.

The young agent solves the following problem:

$$\max_{c_y, a_y, c_o, a_o, n_y, n_o, c_r} \; U_y + \beta U_o + \beta^2 U_r \; s.t.$$

$$\begin{aligned} c_y + a_y &\leq w_{my} + (1 - \gamma_0 n_y) w_{fy} \\ c_o + a_o &\leq (1+r) a_y + w_{mo} + (1 - \gamma_0 n_o - \gamma_1 n_y) w_{fo} \\ (1+r) a_o &= c_r \\ a_y &\geq 0 \end{aligned}$$

where

$$U_y = \frac{c_y^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{(\nu + n_y)^{1-\sigma_n}}{1-\sigma_n}$$

$$U_o = \frac{c_o^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{(n_y + n_o)^{1-\sigma_n}}{1-\sigma_n}$$

$$U_r = \frac{c_r^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{(n_y + n_o)^{1-\sigma_n}}{1-\sigma_n}$$

The old agent solves the following problem:

$$\max_{c_y,a_y,c_o,a_o,n_y,n_o,c_r} U_o + \beta U_r \; s.t.$$

$$\begin{aligned} c_o + a_o &\leq (1+r)a_y + w_{mo} + (1 - \gamma_0 n_o - \gamma_1 n_y) w_{fo} \\ (1+r)a_o &= c_r \\ a_y &\geq 0 \end{aligned}$$

where

$$U_o = \frac{c_o^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{(n_y+n_o)^{1-\sigma_n}}{1-\sigma_n}$$

$$U_r = \frac{c_r^{1-\sigma_c}}{1-\sigma_c} + \alpha_n \frac{(n_y+n_o)^{1-\sigma_n}}{1-\sigma_n}$$

In the 1st period utility of the agent (U_y), the utility from children has a different structure. The agent derives utility from kids (if any when young) but they have a preference parameter (ν) which can be thought as the utility from being childless and which allows them to postpone fertility if necessary. [Baudin et al., 2015] finds that 2.5% of women remain childless due to poverty and 8.1% due to high opportunity cost. Hence, this parameter can serve to both purposes faced by young women. Hence even if young agent does not have a kid, they still have some positive utility. a_y and a_o represent saving when young and old respectively.

Assumption 1 Agents face borrowing constraints when they are young which implies $a_y \geq 0$.

Assumption 2 Time cost associated to young and older kids are different.

Assumption 3 There is an implicit assortative mating in terms of age groups. Young women are mating to young men and old women are mating to old men.

6.3 Gender Bias in Industries and Income Cyclicality

Female and male workers have different weights in industry employment and industries have different cyclicality in total compensation. Empirically, sticky wage rule implies that wages do not change much with business cycles but employment does. Hence, a good measure of earning changes in a model without incorporating unemployment would be total compensation which implicitly captures the changes in both earnings and employment at industry level. Hence, we provide an empirically tractable way of measuring the total compensation of men vs. women, its time series movement as well as gender bias in employment. Equations below are used to estimate total compensation of men vs. women weighted by industry employment using industry compensation. ω_{fi} and ω_{mi} represent fraction of female and male employment in industry i respectively. These shares do not depend on time, as they are independent of time as shown previously. w_{it}[4] represents total compensation of industry i, γ_{fi} represents the gender gap in earnings in industry i. Finally, η_{fi} and η_{mi} represent earnings gap between young and old workers. Hence w_{yft} , w_{oft}, w_{ymt} and w_{omt} become total female and male compensation for young and old workers separately. The advantage of such an analysis is that it allows us to observe: 1-The effect of changes of industrial compensation on female and male earnings. 2- The effect of gender weights on cyclicality of male and female earnings.

$$w_{yft} = \Sigma_{i=1}^{i=n} \omega_{fi} w_{it} \gamma_{fi} \eta_{fi} \tag{6}$$

$$w_{oft} = \Sigma_{i=1}^{i=n} \omega_{fi} w_{it} \gamma_{fi} (1 - \eta_{fi}) \tag{7}$$

$$w_{ymt} = \Sigma_{i=1}^{i=n} \omega_{mi} w_{it} (1 - \gamma_{fi}) \eta_{mi} \tag{8}$$

$$w_{omt} = \Sigma_{i=1}^{i=n} \omega_{mi} w_{it} (1 - \gamma_{fi})(1 - \eta_{mi}) \tag{9}$$

Assumption 4 Industry weights in employment are stable over time but different for genders.

Assumption 5 Gender earnings gap is stable over time but vary across industries.

Assumption 6 Age earnings gap is different across genders and industries but stable over time.

6.4 Estimating Model Parameters

In this paper, we are not only looking at theoretical implications of female and male wage changes on fertility but also estimate those changes as well as relative earnings between agents using industry compensations. Hence, these estimates are crucial in approximating income shocks to the observed shocks in the Great Recession.

