Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Spillovers from High-Skill Consumption to Low-Skill Labor Markets

Francesca Mazzolari and Giuseppe Ragusa

November 10, 2010

ABSTRACT

The least-skilled workforce in the United States is disproportionally employed in the provision of time-intensive services that can be thought of as market-substitutes for home production activities. At the same time, skilled workers—with their high opportunity cost of time— spend a larger fraction of their budget in these services.
Given the skill asymmetry between consumers and providers in this market, product demand shifts—such as those arising when relative skilled wages increase—should boost relative labor demand for the least-skilled workforce. We estimate that this channel may explain one-third of the growth of employment of non-college workers in low-skill services in the 1990s.

* Centro Studi Confindustria, Rome and Luiss University, Rome, respectively.
The authors are grateful to David Autor, Marianne Bitler, Jan Brueckner, Julie Cullen, Patricia Cortes, David Dorn, Mireille Jacobson, David Levine, David Neumark, Giovanni Peri, Giovanni Pica, Cordelia Reimers, Lara Shore-Sheppard and seminar participants at University of California Irvine and San Diego, CalState Fullerton and San Diego, MIT, the San Francisco Federal Reserve and the MILLS workshop 2008 for helpful suggestions. They are especially thankful to Roger Gordon and Eli Berman for many helpful discussions and to an anonymous referee for valuable comments. The authors thank the University of California Labor and Employment Research Fund for financial support.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

I. Introduction

Census data show that the least-skilled workforce in the United States is disproportionally employed, relative to more skilled workers, in the provision of time-intensive services like food preparation, cleaning, repair and delivery, which can be broadly defined as market-substitutes for home production activities. In 2005, this sector absorbed almost 25% of the workforce in the lowest decile of the wage distribution, while it employed only 5% of workers earning the median wage, and less than 2% of top-wage earners. While employment shares in this sector monotonically decline along the skill distribution, consumer expenditure data show that consumption of home production substitutes, as a fraction of total expenditures, monotonically increases with an individual's skills. These facts (documented in Section II) are consistent with economic theory: more skilled workers—with their high opportunity cost of time—should be net buyers of home production substitutes, while less-skilled workers should be net sellers.

From the asymmetry between the skills of consumers and providers in the market for services that substitute for home production arises the hypothesis of "consumption spillovers" put forward in this paper: product demand shifts in this sector—driven by the consumption choices of skilled workers—will cause labor demand shifts that favor the least-skilled workforce, where the mapping between product demand and labor demand shifts is meaningful in light of the non-tradeable nature of the services we focus on.

Manning (2004) is the only study that has previously emphasized the dependence of unskilled employment opportunities to physical proximity of skilled workers, because the latter are more likely to buy low-skill time-intensive services that free them from home production tasks. Manning tests for this idea by studying the cross-city association between the fraction of college graduates and either employment rates of low-educated workers or their employment shares in non-traded activities. We instead test whether the demand for home production substitutes (and for workers providing them) increases with measures of relative wage income inequality, such as the share of income accruing to the higher-income groups. Since the fraction of expenditures in home production substitutes is larger in higher income percentiles, we expect economies with higher income inequality to allocate a larger share of aggregate income towards these services, and to demand more of the unskilled labor that provides them.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

As shown in Section II-C, time series evidence at the national level supports the existence of consumption spillovers. The growth in wage inequality over the last three decades is one of the better-documented facts about the U.S. labor market (see Katz and Autor (1999) and Acemoglu (2002) for reviews). Over the same period, the share of wage earners at the bottom of the U.S. wage distribution employed in the provision of market substitutes for home production activities has steadily increased, from 16% in 1980 to 25% in 2005. Employment growth in this sector might as well stem from labor supply shifts, such as those caused by the large influxes of low-skill immigrants into the United States in recent decades (Cortes, 2008). Quantile regressions of individual log hourly wages on sector of employment, however, show that since 1980 the wage penalty for providers of home production substitutes has decreased, especially at the lowest quantiles. Positively correlated employment and wage changes suggest a central role for labor demand shifts, such as those predicted by consumption spillovers.

In Section III we turn to test our hypothesis on city-level data, where the gain in degrees of freedom gives us the chance of improving the characterization of the source of demand shifts from consumption spillovers. We pool data from the 1980, 1990 and 2000 censuses and the 2005 American Community Survey and study the cross-city association between employment growth in home production substitutes and variation in the top wage bill share. To the extent that changes in the latter are driven by falling bottom end wages—wages that largely determine the price of low-skill time-intensive services—then estimation of the effects of consumption spillovers on the demand for these services is potentially confounded by own-price effects. To address this concern, we instrument changes in top wage shares using *predicted* changes in the wage bill accruing to top wage earners. We find that growth in a city top wage bill share is associated with economically (and statistically) significant low-skill employment growth in the sector of services that substitute for home production activities.

Our paper relates to the large literature on wage inequality. Differently from most other work, however, it investigates a consequence of increasing inequality, rather than its causes. Consumption spillovers predict that the growth of wage inequality—a phenomenon that has been often explained as arising from growth in the demand for skilled labor—should in turn give rise to increasing relative demand for the least-skilled labor. This is of particular relevance in light of recent evidence on the "polarization" of

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

the U.S. labor market. While a feature of the growth of earnings inequality in the 1980s was the decline in employment and earnings of the least-skilled workforce (Bound and Johnson, 1992; Katz and Murphy 1992; Juhn, Murphy and Pierce, 1993), Autor, Katz and Kearney (2006) show that since 1990 to the mid-2000's changes in occupational shares are U-shaped.[1] At the same time, the 90-50 wage gap kept expanding, whereas the 50-10 gap declined.[2]

Autor, Katz and Kearney (2006, 2008) argue that wage and employment growth "polarization" is consistent with a model of technological change in which information technology can only replace human labor routine tasks (Autor, Levy and Murnane, 2003; ALM henceforth). Because jobs that can be routinized are not distributed uniformly across the wage distribution (Goos and Manning, 2007), the secularly declining price of computer capital has non-monotone impacts: it raises demand for the non-routine abstract tasks that are performed by educated professionals and managers, while it lowers demand for the routine tasks that tend to be performed by moderately skilled workers. Even if improvements in technology have no direct impact on the non-routine manual tasks performed by low-skill workers, they do cause labor to be reallocated away from repetitive, traditionally middle-skilled tasks towards lower-skilled activities that require a higher degree of interpersonal and environmental adaptability. As such, the ALM framework predicts employment growth polarization. Labor supply shifts towards the least-skilled jobs, however, might depress observed unskilled relative wages and expand lower-tail inequality.

Demand forces like consumption spillovers can complement technological-based explanations that focus on the production side of the economy, and provide a viable explanation for positively correlated employment and wage changes at the bottom of the skill distribution. In our setting it is the growth in earnings at the top end of the distribution that should spur demand for services consumed by high-income people. Since it is the least-skilled workers that provide these services, this will in turn increase

[1] A similar polarization of employment has been shown to take place in other industrialized economies. See Goos and Manning (2007) for the case of the United Kingdom; Spitz-Oener (2006) for Germany; and Goos, Manning and Salomons (2009) for a larger set of European countries.
[2] Murphy and Welch (2001) and Angrist, Chernozhukov and Fernandez-Val (2006) also document divergent trends in upper and lower-tail U.S. wage inequality in the 1990s.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

labor demand for workers at the bottom end, but not in the middle, of the distribution. Analyses of tax return data (Piketty and Saez, 2003) show that, after increasing steadily until the mid 1980s, the wage income shares of the (very) top percentiles of tax units in the United States underwent unprecedentedly sharp rises in the late 1980s, and then again in the mid to late 1990s. Larger growth in the driving force of consumption spillovers in the 1990s implies that they account well for the timing of changes in the U.S. labor market—that has started to polarize in the 1990s.

II. The market for home production substitutes

A. Theoretical Overview and Related Work

The main intuition of the consumption spillovers hypothesis put forward in this paper is the notion that consumers and providers in the market of services that substitute for home production activities belong to groups at the opposite ends of the skill distribution.

The prediction that skilled workers do less home production than unskilled workers, and consume more market substitutes for home goods and services, is a standard result in the theory of allocation of time—as pioneered by Mincer (1963) and Becker (1965) and formalized by Gronau (1977). Following Manning (2004), we embed this concept in a model for an economy with two types of workers ("skilled" and "unskilled") who derive utility from consuming two types of goods: a general good y—produced by firms using a technology in both skilled and unskilled labor, and a domestic good x—which is the output of time-intensive activities (such as cooking and cleaning the house) that an individual can either produce domestically (using her own time), or purchase in the market (by buying-in someone else's time). Assuming that individuals are equally effective at producing the home good, regardless of their different skills in the production of y, then skilled workers, with their high opportunity cost of time, will be net buyers of time-intensive services that substitute for home production, while unskilled workers will be net sellers. In the extreme case that time is the only input in the production of x, no skilled worker will ever work in the household sector and the wage at which domestic help can be hired will be w_u, the unskilled wage. In the presence of agency costs, no unskilled worker will ever hire any help in household production and the demand for

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

domestic help will be an increasing function of the real skilled wage and a decreasing function of the unskilled wage.