6.4.1 Gender Asymmetric Industry Employment

Table 3 documents the percentage of people employed in each industry separately for male and female. Since these shares do not change significantly over time, the average of the sample year 2002-2015 has been reported and has been used for the analysis. Almost half of employed women are working in education, health services and government. More than half of employed men on the other hand, are working in the most procyclical industries; construction, manufacturing, trade-transportation and professional and business services. These shares are used to construct male and female compensation and also to perform counterfactual compensation scenarios.

[4] Total compensation levels are divided by CPI index to remove price effects.

$i = industry$	ω_{fi}	ω_{mi}
Mining and Logging	0.1%	0.9%
Construction	1.2%	8.3%
Manufacturing	5.7%	13.7%
Trade, Transportation, and Utilities	15.8%	22.3%
Information	1.9%	2.5%
Financial Activities	7.2%	4.8%
Professional and Business Services	11.8%	14.1%
Education and Health Services	22.4%	6.4%
Leisure and Hospitality	10.5%	9.3%
Other Services	4.3%	3.8%
Government	19.0%	13.8%

Table 3: Industry Shares in Male vs. Female Employment

Note: The data on gender specific employment at industry level is taken from BLS for the sample years of 2002-2015.

6.4.2 Age Profile in Earnings

Since we are constructing compensation changes using macro level data and age-specific compensation changes are not available, we developed a measure of difference in earnings according to age groups. Table 4 represents the fraction of compensation captured by younger workers (20-30 age group) differently for men and women. We estimated η_{fi} and η_{mi} by using Current Population Survey for the years 2002-2015 and averaged across years. We have estimated average earnings of men and women of different age groups at industry level. Finally, we took the ratio of young to old by normalizing the sum to 1.

$i = industry$	η_{fi}	η_{mi}
Mining and Logging	0.40	0.42
Construction	0.44	0.41
Manufacturing	0.40	0.37
Trade, Transportation, and Utilities	0.38	0.35
Information	0.37	0.34
Financial Activities	0.40	0.33
Professional and Business Services	0.41	0.34
Education and Health Services	0.40	0.29
Leisure and Hospitality	0.40	0.36
Other Services	0.44	0.40
Government	0.41	0.40

Table 4: Age Profile in Industry Earnings

Note: Current Population has been used to calculate earnings difference across age, gender, industries. η_{fi} represents the fraction of earnings captured by young female and $(1 - \eta_{fi})$ represents the fraction captured by old female.

6.4.3 Gender Gap in Industry Earnings

Since we are not able to observe the actual compensation captured by each gender at industry level, we construct a measure of gender gap (γ_{fi}) which represents the fraction of compensation captured by female in each industry. We used Current Population Survey for the years 2002-2015 and estimated average earnings of men and women at industry level. Finally, we took the ratio of women to men by normalizing the sum to 1 and averaged across years.(see Table 5)

$i = industry$	γ_{fi}
Mining and Logging	0.40
Construction	0.46
Manufacturing	0.41
Trade, Transportation, and Utilities	0.38
Information	0.41
Financial Activities	0.36
Professional and Business Services	0.39
Education and Health Services	0.38
Leisure and Hospitality	0.40
Other Services	0.38
Government	0.42

Table 5: Gender Gap in Industry Earnings

6.4.4 Aggregated Compensation Changes

By using the estimates reported in Table 3,4,5 and equations 4 through 7, we have constructed earnings of four agents (young women, old women, young men, old men) in the model. This measurement captures the effect of: 1- industry shares in earnings, 2-industry compensation changes, 3- gender gap in earnings, 4- age gap in earnings. Then, we report the annual changes in compensation levels of four agents in the model in Table 6. In the last row, we show the changes for the recession period 2007-2011 for which we observe the sharpest decline both in fertility, employment and compensation levels. As argued before, male compensation levels show a significant (5%) decline during that period, even after taking into account the changes in all the industries. However, the compensation change for female income is relatively small (around 0.7%).

	w_{yft}	w_{oft}	w_{ymt}	w_{omt}
2003	1.5%	1.5%	0.3%	0.4%
2004	2.9%	2.9%	2.4%	2.5%
2005	1.4%	1.4%	1.2%	1.3%
2006	2.9%	2.9%	2.6%	2.7%
2007	2.8%	2.8%	2.3%	2.4%
2008	-0.4%	-0.5%	-1.7%	-1.7%
2009	-1.4%	-1.4%	-4.2%	-4.2%
2010	0.8%	0.8%	0.2%	0.3%
2011	0.3%	0.4%	0.7%	0.9%
2012	2.0%	2.0%	2.0%	2.2%
2013	0.9%	0.9%	0.9%	0.9%
2014	2.9%	2.9%	3.3%	3.4%
2015	4.8%	4.9%	4.8%	4.9%
2007-2011	-0.7%	-0.8%	-5.0%	-4.7%

Table 6: Computed Measures of Model Earnings

6.4.5 Fertility of Young and Old

Table 6.4.5 documents the average number of children for the age group of 20-29 and 30-40 to be used as the targets in the model. In order to obtain this measure, the birth rates of 5-year bracket age groups are multiplied by 5. The fertility of both groups are the highest in 2007, then decline afterwards until 2011. After 2011, the changes are relatively modest. Comparing younger and older women's fertility show us that younger women respond more to the economic shocks, i.e. the average number of children decreases from 1.11 to 0.96 for the age group 20-29, whereas it decreases from 0.74 to 0.71 for age group 30-40. This is partly due to delaying motive for younger women, and also borrowing constraints for young families.

	n_y	n_o	n_{total}
2003	1.09	0.69	1.78
2004	1.08	0.70	1.78
2005	1.08	0.71	1.79
2006	1.11	0.73	1.84
2007	**1.11**	**0.74**	**1.85**
2008	1.08	0.72	1.80
2009	1.03	0.71	1.74
2010	0.99	0.71	1.69
2011	**0.96**	**0.71**	**1.67**
2012	0.94	0.72	1.66
2013	0.93	0.73	1.66
2014	0.92	0.75	1.67
2015	0.90	0.76	1.66
2016	0.87	0.77	1.64

Table 7: Average number of kids per age group

Note: The data is from National Health Statistics. The birth rates for 5-year bracket age groups are multiplied by 5 to get the average number of child at every age group. n_y represents the average number of children for the group of age 20-29, n_o is the average number of children for the group of age 30-40.

6.4.6 Relative Compensation between Agents

When calibrating the model, we need to determine a relative measure between wages of four different agents, then the changes will follow according to Table 6. We use computed model earnings according to the structure described in section 6.3 and summarize in Table 12. In order to find the relative measure between compensation levels when calibrating the model, we take the averages across years, normalize w_{fy} to 1 and calculate w_{my}, w_{mo} and w_{fo} as summarized in Table 8.

Variable	Definition	Value
w_{my}	Young male wage	$1.37w_{fy}$
w_{mo}	Old male wage	$2.44w_{fy}$
w_{fo}	Old female wage	$1.49w_{fy}$
w_{fy}	Young female wage	1

Table 8: Relative Compensation

Note: The data on compensation levels is from BEA. Computed model wages is shown in Table 12

7 Results

We parameterized the model as summarized in Table 9. The discount rate and the intertemporal elasticity of substitution are taken as standard from the literature. For the curvature parameters, σ_c and σ_n, we have selected within the range used in the literature. Setting them equal to 1, leads to log-utility case in which income ans substitution effects cancel out each other, hence we observe no change in fertility when incomes of all agents change equally. In order to get rid of that effect, we set them greater than 1. Moreover, when both curvature parameters equal to each other, gender differentiated wage shocks produce the same effect. However, we are confident that our qualitative results do not depend on the choice of curvature parameters.

In order to determine the level of fertility, as well as the difference between young and old, we calibrated α_n and ν. If young families do not derive any utility from being childless, then everybody would be having babies when young because there is higher return due to having them for a long time. However, this is not compatible with the data. To address this issue, we use two source of variation. The purpose of ν is that it gives flexibility to young families to postpone childbearing as they are financially constrained. Having ν positive, allows young families to have some utility from being childless. Also, we allocate different time cost for younger and older children as shown by Kleven et al. [2018]. They find that hours worked decline by 20% following the first birth, then increase by time but still remain 0.97% lower than women without children. Hence, we took these estimates as the time cost of children (γ_o and γ_1).

Finally, we normalized wage of young female to 1 and estimate the ratio of compensations between four agents in the model. More details are given in section 6.4.6. Hence, we calibrate two parameters α_n and ν to target fertility of young and old women. The results of the calibration are shown in Table 9.

7.1 Calibration Results

Parameters	Definition	Value	Source
r	Discount rate	0.01	
β	Intertemporal elasticity of substitution	0.99	
σ_n	Curvature of utility wrt fertility	1.5	
σ_c	Curvature of utility wrt consumption	2	
w_{fy}	Young female wage	1	
γ_0	Time cost of young children	0.2	Kleven et al. [2018]
γ_1	Career cost of children	0.097	Kleven et al. [2018]
w_{my}	Young male wage	$1.37w_{fy}$	CPS, BEA
w_{mo}	Old male wage	$2.44w_{fy}$	CPS, BEA
w_{fo}	Old female wage	$1.49w_{fy}$	CPS, BEA
Calibrated Parameters			
α_n	Preference of fertility wrt consumption	0.1	Target $n_y = 1.1$
ν	Childlessness utility when young	2.76	Target $n_o = 0.74$

Table 9: Calibration Results

7.2 Counterfactual Analysis

We argue that the fertility decline is amplified during recessions due to gender biased industry employment and cyclical properties of industries. In order to show this amplification mechanism, we perform counterfactual analysis. First, we apply the computed compensation changes from Table 6 to the model and observe how well we can approximate the fertility changes in the data. The model performs well in delivering the fertility outcomes in 2011 (Figure 11). Hence, observed changes in industry compensations as well as gender-specific employment are crucial in explaining fertility trends. Then, instead of applying observed changes which is larger decline in male-dominant industries, smaller decline in female-dominant industries, we apply the average decline in compensation at national level after taking into account all the industry compensation changes. In that case, fertility decline would have been milder. It is because of 2 effects: 1- Male income loss is smaller, hence affects fertility less. 2- Female income loss is larger, due to lower opportunity cost, fertility increases.