In this setting, a rise in skilled market wages—as long as it is higher than the rise in unskilled wages—will cause a positive shift in the demand for unskilled labor in the sector of services that substitute for home production. We test for this prediction both on time-series data (Section II-C) and on cross-city data (Section III).

Our framework closely relates to the one proposed by Autor and Dorn (2010), who also emphasize the role of growing low-skill in-person service jobs in explaining the twisting of the lower tail of the U.S. wage and employment distributions observed in recent decades. Building upon ALM, the authors identify personal services as a sector that is less likely to experience technological improvements, since it delivers manual non-routine tasks. Even if we emphasize different parts of our models, our approaches are complementary. We stress a consumption explanation, but by positing that technical change in the home production substitute sector is limited, we make an assumption that is similar to the one in Autor and Dorn (2010) and is crucial for consumption spillovers to exist: only if home production is time-intensive, rising returns to skill, by raising the opportunity cost of time of skilled workers, spur their demand for household services. Autor and Dorn focus on the production side of the economy and on the effects of non-neutral changes in productivity, but also make an assumption on consumers' preferences: in their framework, as in Weiss (2008), rising demand (and wages) in the service sector crucially depend on the elasticity of substitution between goods and services.

In what follows, we use consumption expenditure data and employment data to test the main prediction of our framework, that is, consumption of home production substitutes should increase with measures of an individual's skills, while employment in these services should decrease with them. We measure skills either in terms of highest educational attainment or hourly wages. The basic rule to identify the *x*-sector is that it must provide goods/services that an individual would be able to produce domestically using her own time as a primary input. We also impose the criterion that the producer of the good/service has to be located in physical proximity to the consumer of that product, as only in the case of non-tradable goods, prices will reflect the local cost of labor inputs—a crucial feature to map product-demand shifts into demand shifts.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

B. The consumers of home production substitutes

The Consumer Expenditure Survey (CEX) is the only micro-level data reporting comprehensive measures of consumption expenditures for large cross-sections of households in the United States. It consists of two independent nationally representative surveys, one based on retrospective interviews about expenditures in the previous quarter (the Interview Survey) and one based on weekly diaries (the Diary Survey). We use data from the Diary Survey, because weekly record keeping more accurately accounts for the kind of expenditures that we want to measure: Services that are substitutes for home production activities are likely to constitute small and frequent purchases, difficult to recall over longer periods of time (Attanasio, Battistin and Ichimura, 2007).

For each household we calculate both a measure of total weekly expenditures, and a measure of expenditures in goods and services that substitute for home production activities. The latter measure includes purchases of food and drinks consumed away from home at full service places; repair and maintenance, delivery, babysitting, housekeeping and personal care services.[3] On a sample drawn from the 2004 Diary Survey and restricted to households headed by individuals at least 18 and no more than 65 who worked for salary in the twelve months before the interview, we investigate the correlation between the head's education and hourly wage,[4] and the household's expenditure share of home production substitutes.[5] To shed light on the potential differences across family types, we also run separate analyses for (i) husband/wife families where only the head works (15% of the sample), (ii) husband/wife families where both spouses work (40%), and (iii) other households (45%).

As shown in the last panel of Figure 1, the household budget share of home production substitutes monotonically increases with the head's educational attainment: these consumption items represent 4.5 percent of the total expenditures of households headed

[3] Table A1 (in the web-appendix available at ADDRESS) provides details on the way in which specific expenditure items are mapped into these categories.
[4] The family head is conventionally fixed to be the male in all husband/wife families. Hourly wages are calculated as annual earnings (in the 12 months before the interview) divided by annual hours of work.
[5] We study budget shares, instead of dollar amounts spent, to abstract from differential saving decisions across skill groups.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

by high-school dropouts, but 11 percent of those of households headed by college post-graduates. The first three panels show that this pattern is common across family types.[6]

Table 1 reports Ordinary Least Squares (OLS) regressions of household budget shares on head's log hourly wages: as shown in column 1, we find evidence of a statistically significant positive relationship. Columns 2 through 5 report estimated coefficients from regressions separately run for different family types. A ten percent increase in the male head's hourly wage is associated with around a 0.1 percentage point increase in the budget share of home production substitutes in husband/wife families (columns 2 and 3). As shown in column 4, in husband/wife families where the woman works, we find a stronger relationship between budget shares and the woman's wage, suggesting that when the woman participates in the labor market, the opportunity cost of home production time is more closely tied to her wage than the male's wage. Also in the case of other families (column 5), there is a statistically significant relationship between budget shares and head's hourly wages. The magnitude of the relationship is smaller than for other family types, but the fraction of expenditure on these services is on average higher.

These stylized facts show that consumption of outsourced home production activities monotonically increases with proxies for family members' opportunity cost of time. If workers are more likely to consume these services because by doing so they can substitute their own "costly" time in home production activities with cheaper bought-in-time, then they should be more likely to do so the larger is the difference between their own skills and the skills of those providing these services—who, as we show next, are predominantly the least-skilled in the economy.

C. The providers of home production substitutes

To evaluate the skills of the providers of home production substitutes, we use data from the 1980, 1990 and 2000 censuses and the 2005 American Community Survey (ACS), specifically the Integrated Public Use Microsample Series (IPUMS) files

[6] The strictly increasing pattern is less pronounced for married couples where the wife works. However, as shown in Figure A1 (in the web-appendix), when setting the family head in husband/wife families to be the female (instead of the male), the pattern is sharp for these families as well. As documented in Figure A2, the monotonically increasing pattern is also similar across specific service categories.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

(Ruggles et al., 2004).[7] We use industry of work to identify those service jobs that are likely to provide the labor inputs for the production of the items we study in CEX data.[8] "Outsourced home production" jobs include personal services (other than in hotels or lodging places), repair, protective, cleaning and child care services. All of these services cannot be traded outside of a local labor market, and their price is likely to reflect the costs of labor inputs in the place where the consumer lives.[9] We also separately identify other clearly non-traded jobs, which include retail trade (except jobs at eating and drinking places that are categorized as outsourced home production activities), health, social and entertainment services.

When calculating employment shares in different sectors for workers in each decile of the hourly wage distribution,[10] we find that in any given year the share of workers employed in outsourced home production jobs drops monotonically and sharply along the wage distribution. For instance, as shown in the first panel of Figure 2, in 2005 these services employed 25% of wage earners in the first decile of the distribution, 19% in the second, 12% in the third, 9% in the fourth, and so on, down to 1.6% in the top decile. There are other sectors where employment shares systematically vary along the wage distribution, but only outsourced home production services exhibit this striking strictly-monotonic downward pattern. Employment shares in other non-traded activities are stable at around 30% in deciles in the lower half of the wage distribution and drop only in the upper-half; those in constructions and personal services in lodging places are fairly constant along the entire wage distribution, while those in other sectors monotonically increase along the distribution. Overall, these figures suggest that the sector of home production substitutes is peculiar in that: (i) product demand shifts in this sector can be

[7] The analysis is restricted to respondents aged 16 through 65 who did not live in group quarters, were employed in the civilian labor force at the time of the survey and received positive salary in the previous year. For consistency with later analyses, the sample is restricted to respondents who resided in census-defined metropolitan areas. Hourly wages are calculated by dividing total wage and salary income by annual hours worked (the product between weeks worked and hours usually worked per week).

[8] Appendix Table B1 (in the web-appendix) provides details on the mapping between industrial classification and the categories of employment that we want to analyze separately.

[9] Personal services provided in hotels, motels and other lodging places are likely to be consumed while away from the place where one lives, so they might be thought of as traded goods, where the consumer is transported instead of the good.

[10] Table B2 (in the web-appendix) reports all figures for all years. Results discussed in this section are robust to using education, instead of hourly wages, as a measure of individual skills.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

expected to predominantly affect labor demand for the very least-skilled workforce; (ii) the higher the percentile a wage-earner belongs to, the larger the expected gap between his own wage and the average wage of those delivering home production substitutes.