As a result, in a such scenario where genders are equally employed in industries, everybody would experience the same average decline in earnings. Thus, fertility would not decline as much. The same is true if all industries would experience same cyclical properties. A simple accounting gives an estimate of 28% as the amplification effect due to different cyclical properties and 44% due to gender asymmetric industry employment.

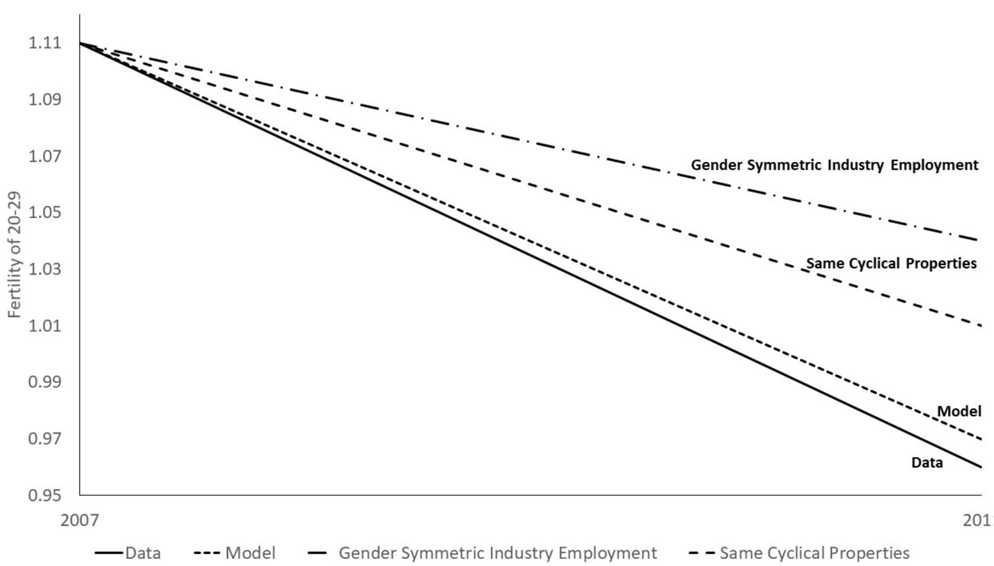

Figure 11: Model Fit and Counterfactuals

	2007 Data	2011 Data	2011 Model	Gender Symmetric Employment	Same Cyclicality
n_y	1.11	0.96	0.97	1.04	1.01
n_o	0.74	0.71	0.68	0.71	0.7
$\%\Delta w_{fy}$		-0.7%	-0.7%	-2.8%	-4.4%
$\%\Delta w_{fo}$		-0.8%	-0.8%	-2.8%	-4.4%
$\%\Delta w_{my}$		-5.0%	-5.0%	-3.3%	-4.4%
$\%\Delta w_{mo}$		-4.7%	-4.7%	-2.8%	-4.4%

Table 10: Counterfactual Analysis

Employment change of men versus women have different effect on fertility

We showed in our empirical analysis that employment change in male-dominant industries affect fertility positively and employment change in female-dominant industries affect fertility negatively at state level. Moreover, in our theoretical framework, we showed that under reasonable assumption, male income has positive impact on fertility whereas female income has negative impact on fertility. In order to incorporate both employment and wage changes during the recession, we used compensation data and we got the same results.

Part of fertility decline can be explained by gender-biased industry employment and industrial cyclical properties:

Our quantitative model predicts that 28% to 44% of the fertility decline can be explained by the fact that women and men are employed in different industries with different cyclical properties. Hence, in an hypothetical world where everything is symmetric across genders, fertility decline should have been milder during recessions.

8 Conclusion

This paper attempts to give a complementary explanation for procyclical feature of fertility. We argue that part of the reason why fertility is procyclical is due to gender asymmetry in industries as well as different cyclical properties of industries. Men are employed in heavily procyclical industries whereas women are employed in acyclical industries. In recession times, worse labor market outcomes of men negatively affect fertility. On the other hand, better or stable labor market outcomes of women also negatively affect fertility due to substitution effect of female wage. Hence, gender asymmetry feature of the labor market aggravates the fertility response to business cycles.

We show that increases in employment (and total compensation) in male dominant industries have positive impact on fertility at state level whereas increases in female dominant industries have negative impact on fertility. Our empirical analysis shows that the results are robust to the measure used (either employment or compensation) and also robust when all industry changes are incorporated. The outcome changes in gender-equal industries do not seem to have a significant effect on fertility.

We build a model of household fertility choice with partial specialization. We show qualitatively that under reasonable parameters, female wage affects fertility negatively and male wage affects fertility positively. With a 3-period model, we are able to present quantitative results by also incorporating fertility differences among age groups. Our quantitative model predicts well the fertility change among younger and older women as a result of compensation changes in male and female income measured from the data.

In order to quantify the importance of gender asymmetry in industries, we perform a counterfactual analysis by asking the question " what would be the fertility after the recession if industries were gender-equal and/or genders experience same cyclical shocks?". In all scenarios, we find that fertility decline would have been milder. Our accounting shows that 28% to 44% of the fertility decline in the Great Recession can be attributed to gender-biased industry employment and cyclical properties of industries.

We believe that our findings are important in order to understand why fertility is procyclical, what feature of the labor market causes this phenomenon and finally why better labor market outcomes of women means lower fertility. One reason why we obtain such a conclusion is that women still incur majority of childbearing and another reason is that women have to sacrifice hours worked when they have children. Hence, other than gender symmetric labor market conditions, policies which may potentially reduce the opportunity cost of child to mothers may help in rising fertility.

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A Appendix

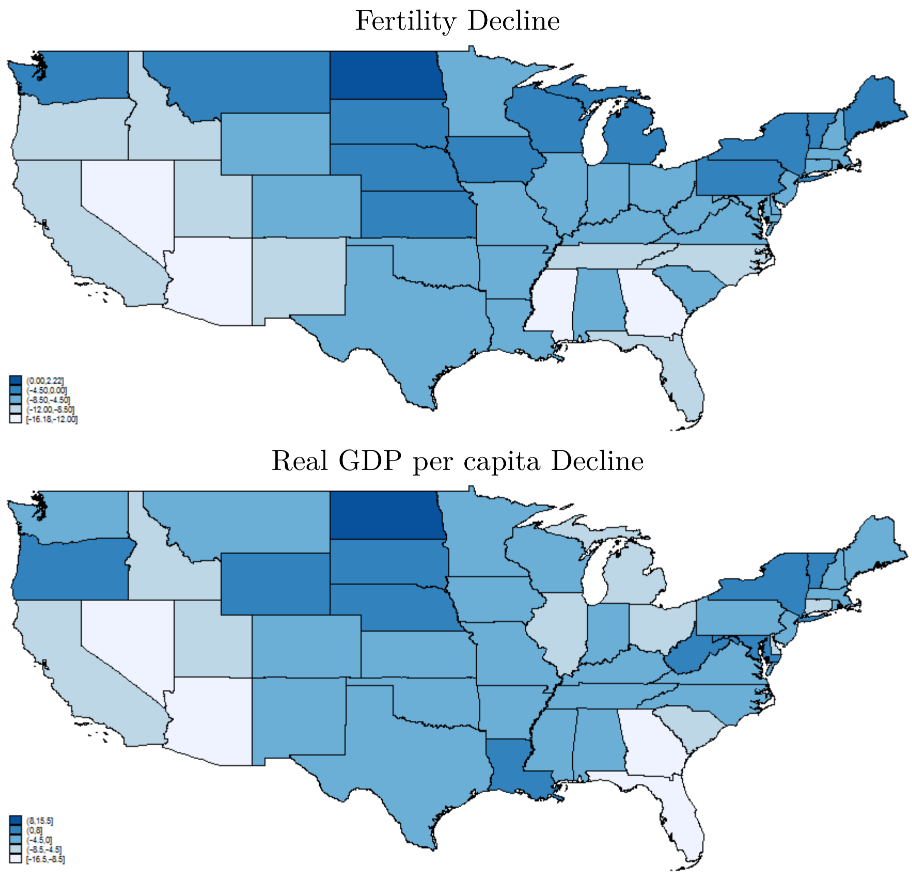

Figure 12: Fertility and Real GDP per capita

Note: Upper figure shows the fertility decrease from 2007 to 2010. Below figure shows the real GDP per cap decrease for the same period. The data is taken from National Health Statistics for fertility and Bureau of Economic Analysis for real GDP per capita.