Disaggregating the analysis by specific subcategories of outsourced home production services shows that the strictly decreasing pattern of employment shares along the skill distribution is common across categories. Moreover, an analysis of the socio-demographic characteristics of the workforce employed in these services versus the workforce in other industries reveals that this sector employs a close to average share of females, but a higher-than-average share of immigrants.[11]

Another peculiar feature of outsourced home production services emerges when studying changes over time in the sectoral distribution of employment. Between 1980 and 2005, employment opportunities in the United States have been increasingly represented by non-traded jobs. This is not surprising, since labor is cheaper in developing countries and transportation and shipping costs have been decreasing over time. As shown in Figure 3, the employment trend out of traded activities is common to the least skilled (wage-earners in the bottom two deciles of the hourly wage distribution) and the rest of the workforce. However, peculiar to the least-skilled workforce is the fact that employment shifts into outsourced home production services have been more pronounced than shifts into other non-traded activities. Based on our simple theoretical framework, we could argue that what drives employment growth of the least-skilled workforce in outsourced home production jobs in decades of growing wage inequality is the increasing demand for these services generated by skilled workers. The latter should find it profitable to buy more (and a wider varieties of) home production substitutes when the gap between the wage of those providing these services and their own wage increases. It is well known that the rise in wage inequality in the United States (at least in the 1980s) was due not only to wage gains for high-paid workers, but also to real wage drops for the least skilled, arising for example from the decline in the real value of the minimum wage. As such, increasing employment in home production substitutes might not only be explained by positive demand shifts, but might as well occur along a downward sloping demand function. The role of own-price effects arising from labor supply shifts can also be expected to be relevant in light of (i) the large inflows of low-skill immigrants into the

[11] See Figures B1-B3 in the web-appendix.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

United States in recent decades, and (ii) the fact that immigrant inflows have been shown to reduce the price of immigrant-intensive services, such as the ones we study here (Cortes, 2008).

We use quantile regressions of individual log hourly wages to explore whether positive demand shifts plausibly play a role in explaining the observed employment shifts into home services. Figure 4 reports the coefficients on a dummy variable for employment in the "home service" sector from quantile regressions that also include controls for individual characteristics (gender, age, education, race, Hispanic origin, foreign-born status) and are separately run for 1980, 1990, 2000 and 2005. The coefficients are always negative, confirming the well-known fact that these services are traditionally low-paid jobs. The wage penalty associated with working in this sector, however, has decreased over time, especially at lower quantiles, as graphically shown by the fact that lines connecting coefficients estimated for each subsequent year lie above those for the previous year, and the upward shift is particularly pronounced at the bottom. Since these estimated wage changes are positively correlated with the employment shifts documented above, time-series evidence appears to be consistent with the existence of demand shifts.

III. Consumption spillovers within cities

To this point we have provided time series evidence on employment and wage changes in low-skill labor markets at the national level that is consistent with the existence of positive demand shifts for home production substitutes such as those we would expect to arise from increasing consumption of these services by skilled workers in decades of rising wage inequality. There are however too many secular changes, such as the increasing labor force participation of women, that might drive the rise in the demand for outsourced home production services over time. Since these contemporaneous changes prevent drawing any conclusive inference from time-series evidence alone, we now turn to an analysis of local level data. As a proxy for local labor markets, we use Metropolitan Statistical Areas (MSAs).[12] City-level figures are

[12] MSA's are geographic entities defined by the U.S. Office of Management and Budget, and include counties that center on a urban core and are characterized by a high degree of social and economic integration (as measured by commuting to work) with the core.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

constructed using individual records from IPUMS extracts from the 1980, 1990 and 2000 censuses and the 2005 ACS. We restrict the analysis to the 242 MSAs that are defined throughout the sample period.[13]

Because of the non-tradeable nature of the time-intensive services that substitute for home production activities, the consumption spillovers hypothesis predicts that employment in this sector should increase with measures of the inequality of a city's wage income distribution. Predictions on wage effects, on the contrary, crucially depend on the assumptions we make about labor mobility and local prices. For example, in response to an unexpected demand shock for unskilled workers, wage rates might rise temporarily. In the long-run, however, labor mobility will re-equilibrate wage rates across locations. On decennial censuses—the only data providing large enough sample sizes for city-level analyses—it is impossible to distinguish between the short-run and long-run effects of demand shocks. The dynamics of local prices is another complicating factor. If unskilled workers spend a higher fraction of their budget on housing and if land values are higher where the fraction of high-income families is larger (Gyourko, Mayer and Sinai, 2006), then a positive correlation between inequality measures and unskilled wage growth might arise from compensating wage differentials. In light of these considerations, the wage analyses carried at the city level should be viewed as suggestive at best.

D. Employment effects

We start by investigating the employment effects of consumption spillovers. Our main analyses consist in studying the cross-city relationship between decadal changes in the wage bill share of a city top decile of wage earners (calculated as the ratio between the wage bill accruing to the ten percent of highest wage-earners in a city and the total city wage bill) and the percentage employment growth in the sector of services that substitute for home production (calculated as the change in the log of hours worked in home services in a city). The specification of the dependent variable is meant to avoid the

[13] The geographic definition of MSA's is periodically adjusted to reflect the growth of cities. Even if here we do not correct for potential inconsistencies over time, other work suggests that this issue should not significantly affect the results. For example, in his analysis of the correlation between employment growth and growth in the share of college graduates across MSA's, Shapiro (2006) shows that his results are robust to examining only those areas whose definitions did not change over time.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

potentially confounding effects of other forces—extraneous to our model (demographic changes, human capital externalities, international outsourcing)—driving either changes in the area's total employment or demand changes in other sectors. These effects would be captured by relative measures, such as changes in the ratio between employment in home services and the population, or changes in the share of hours worked in this sector. As shown later, the results are robust to using alternative measures of income inequality and to the way in which employment growth is measured.

Employment figures by MSA are obtained for people in the 16 to 65 age range, who worked at least one week and received positive salary in the year prior to the survey. They are constructed by weighting each individual by the product of the sample weight and a labor supply measure (the product between number of weeks worked last year and usual number of hours worked per week). Percentiles of the hourly wage distribution in a city and a given year are weighted as well.

We pool data from various years and estimate first-difference models of the relationship between decadal changes in employment and inequality:

$$(1) \qquad \Delta log(Employment)^{HP\ sub's}{}_{ct} = \alpha + \beta \Delta WB^{90} share_{ct} + \gamma_t + \varepsilon_{ct}$$

where γ_t is a period fixed effect. Since the third period available (2000-2005) is half the length of the first two, all 2000-2005 changes are multiplied by two. Estimates are weighted by the average share of national workforce in each city over the sample period. Standard errors are corrected for general heteroskedasticity and clustered at the city level.

As reported in column 1 of Table 2, the OLS estimate of β is positive, as predicted by the consumption spillovers hypothesis. However, even if first-difference models net out the effects of time-invariant city-specific characteristics that may otherwise be picked up by the estimated β, there remains a series of potentially confounding factors.

First, alongside the demand shifter represented by high skill workers' consumption patterns, a host of other time-varying factors, potentially correlated with a city distribution of income, may explain differences across metro areas in the growth of service employment. As shown in column 2, the estimated β decreases but remains positive and significant when controlling for other city-level contemporaneous changes that capture shifts in the demand for low-skill services (that is, changes in female labor force participation rate, in the proportion of college educated individuals in the workforce

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

of the city, and in the share of elderly in the population) or shifts in the supply of unskilled labor (changes in the share of workers aged 16 to 25 and in the share of low-skill foreign-born workers, as in Cortes, 2008). Rather than driving service employment growth, however, these factors may themselves result from it: for example, female labor supply may respond to the availability of home production substitutes, and immigrants' location choices may be endogenous to employment opportunities in an area. As such, controlling for these factors arguably biases all of the estimated coefficients, also the one of interest.

A second, even more serious issue in interpreting a positive estimated β as evidence of consumption spillovers is that an increase in the top wage bill share ($\Delta WB^{90}share_{ct}$) might depend on changes that happen at any point of the distribution—also at the very bottom, where wages are proxies for the price of home production substitutes. To purge our main regressor from "own price" effects and to decrease the risk that it is correlated with other city-specific shocks to local low-skill labor markets, we instrument the change in the wage bill of top wage earners in city c and decade t (ΔWB_{ct}^{90}) with its prediction based on *nationwide* decadal growth of wages of workers in different occupations, weighted by the city-specific employment share in those occupations among top wage earners at the start of the sample period:

$$(2) \qquad \overline{\Delta WB_{ct}^{90}} = \sum_{j} \delta_{jc,1980} \Delta w_{(jt)-c}$$

where $\delta_{jc,1980}$ is the share of wage-earners in the top decile of the city wage distribution in 1980 employed in occupation j, and $\Delta w_{(jt)-c}$ is the change over decade t in the log wages of workers in that same occupation living in cities other than c. Occupations are defined on the basis of 41 roughly two-digit occupation cells.