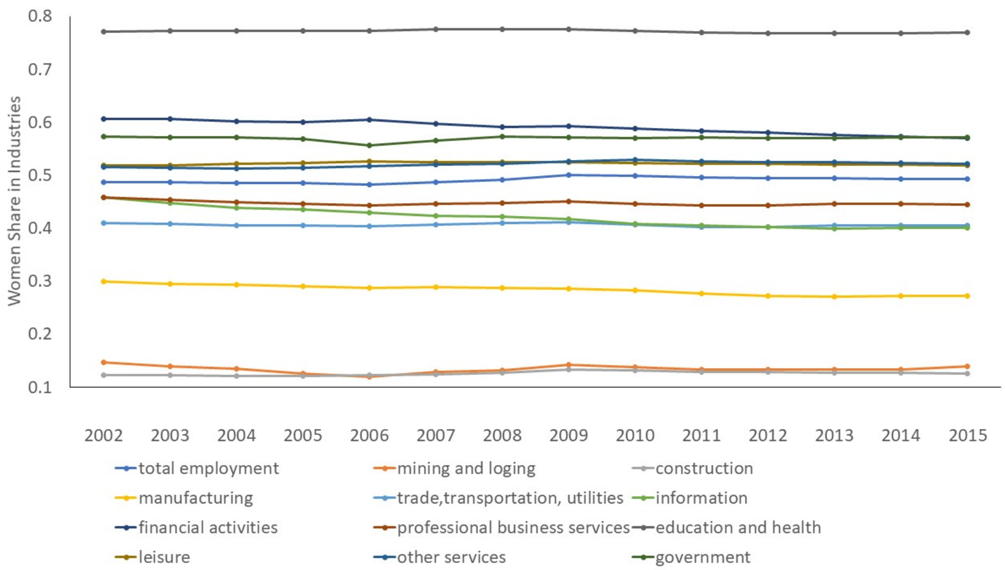

Figure 13: Women Share in Industries over time

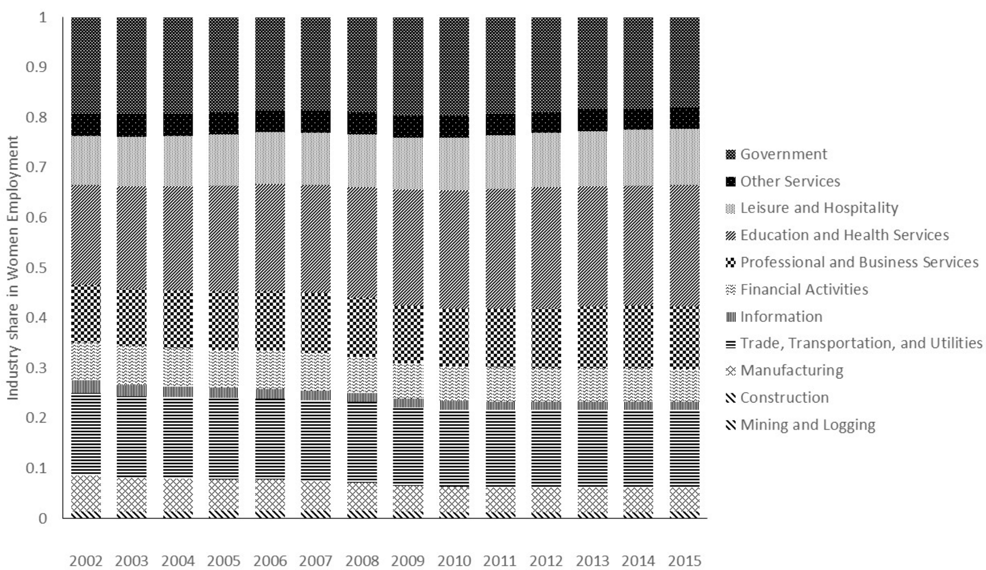

Figure 14: Industry Shares in Women Employment over time

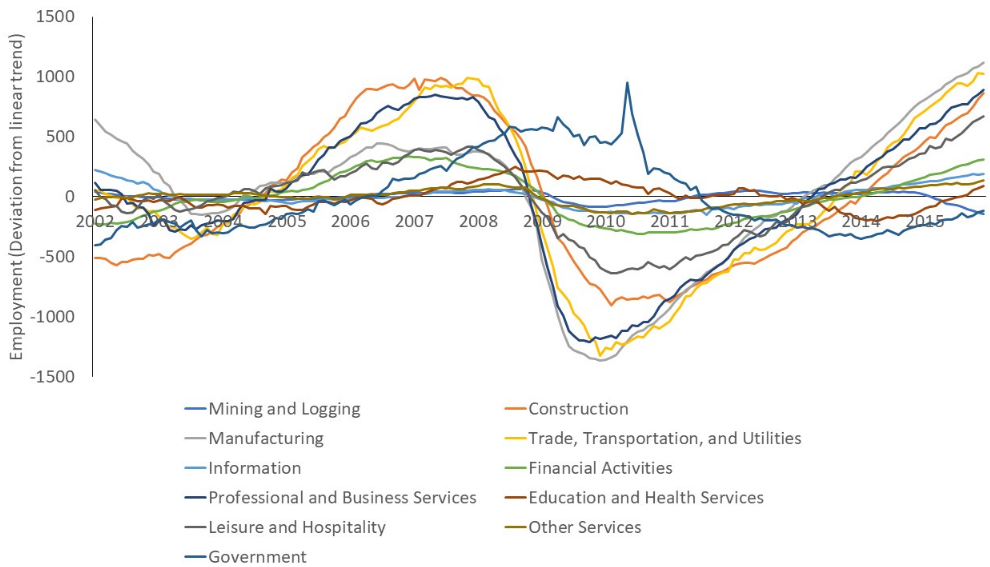

Figure 15: Cyclicality of Industry Employment

	w_{yft}	w_{oft}	w_{ymt}	w_{omt}
2002	2116312	3150660	3026713	5378163
2003	2147601	3196593	3037111	5397823
2004	2209960	3289543	3109446	5532591
2005	2241752	3336533	3147912	5605351
2006	2307246	3433944	3228804	5754043
2007	2372942	3531621	3302874	5892843
2008	2362429	3513974	3245149	5789971
2009	2330380	3464231	3109303	5547075
2010	2348195	3490988	3114752	5565495
2011	2355309	3503298	3136468	5614329
2012	2401544	3573281	3199908	5738855
2013	2423357	3606557	3227163	5792470
2014	2493418	3711474	3335110	5989864
2015	2614058	3891777	3494359	6281531
Average	2337464	3478177	3193934	5705743

Table 12: Compensation Levels

	(2002-2016)			(2007-2011)			
Dependent Variable: $\Delta Birth\ Rate_{t,t-1,s}$	1	2	3	4	5	6	7
$\%\Delta Employment\ Female\ Dominant\ Industries_{t-1,t-2,s}$	-0.31***	-0.22*			-0.64***		
	(0.11)	(0.13)			(0.09)		
$\%\Delta Employment\ Male\ Dominant\ Industries_{t-1,t-2,s}$	0.22***	0.30***			0.17***		
	(0.01)	(0.06)			(0.01)		
$\%\Delta Total\ Employment_{t-1,t-2,s}$		-0.21					
		(0.18)					
$\%\Delta Total\ Compensation\ Female\ Dominant\ Industries_{t-1,t-2,s}$			-0.22***			-0.35***	
			(0.06)			(0.04)	
$\%\Delta Total\ Compensation\ Male\ Dominant\ Industries_{t-1,t-2,s}$			0.11***			0.16***	
			(0.04)			(0.02)	