First-stage regressions reveal that $\overline{\Delta WB_{ct}^{90}}$ is a good predictor of the change in a city top wage bill share. Notably, these predicted values are based exclusively on variation in top wages, so this instrument addresses the second of the issues raised above.[14] It only addresses the first issue under the assumption that other city specific shocks that affect low-skill employment growth are not systematically related to the occupational structure

[14] See Table B3 in the web-appendix, which also shows that $\overline{\Delta WB_{ct}^{90}}$ is a good predictor for changes in the 90th percentile, not the 10th.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

of the top decile of wage earners in the city at the start of the period. Initial market conditions, however, have been shown to matter for subsequent labor demand and supply shocks. In particular, they may influence the direction of research and favor innovations that are biased towards or against a particular factor of production or sector: for example, a high-proportion of skilled workers in the labor force might encourage skilled-biased technical change (Acemoglu, 1998 and 1999; Beaudry, Doms and Lewis, 2006). Moreover, because of network effects, an initial large settlement of foreign-born individuals might attract large subsequent immigrant inflows, especially from the same countries of origin as the existing immigrant community (Card, 2001). To the extent that a city top decile initial occupational structure is correlated with these or other initial conditions that also predict subsequent shocks to a local labor market, then the estimated β would pick up as well the effects of these shocks. To address this concern, we expand Equation (1) to include a series of city characteristics measured as of the beginning of the sample period.

Columns 3 through 7 of Table 2 present Instrumental Variables (IV) estimation results of Equation (1) and test their robustness to a series of specification checks. IV estimates reported in column 3 indicate that a one-standard deviation (4 percentage points) differential growth in a city top wage bill share is associated with one-fourth of a standard deviation (8 percent) percentage growth in the number of hours worked in home services. As shown in column 4, the results are robust to the inclusion of those city-level contemporaneous shifts also specified in column 2. However, to the extent that places where inequality grows more are also places where average income grows more, our estimates might simply reflect a general positive income effect favoring locally-produced non-traded goods. Against this notion, the estimated association between income inequality and employment growth in services that substitute for home production activities is robust to controlling for city-level changes in median hourly wages (column 5). We turn next to include controls for local time-invariant characteristics in an attempt to rule out that confounding factors are driving the results. In column 6, we add region fixed effects,[15] and we also control for initial values (instead of changes) of the socio-

[15] We consider the following nine divisions, corresponding to groupings of states: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain and Pacific Division.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

demographic characteristics of the workforce and the population of the city. We find evidence of an even larger relationship between inequality and home service employment: a one-standard deviation differential growth in a city top wage bill share is found to be associated with half of a standard deviation (16 percent) percentage growth in the number of hours worked in home services. Finally, column 7 adds two variables capturing the occupational structure of the city as of the beginning of the sample period, that is, the share of employment in home production substitutes and the share of employment in the 10 most routine-intensive occupations (Autor and Dorn, 2010). The estimated association is found to be robust to the inclusion of these variables, suggesting that our results are not confounded with path-dependent changes in the occupational structure of a city, or changes due to forces other than consumption spillovers, such as unbalanced productivity growth across sectors that depends on the degree to which tasks can be routinized. [16]

Table 3 presents results from additional specification checks based on variants of Equation (1), which are meant to test the robustness of our findings to (i) splitting the analysis of sectoral employment growth by workers' skills (we consider separately non-college educated and college educated workers, in columns 3 and 4 respectively) (ii) different choices of the measure of inequality (panel A), (iii) different ways of measuring employment growth (panels B and C), and (iv) studying employment growth in other non-traded sectors (panel D). Each entry in the table corresponds to a different regression and reports the IV estimated coefficient on the variable measuring the change in wage inequality. For comparison, OLS estimates are reported in column 1. All regressions include controls for city-level contemporaneous changes that capture demand and supply shifts in the market of home-production substitutes (as in columns 2 and 4 of Table 2). The results of our robustness checks can be summarized as follows.

[16] As shown in Autor and Dorn (2010), if technological progress raises productivity in routine tasks but does little to augment manual tasks, then markets with higher initial concentration in routine tasks are predicted to experience greater growth of service employment. To test this prediction, the authors use task measures from the Dictionary of Occupational Titles and develop an index of the share of labor employed in routine task-intensive occupations. We proxy for this variable using the share of labor in the 10 most routine-intensive occupations, that are: secretaries and stenographers, bank tellers, pharmacists, payroll and timekeeping clerks, motion picture projectionists, boilermakers, butchers and meat cutters, accountants and auditors, actuaries and proofreaders (Autor and Dorn, 2010, Appendix Table 1).

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

First, increasing inequality is associated with employment growth in the sector of home production substitutes among non-college educated workers, while the relationship is not statistically significant among college educated ones. This is consistent with our hypothesis: consumption of home production substitutes creates employment opportunities for unskilled workers. On the contrary, for college-educated workers, we expect other forces—extraneous to our model—to be at play (e.g., human capital externalities) and to drive employment shifts into other more skilled sectors (e.g., financial and business).

The estimation results are robust to the use of alternative measures of income inequality, such as the 90-10 log hourly wage gap. This measure of inequality is a better proxy for the relative skilled-unskilled wage, which –as predicted by our model– should influence skilled workers' decision to buy market substitutes for home production. Since it mechanically varies with wages of the least-skilled, however, it is also more likely to pick up the effects of labor supply shifts. The issue is addressed by using as an instrument the index defined in (2), which exploits predicted differences in the growth of wages for top earners only. Moreover, the results are robust to using the 90-50 log wage gap as a measure of wage inequality. Notably, as shown in the last row of panel A, results are qualitatively unchanged when using changes in the 90^{th} percentile of the distribution of log hourly wages as the main regressor.

Our finding of a positive association between growth in wage inequality and employment growth in home services is also robust to the way in which we measure employment growth. To address the concern that our estimates might simply pick up a general increase in city scale associated with upper tail inequality, the dependent variable in panel B is specified as the percentage growth in the number of hours worked in home services net of the growth in the area's population: as shown in column 3, our findings appear not to be driven by a scale effect. Changes in the share of hours worked in home services are the dependent variable of regressions displayed in panel C.

We can use these city-level estimates to quantify how much of the growth of employment of non-college workers in home production substitutes observed at the national level may be attributed to the channel suggested in this paper. The wage bill share of the top decile of wage earners was 28.1 in 1980 and increased by 0.5 and 2.9 percentage points in the 1980s and the 1990s respectively. The share of non-college

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

workers employed in home production substitutes was 10.1 in 1980 and increased by 1.4 and 1.6 percentage points in the 1980s and the 1990s respectively. Using the coefficient estimated in column 3 of panel C, consumption spillovers may explain one-tenth of the growth in employment in home services in the 1980s but around one-third of the growth in the 1990s.[17]

Even if our model has no predictions on changes in sectors other than the one of home production substitutes, studying employment growth in other non-traded activities is a meaningful exercise, since it can serve as a test to separate our hypothesis from the effects of increasing demand for any kind of locally produced good. As shown in Panel D, increasing inequality is associated with low-skill employment growth in other non-traded activities that is no more than a half of the growth in home production substitutes and not statistically significant.

E. Wage analysis

We turn next to study whether within-city changes in the wage structure between sectors are consistent with the existence of demand shifts arising from consumption spillovers. As before, we pool data from 1980, 1990, 2000 and 2005, but this time we model *individual* log hourly wages of non-college workers, which allows to control for individual demographic characteristics (X_i):

$$(3) \qquad w_{ict} = \alpha + \beta_1 WB^{90}sh_{ct} + \beta_2 HPS_i + \beta_3 (WB^{90}sh_{ct} \times HPS_i) + X_i\delta + \gamma_t + \gamma_c + \varepsilon_{ict}$$

The inclusion of MSA-fixed-effects implies that we consider variation within cities. To assess whether increasing top wage bill shares are associated with differential unskilled wage changes across sectors, we include not only controls for a city top wage bill share ($WB^{90}sh_{ct}$) and for whether the individual is employed in the provision of home production substitutes (HPS_i), but also their interaction. If the positive association between changes in top wage bill shares and employment shifts into home production substitutes documented in the previous section is demand-driven, then we would expect the coefficient of the interaction term (β_3) to be non-negative.

Table 4 reports the estimated β's when Equation (3) is estimated with OLS (column 1) or with quantile regressions for the median (column 2) as well as for lower deciles (from

[17] The calculations are as follows. For the 1990s: (0.175 × 0.029)/0.016≈33%; for the 1980s: (0.175 × 0.005)/0.014≈10%.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

the 4th to the 1st in columns 3 through 6). The estimation results can be summarized as follows. Working in the provision of home production substitutes is associated with a large wage penalty at any point of the distribution, as captured by a negative β_2. The coefficient of a city top wage bill share is positive and of similar magnitude in columns 1 and 2, implying that a larger top wage bill share is associated with larger (and similar) growth of mean and median hourly wages of non-college workers employed in sectors other than the one under study here. The estimated β_1, however, decreases and turns negative for lower quantiles – which is consistent with widening wage inequality within cities. As regards the estimated coefficient of the interaction term, two facts are worth noting. First, the estimated β_3 is always positive, which implies that non-college workers in cities with larger growth in the wage bill share of top earners experience relative wage growth if employed in home production substitutes. A one-standard deviation (4 percentage point) larger top wage bill share is associated with 1.6 percent growth of mean hourly wages of non-college workers in home production substitutes versus 1.1 percent growth in other sectors.[18] At the median, the differential wage growth is even larger: 1.9 versus 0.8 percent. Second, as shown by the increasing magnitude of β_3 across columns, relative wage growth in home services is larger and larger at lower percentiles. For example, at the tenth percentile, a 4 percentage point larger top wage bill share is associated with a 0.4 percent growth of hourly wages of non-college workers in home production substitutes but with a 1.2 percent drop in other sectors. The increasing magnitude of the estimated β_3 in lower quantile regressions suggests that differential wage changes in home production substitutes associated with increasing top wage shares may mitigate the widening of wage inequality towards the bottom of the distribution.

IV. Conclusions

The growth in wage inequality over the last three decades is one of the better-documented and more extensively researched facts about the U.S. labor market. A voluminous amount of research has investigated the causes for this phenomenon and has identified two leading explanations: the increase in the relative demand for skills—due to

[18] Using the coefficients reported in column 1 of Table 5, the figures are calculated as: $100(0.284 \times 0.04)=1.1\%$ and $100[(0.284 + 0.112) \times 0.04)=1.6\%$.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

SBTC (Krueger, 1993; Berman, Bound and Griliches, 1994) or international trade (Feenstra and Hanson, 2003); and changes in wage setting institutions, such as the decline in unionization (Freeman, 1993), the drop in the real value of the minimum wage (DiNardo, Fortin and Lemieux, 1996; Lee, 1999) and the growth in performance-pay schemes (Lemieux, Macleod and Parent, 2006). On the contrary, what changes have resulted from growing wage inequality is still a question that "should embarrass social scientists, because there is so little we can point to" (Welch, 1999). Evidence presented in this paper suggests that increasing demand for market substitutes of home production activities is a change we might be able to add to this sparse list.

We build on the observation that there is a sharp asymmetry in the skills of providers and consumers in the sector of services that substitute for home production activities. Since consumers are disproportionally drawn from the highest percentiles of the skill (wage) distribution, we form the prediction that demand for these services should increase where and when the share of income accruing to the highest-paid workers increases. In turn, these product demand shifts are expected to raise the relative demand for the least-skilled workers, since the latter are the primary providers of these services.[19]

The main empirical challenge we face in this paper is to identify an arguably exogenous source of growth in the wage bill share accruing to skilled workers—exogenous to changes in low-skill labor markets. On city level data, we propose predicting changes in top wage bill shares using national level changes in wages paid in different occupations weighted by city-specific start-of-period employment shares in those occupations among top wage earners. In this way we arguably break the direct link between city-level changes in high-skill and low-skill labor markets. We find evidence of a strong positive relationship between the change in a city top-wage bill share and the growth in local employment in jobs that substitute for home production. When using city-level estimates to predict national changes, we find that consumption spillovers may

[19] In stressing that consumption demand shifts can lead to changes in the relative demand for skills, a paper closely related to ours is Leonardi (2008). Leonardi highlights those skill-intensive goods that are more heavily consumed by more educated and richer workers (such as education and professional services), and investigates the importance of changes in the demand for these goods in explaining the increase in the relative demand for skilled workers in the United States and the United Kingdom between 1980 and 2000.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

account for one-third of the growth of employment in home production substitutes experienced in the 1990s by non-college workers in the United States.

Within-city changes in the wage structure across sectors are also consistent with the existence of positive demand shifts arising from consumption spillovers. We find a positive association between a city top wage bill share and relative wages paid to non-college workers in the home production sector– which is consistent with employment shifts into this sector being demand-driven. Interestingly, the association is larger when modeling lower quantiles of the wage distribution, suggesting that consumption spillovers may contribute to a compression of wages in the lower end of the distribution.

Because workers in home production substitutes are heavily concentrated at the very bottom of the wage distribution, our findings of relative labor outcome gains for them suggest that consumption spillovers may explain some of the earnings improvements experienced in recent periods by workers at the bottom of the U.S. wage distribution relative to those in the middle. Quantifying these effects would be of great interest. Unfortunately, this is not straightforward since predicting changes in aggregate wage inequality using city-level estimates would require aggregating local economies in a way that takes into account their position in the national distribution of wages. To illustrate this point, consider the case of the metropolitan area of Minneapolis and Saint Paul, which in the 1990s experienced above average increases in the wage bill share of top earners and in employment in home production substitutes, as well as a rise in the tenth percentile of the wage distribution relative to the median. Even if this case is consistent with the existence of consumption spillovers and contemporaneous compression of lower tail inequality, it is not clear how much it can explain of the compression observed at the national level, since the 10^{th} percentile of the wage distribution in Minneapolis-Saint Paul corresponds to the 20^{th} percentile of the national wage distribution.

An important extension of the present paper would be an attempt to provide a more complete assessment of changes in the *well-being* of low-skilled workers arising from the existence of consumption spillovers and, more broadly, from the increasing dependence of unskilled employment opportunities to the physical/geographical proximity of skilled workers. This assessment would entail a local-level analysis of changes in employment rates, local prices (including housing values), *real* wages and commuting time to work for low-skill workers.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

References

Angrist Joshua, Victor Chernozhukov, and Ivan Fernandez-Val. 2006. "Quantile Regression Under Misspecification, with an Application to the U.S. Wage Structure." *Econometrica*, 74(3): 539-563.

Acemoglu, Daron. 1998. "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality." *Quarterly Journal of Economics*, 113(4): 1055-1089.

Acemoglu, Daron. 1999. "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence." *American Economic Review*, 89(5), 1259-1278.

Acemoglu, Daron. 2002. "Technical Change, Inequality and the Labor Market." *Journal of Economic Literature*, 40, 7-72.

Attanasio Orazio, Erich Battistin and Hidehiko Ichimura. 2007. "What Really Happened To Consumption Inequality in the US?" In *Hard-to-Measure Goods and Services: Essays in Honor of Zvi Griliches*, ed. E. Berndt and C. Hulten, University of Chicago Press.

Autor, David, Frank Levy, and Richard P. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Investigation." *Quarterly Journal of Economics*, 118(4): 1279-1333.

Autor, David, Lawrence F. Katz, and Melissa Schettini Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review, Papers and Proceedings*, 96(2): 189-194.

Autor, David, Lawrence F. Katz, and Melissa Schettini Kearney. 2008. "Trends in U.S. Wage Inequality: Revising the Revisionists." *Review of Economics and Statistics* 90(2): 300-323.

Autor, David and David Dorn. 2010. "Inequality and Specialization: The Growth of Low-Skill Service Jobs in the United States," MIT working paper, August.

Becker, Gary. 1965. "A Theory of the Allocation of Time." *Economics Journal*, 75: 493-517.

Beaudry, Paul, Mark Doms and Ethan Lewis. 2006. "Endogenous Skill-Bias in Technology Adoption: City-Level Evidence From the IT Revolution." NBER Working Paper No. 12521.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Berman Eli, John Bound and Zvi Griliches. 1994. "Changes in the Demand for Skilled Labor within U.S. Manufacturing Industries: Evidence from the Annual Survey of Manufacturing." *Quarterly Journal of Economics*, 109(2): 367-397.

Bound, John and George Johnson. 1992. "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations." *American Economic Review*, 82(3): 371-392.

Card, David. 2001. "Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration." *Journal of Labor Economics*, 19(1): 22-64

Cortes, Patricia. 2008. "The Effect of Low-Skilled Immigration on US Prices: Evidence from CPI data." *Journal of Political Economy*, 116(3): 381-422.

DiNardo, John, Nicole Fortin, and Thomas Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973–1992." *Econometrica*, 64(5): 1001–1044.

Freeman, Richard. 1993. "How Much has Deunionization Contributed to the Rise of Male Earnings Inequality?" In *Uneven Tides: Rising Income Inequality in America*, ed. S. Danziger and P. Gottshalk, 133-163. New York: Russell Sage Foundation.