$\%\Delta Total\ Compensation\ in\ Mining_{t-1,t-2,s}$				-0.01			-0.01
				(0.01)			(0.01)
$\%\Delta Total\ Compensation\ in\ Construction_{t-1,t-2,s}$				0.18***			0.1***
				(0.02)			(0.01)
$\%\Delta Total\ Compensation\ in\ Manufacturing_{t-1,t-2,s}$				0.03			0.02
				(0.03)			(0.03)
$\%\Delta Total\ Compensation\ in\ Trade_{t-1,t-2,s}$				0.1			0.11
				(0.07)			(0.07)
$\%\Delta Total\ Compensation\ in\ Information_{t-1,t-2,s}$				-0.03**			0.01
				(0.01)			(0.01)
$\%\Delta Total\ Compensation\ in\ Finance_{t-1,t-2,s}$				0.11***			0.01
				(0.03)			(0.03)
$\%\Delta Total\ Compensation\ in\ Business_{t-1,t-2,s}$				-0.05**			-0.06**
				(0.03)			(0.03)
$\%\Delta Total\ Compensation\ in\ Education, Health_{t-1,t-2,s}$				-0.17***			-0.29***
				(0.06)			(0.05)
$\%\Delta Total\ Compensation\ in\ Leisure_{t-1,t-2,s}$				-0.13***			-0.04
				(0.05)			(0.06)
$\%\Delta Total\ Compensation\ in\ OtherServices_{t-1,t-2,s}$				-0.3***			-0.06
				(0.04)			(0.05)
$\%\Delta Total\ Compensation\ in\ Government_{t-1,t-2,s}$				0.0414			-0.11**
				(0.05)			(0.04)
Constant	0.00*	0.00**	-0.01***	0.01***	-0.00**	-0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
n	576	576	611	579	384	408	383
R^2	0.352	0.355	0.201	0.512	0.566	0.514	0.567

Table 11: Robustness Checks

Note: The dataset is a merged dataset using state level compensation levels from BEA, state level fertility rates from National Health Statistics and state-industry level employment from BLS. All the regressions are weighted by state total employment.

	%Δ from previous year												
$i = industry$	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mining and Logging	0.1%	6.5%	9.9%	12.1%	7.7%	9.6%	-10.5%	5.9%	11.4%	7.7%	2.6%	6.9%	-7.3%
Construction	-0.1%	3.7%	4.2%	7.5%	1.3%	-5.2%	-15.2%	-8.5%	-1.5%	2.8%	4.3%	6.7%	8.8%
Manufacturing	-2.6%	0.0%	-0.7%	0.0%	-0.7%	-4.8%	-10.9%	0.8%	1.6%	1.6%	0.0%	3.1%	3.0%
Trade, Transportation, and Utilities	0.0%	2.1%	0.5%	2.1%	2.0%	-3.5%	-5.2%	-0.5%	1.6%	2.2%	1.1%	3.6%	5.0%
Information	-4.1%	0.5%	-1.7%	1.3%	2.1%	-3.8%	-5.2%	-0.6%	1.5%	2.8%	5.1%	4.1%	5.5%
Financial Activities	2.5%	5.9%	2.8%	5.5%	3.4%	-5.0%	-9.6%	1.9%	2.9%	2.8%	0.0%	5.4%	5.1%
Professional and Business Services	0.0%	5.0%	4.8%	5.1%	5.4%	0.0%	-5.6%	2.7%	3.2%	5.6%	1.9%	4.8%	6.4%
Education and Health Services	4.1%	4.0%	1.5%	3.8%	3.6%	2.1%	4.8%	2.0%	0.0%	2.6%	1.9%	1.8%	5.4%
Leisure and Hospitality	1.7%	3.1%	1.1%	3.4%	2.7%	-0.7%	-3.4%	0.7%	1.7%	4.3%	3.2%	5.4%	6.8%
Other Services	2.4%	1.8%	-1.3%	2.2%	2.0%	-0.4%	-2.0%	-1.1%	0.2%	2.1%	1.5%	4.6%	4.4%
Government	2.1%	1.5%	0.5%	1.5%	2.0%	1.4%	2.9%	-0.5%	-2.8%	-1.4%	-1.0%	1.0%	2.9%

Table 13: Change in Total Industry Compensation

	Black		Hispanic		Other		White	
	male	female	male	female	male	female	male	female
agriculture	0.52%	0.06%	1.10%	0.14%	0.73%	0.17%	1.48%	0.19%
mining and loging	0.52%	0.06%	1.10%	0.14%	0.73%	0.17%	1.48%	0.19%
construction	5.97%	0.58%	21.23%	1.38%	6.54%	1.02%	12.86%	1.63%
manufacturing	13.12%	5.83%	12.83%	8.94%	12.10%	7.21%	14.26%	5.76%
trade, transportation, utilities	26.38%	15.95%	19.51%	16.95%	19.77%	15.72%	21.49%	15.37%
information	2.91%	2.35%	1.62%	1.58%	3.10%	2.02%	2.90%	2.06%
financial activities	5.44%	7.88%	3.79%	7.03%	6.53%	8.19%	6.39%	8.57%
business services	11.17%	8.70%	11.34%	10.83%	16.13%	11.31%	11.62%	10.14%
education and health services	13.64%	38.49%	5.68%	27.49%	13.70%	31.08%	10.14%	37.15%
leisure services	10.17%	9.07%	12.15%	14.82%	11.99%	11.93%	7.25%	9.34%
other services	4.36%	3.99%	4.65%	6.27%	4.12%	5.92%	4.05%	5.06%
government	5.88%	7.02%	2.89%	3.51%	4.47%	5.07%	5.35%	3.98%
armed forces	0.52%	0.06%	1.10%	0.14%	0.73%	0.17%	1.48%	0.19%

Table 14: Industry Shares across Gender- Race

	Less than HS		HS degree		Some College		College Degree		More than College	
	male	female	male	female	male	female	male	female	male	female
agriculture	1.16%	0.15%	1.26%	0.16%	1.28%	0.17%	1.31%	0.18%	1.28%	0.18%
mining and loging	1.16%	0.15%	1.26%	0.16%	1.28%	0.17%	1.31%	0.18%	1.28%	0.18%
construction	17.27%	1.34%	13.57%	1.39%	13.00%	1.42%	12.47%	1.46%	11.97%	1.45%
manufacturing	13.23%	7.54%	13.70%	6.50%	13.78%	6.34%	13.84%	6.20%	13.73%	6.19%
trade, transportation, utilities	20.48%	16.28%	21.43%	15.78%	21.53%	15.69%	21.46%	15.59%	21.34%	15.58%
information	2.14%	1.84%	2.64%	2.00%	2.72%	2.03%	2.81%	2.04%	2.85%	2.05%
financial activities	4.77%	7.66%	5.75%	8.14%	5.92%	8.23%	6.12%	8.33%	6.19%	8.35%
business services	11.63%	10.42%	11.81%	10.16%	11.87%	10.14%	12.04%	10.20%	12.34%	10.21%
education and health services	7.79%	31.81%	9.76%	35.01%	10.07%	35.48%	10.36%	35.78%	10.64%	35.79%
leisure services	10.58%	12.36%	8.90%	10.56%	8.61%	10.29%	8.35%	10.07%	8.54%	10.05%
other services	4.43%	5.64%	4.21%	5.21%	4.17%	5.17%	4.13%	5.17%	4.12%	5.17%
government	3.85%	4.14%	4.82%	4.38%	4.97%	4.37%	5.08%	4.30%	5.07%	4.34%
armed forces	1.16%	0.15%	1.26%	0.16%	1.28%	0.17%	1.31%	0.18%	1.28%	0.18%

Table 15: Industry Shares across Gender-Education