Goos, Maarten and Alan Manning. 2007. "Lousy and Lovely Jobs: the Rising Polarization of Work in Britain." *Review of Economics and Statistics*, 89(1): 277-282.

Goos, Maarten, Alan Manning and Anna Salomons. . 2009. "Job Recent Changes in the European Employment Structure: The Roles of Technology and Globalization." *American Economic Review, Papers and Proceedings*, 99(2): 58-63.

Gronau, Reuben. 1977. "Leisure, Home Production, and Work--the Theory of the Allocation of Time Revisited." *Journal of Political Economy*, 85(6): 1099-1124.

Gyourko, Joseph, Christopher Mayer and Todd Sinai. 2006. Superstar Cities. NBER Working Paper No. 12355

Juhn, Chinhui, Kevin M. Murphy and Brooks Pierce. 1993. "Wage Inequality and the Rise in Returns to Skill." *The Journal of Political Economy*, 101(3): 410-442.

Katz, Larry and David Autor. 1999. "Changes in the Wage Structure and Earnings Inequality." In *Handbook of Labor Economics*, Vol. 3A, ed. Orley Ashenfelter and David Card. Amsterdam, Netherlands, New York, NY, North-Holland, Netherlands: Elsevier.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Katz, Larry and Kevin Murphy. 1992. "Changes in Relative Wages, 1963–1987: Supply and Demand Factors." *Quarterly Journal of Economics,* 107(1): 35-78.

Koenker, Roger. 2005. *Quantile Regression*, Econometric Society Monograph Series, Cambridge U. Press.

Krueger, Alan. 1993. "How Computers Have Changed the Wage Structures: Evidence from Microdata, 1984-1989." *Quarterly Journal of Economics,* 108(1): 33-60.

Lee, David. 1999. "Wage Inequality in the United States during the 1980s: Rising Dispersion or Falling Minimum Wage." *Quarterly Journal of Economics,* 114(3): 977-1023.

Lemieux, Thomas, W. Bentley Macleod and Daniel Parent. 2006. Performance Pay and Wage Inequality, Mimeograph, September.

Leonardi, Marco. 2008. Product Demand Shifts and Wage Inequality. Mimeograph, October.

Manning, Alan. 2004. "We Can Work It Out: The Impact of Technological Change on the Demand for Low-Skill Workers." *Scottish Journal of Political Economy*, 51(5): 581-608.

Mincer, Jacob. 1963. "Market prices, Opportunity Costs, and Income Effects." In *Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld*, ed. C. Christ et al. Stanford, California: Stanford University Press.

Piketty, Thomas and Saez, Emmanuel. 2003. Income Inequality in the United States, 1913-98." *Quarterly Journal of Economics*, 118(1): 1-39.

Powell, James.1986. "Censored Regression Quantiles." *Journal of Econometrics*, 32:143-155.

Ruggles, S., M. Sobek, T. Alexander, C. A. Fitch, R. Goeken, P. K. Hall, M. King, and C. Ronnander. 2004. "Integrated Public Use Microdata Series: Version 3.0." Minneapolis, MN: Minnesota Population Center.

Shapiro, Jesse M. 2006. "Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital." *Review of Economics and Statistics*, 88(2): 324-335.

Spitz-Oener, Alexandra. 2006. "Technical Change, Job Tasks and Rising Educational Demands: Looking Outside the Wage Structure." *Journal of Labor Economics*, 24(2): 235-270.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Weiss, Matthias. 2008. Skill-biased technological change: Is there hope for the unskilled? *Economics Letters*, doi:10.1016/j.econlet.2008.03.022

Welch, Finis. 1999. "In Defense of Inequality." *The American Economic Review, Papers and Proceedings*, 89(2): 1-17.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table 1

Correlation between household budget share of home production substitutes and household members' hourly wages; 2004

	All Families	Husband/Wife Families			Other Families
		Woman does NOT work	Woman works		
	(1)	(2)	(3)	(4)	(5)
Head's log hourly wage	0.004***	0.012***	0.008***	0.004***	0.0003***
	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)
Wife's log hourly wage				0.008***	
				(0.000)	
Constant	0.058***	0.026***	0.050***	0.041***	0.068***
	(0.004)	(0.011)	(0.008)	(0.000)	(0.000)
Observations	6,058	933	2,373	2,373	2,752

Note: OLS estimates. The dependent variable is the household expenditure share of goods and services that substitute for home production (see Table A1). Sample restricted to household headed by individuals at least 18 and no more than 65 who worked for salary in the 12 months before the interview. The family head is conventionally fixed to be the male in all husband/wife families. "Other families" in column 5 include single-adult families (72%) and other mixed families (28%).

Source: 2004 Consumer Expenditure Diary Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table 2: *Cross-city regressions of employment growth in the sector of services that substitute for home production activities on changes in the top decile wage bill share*

	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) IV	(6) IV	(7) IV
Δ Top decile wage bill share	0.977*** (0.368)	0.631** (0.319)	1.974** (0.981)	2.493** (1.210)	2.482** (1.211)	3.920* (2.319)	4.053* (2.377)
1990-2000 dummy	-0.069** (0.030)	0.030 (0.053)	-0.077** (0.032)	-0.012 (0.061)	-0.016 (0.064)	-0.088*** (0.034)	-0.090*** (0.034)
2000-2005 dummy	-0.131*** (0.034)	-0.051 (0.060)	-0.144*** (0.039)	-0.090 (0.064)	-0.101 (0.068)	-0.172*** (0.044)	-0.174*** (0.045)
Δ Female labor force participation		1.589*** (0.371)		1.386*** (0.409)	1.441*** (0.405)		
Δ Low-skill foreign share of workforce		1.124** (0.504)		0.290 (0.801)	0.288 (0.802)		
Δ 16-24 share of workforce		-0.925* (0.510)		-0.850* (0.512)	-0.964* (0.501)		
Δ 65+/population share		-1.266 (0.897)		-2.087* (1.112)	-1.919* (1.097)		
Δ College graduates share of workforce		-1.823*** (0.601)		-1.925*** (0.633)	-2.191*** (0.614)		
Δ log median wage					0.260 (0.183)		
Female lf particip. in 1980						-0.092 (0.334)	-0.240 (0.343)
Low-skill foreign share in 1980						-0.148 (0.331)	-0.144 (0.351)
16-24 sh. in 1980						1.754** (0.736)	2.060*** (0.755)
65+/pop in 1980						-0.397 (0.402)	-0.189 (0.385)
College sh. in 1980						-0.514 (0.375)	-0.701 (0.438)
Emp. sh. HP sub's in 1980							-2.166** (1.096)
Emp. sh. in routine occup. in 1980							1.821 (1.404)
Constant	0.329*** (0.027)	0.282*** (0.069)	0.307*** (0.032)	0.294*** (0.071)	0.300*** (0.072)	0.173 (0.204)	0.216 (0.209)
Region dummies	No	No	No	No	No	Yes	Yes

Note: Three periods (1980-1990, 1990-2000, 2000-2005) and 242 MSA's are considered, for a total of 726 observations. The dependent variable is the percentage growth in the number of hours worked in the sector of services that substitute for home production activities. The instrument is a weighted sum of nationwide decadal growth of wages of workers in different occupations, where the weights are city-specific employment shares in those occupations among the top 10% of wage earners in 1980. Estimates weighted by the average share of national workforce in each MSA between 1980 and 2005. Standard errors (in parentheses) adjusted for heteroskedasticity and clustering across MSA's. * significant at 10% ** significant at 5% *** significant at 1%.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table 3: *Alternative specifications of inequality and employment measures*

Workforce	(1) OLS All	(2) IV All	(3) IV Non-college graduates	(4) IV College Graduates
A. Δ Log(Employment in Home Production Substitutes)				
Δ 90-10 wage gap	0.272**	1.766*	1.575*	0.777
	(0.107)	(0.936)	(0.942)	(1.253)
Δ 90-50 wage gap	0.202	2.736*	2.440	2.537
	(0.138)	(1.609)	(1.604)	(3.703)
Δ 90^{th} wage percentile	0.350**	2.013*	1.795*	1.855
	(0.156)	(1.086)	(0.085)	(2.742)
B. Δ Log(Employment in Home Production Substitutes) *minus* log (Population)				
Δ Top decile wage bill share	0.582**	1.617*	1.650*	2.682
	(0.252)	(0.892)	(0.935)	(3.249)
C. Δ Employment Share in Home Production Substitutes				
Δ Top decile wage bill share	0.043**	0.115	0.185*	0.077
	(0.022)	(0.077)	(0.110)	(0.101)
D. Δ Log(Employment in Non-Tradeable activities other than HP sub's)				
Δ Top decile wage bill share	-0.067	0.756	0.702	-0.535
	(0.237)	(0.904)	(0.903)	(1.271)

Note: Three periods (1980-1990, 1990-2000, 2000-2005) and 242 MSA's are considered, for a total of 726 observations. Dependent variables are as indicated in the title of each panel. The instrument is a weighted sum of nationwide decadal growth of wages of workers in different occupations, where the weights are city-specific employment shares in those occupations among top wage earners in 1980. All regressions include controls for the city-level variables also included in column 2 and 4 of Table 2. Estimates weighted by the average share of national workforce in each MSA between 1980 and 2005. Standard errors (in parentheses) adjusted for heteroskedasticity and clustering across MSA's. * significant at 10% ** significant at 5% *** significant at 1%.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table 4: *Within-city changes in the wage structure across sectors*

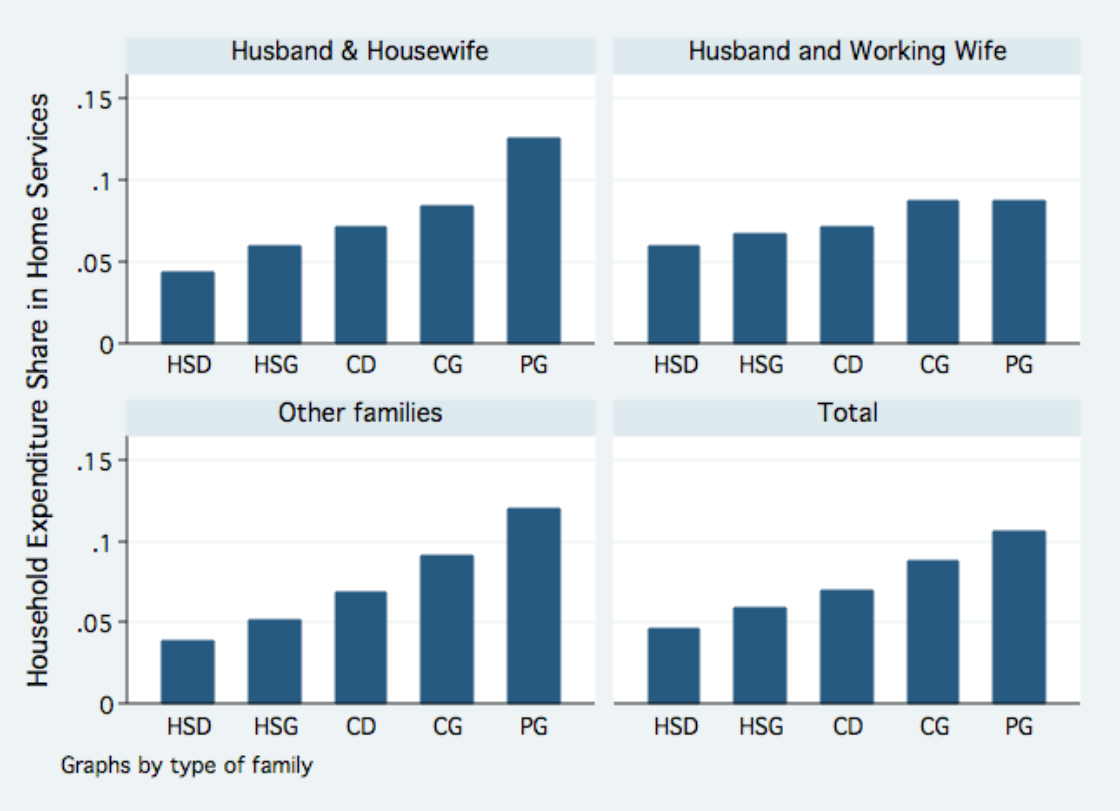
	(1) mean	(2) median	(3) p40	(4) p30	(5) p20	(6) p10
Top decile wage	0.284***	0.213***	0.132***	0.002	-0.118***	-0.310***
Bill share ($WB^{90}sh$)	(0.031)	(0.020)	(0.021)	(0.024)	(0.034)	(0.062)
HPS dummy	-0.288***	-0.344***	-0.359***	-0.370***	-0.385***	-0.410***
	(0.013)	(0.009)	(0.009)	(0.010)	(0.012)	(0.023)
$WB^{90}sh \times HPS$	0.112**	0.269***	0.288***	0.297***	0.333***	0.420***
	(0.045)	(0.032)	(0.031)	(0.037)	(0.042)	(0.079)

Note: Dependent variable: individual log hourly wages of non-college workers. Estimation: OLS (column 1); quantile regressions for the median hourly wage (column 2), and the 40^{th}, 30^{th}, 20^{th} and 10^{th} percentiles in the remaining columns. All models include an intercept, three year dummies (1980, 1990, 2000), 241 MSA's dummies, dummies for age (16-24, 25-34, 35-44 and 45-54), education (no high-school degree, high-school graduates), black, Hispanic, and foreign-born, and interactions of individual level controls with year dummies. Estimates weighted by the product of personal weights and individual annual labor supply. Robust standard errors (in parentheses). * significant at 10% ** significant at 5% *** significant at 1%.
Quantile regressions are estimated exploiting the sparsity of the regression matrix, using the Frisch-Newton interior point algorithm programmed by the authors in R. Standard errors are obtained using methods by Powell (1986) and Koenker (2005). The code is available upon request.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure 1

Household expenditure share of home production substitutes and head's highest educational attainment, by family type; 2004



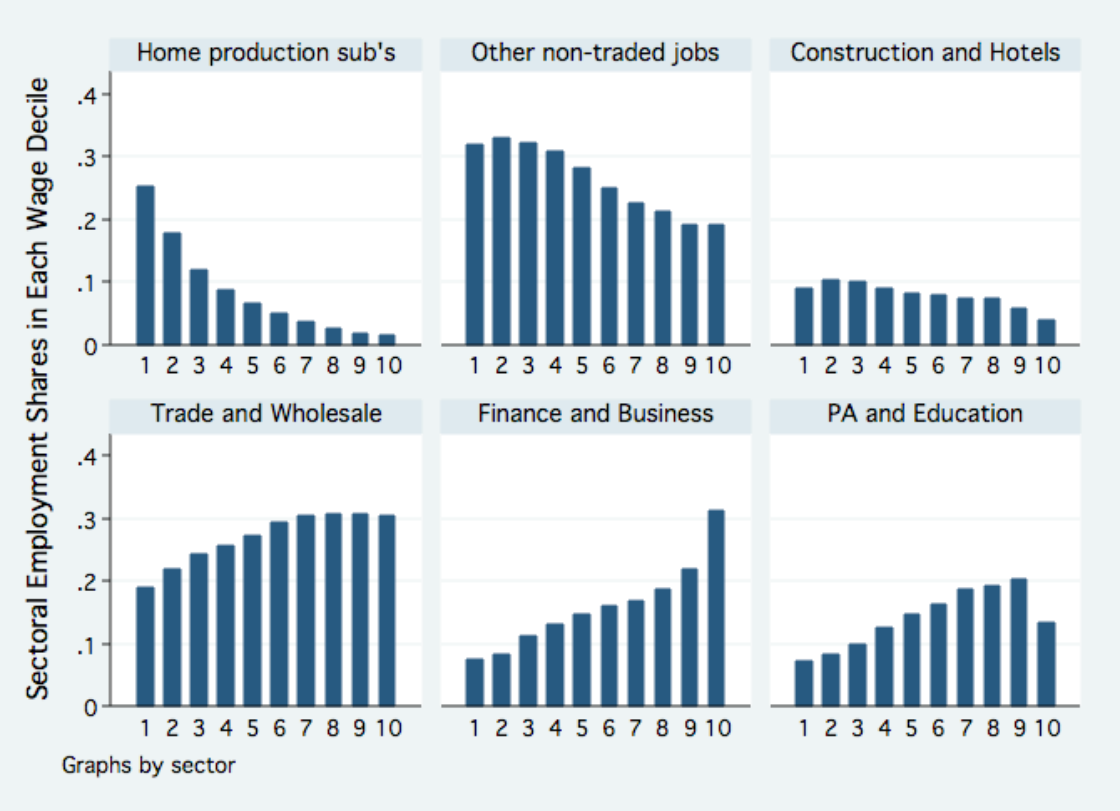
Notes: The graph plots the average fraction of total household expenditure spent in home production substitutes across households headed respectively by high-school dropouts (HSD), high school graduates (HSG), individuals with some college education but no bachelor's degree (CD), individuals with Associate, BA or Master degrees (CG) and individuals with doctorate degrees (PG). The first three panels report budget shares separately calculated for husband/wife families and other families: the latter include single-adult families (73%) and mixed families (27%). All figures are weighted. The sample is restricted to households headed by individuals at least 18 and no more than 65 who worked for salary in the twelve months before the interview. The family head is conventionally fixed to be the *male* in all husband/wife families.

Source: 2004 Consumer Expenditure Diary Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure 2

Employment shares in different sectors by decile of the hourly wage distribution; 2005

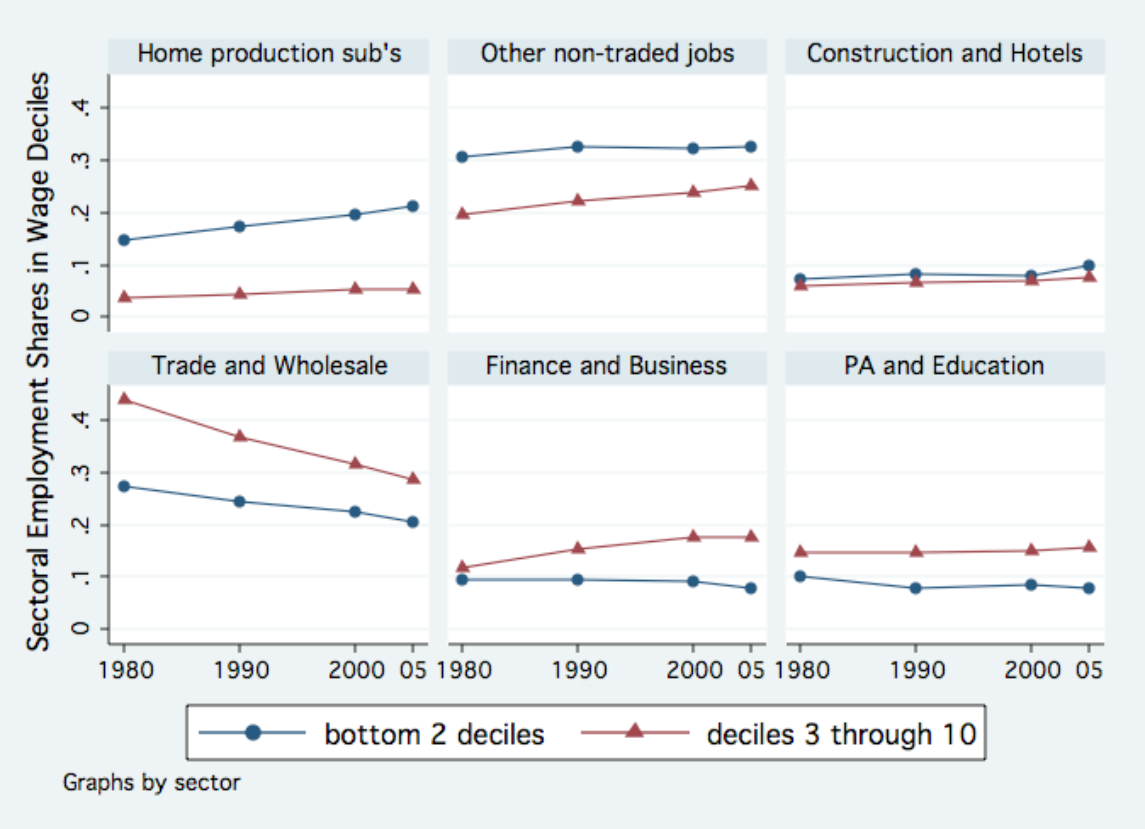


Notes: Each bar represents the fraction of the workforce in each decile of the hourly wage distribution employed in a given sector in 2005. So, the bars for each decile across the six sectors sum vertically to one.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA). Earnings deciles based on hourly wages, defined as annual wages divided by annual labor supply (the product between number of weeks worked and usual number of hours worked per week).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: IPUMS extract from the 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure 3

Employment shares in different sectors of the workforce in the bottom two and the eight highest deciles of the hourly wage distribution; 1980, 1990, 2000 and 2005

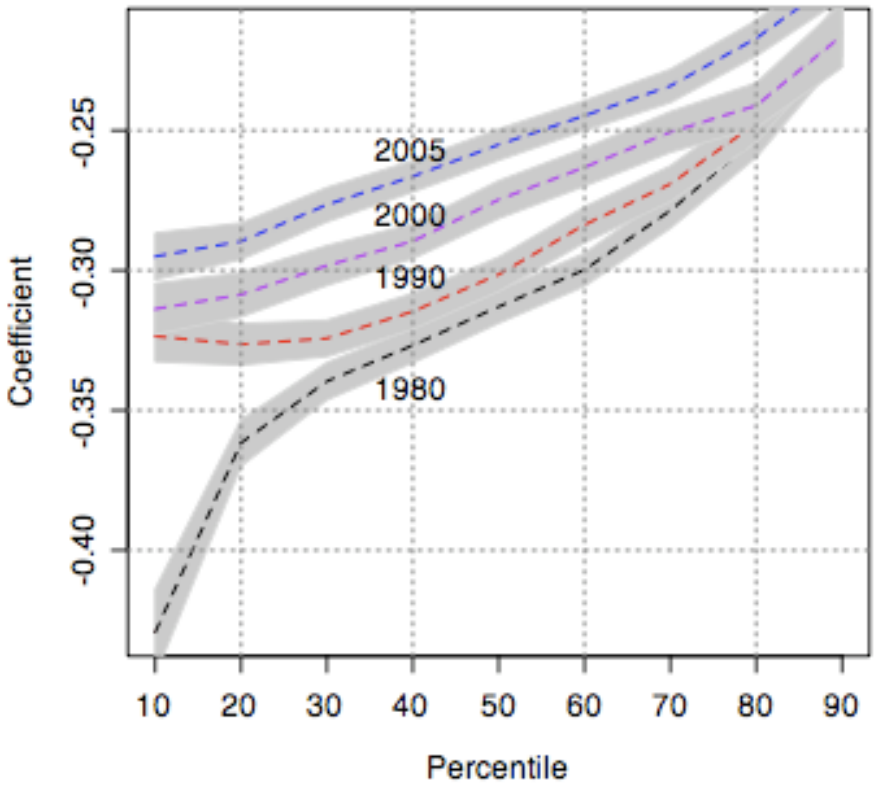


Notes: Each circle and each triangle represents the shares of the workforce in either the bottom 2 deciles or the highest 8 deciles of the hourly wage distribution employed in a given sector in a given year. So, the shares for each group and year across the six sectors sum to one.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA). Earnings deciles based on hourly wages, defined as annual wages divided by annual labor supply (the product between number of weeks worked and usual number of hours worked per week).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure 4

Conditional quantile regressions coefficients; 1980, 1990, 2000 and 2005



Notes: Each line connects the estimated coefficients on a dummy variable for employment in the sector of home production substitutes from quantile regressions of individual log hourly wages. Models also include controls for individual characteristics (age, age squared, 4 dummies for highest educational attainment, dummies for black, Hispanic origin, foreign-born) and are estimated separately for each year and each percentile 1 through 10 and each decile 20 through 90.
The grey areas plot pointwise 95% confidence intervals.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA). All estimates are weighted by the product of IPUMS weights and annual labor supply (the product between number of weeks worked and usual number of hours worked per week).
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

NOT FOR PUBLICATION

APPENDIX A
Consumption Expenditure data

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table A1
Identifying expenditure items corresponding to purchases of goods and services that substitute for home production activities

Category	Universal Classification code (UCC)
Food away from Home	190112, 190212, 190312, 190322 Lunch, Dinner, Snacks and Breakfast at Full Service.
Drinks away from Home	200512, 200522, 200532 Beer, Wine and other Alcoholic beverages at Full Service.
Repair & Maintenance Services	230000 Repair, maintenance, and improvements for built in dishwasher, garbage disposal, and range hood 230110 Maintenance of property, including items such as ceiling repair, black top, brick, or masonry work, air conditioner repair, roof and awning repair, house painting, papering, chimney cleaning, electrical inspection, furnace inspection and repair, wiring, pest control, carpenter, plumber, etc. 270210 Water and sewerage maintenance 270410 Garbage, trash collection 270900 Septic tank cleaning 340610 Repair of television, radio, and sound equipment, excluding installed in vehicles 340620 Repair of household appliances; including stove, vacuum, washer, dryer, sewing machine, refrigerator, and calculator; excluding garbage disposal, range hood, and built-in dishwasher 340630 Furniture repair, refurnishing, or reupholstery 340903 Miscellaneous home services and small repair jobs not already specified 340913 Repair and alterations of miscellaneous household equipment, furnishings, and textiles 440110 Shoe repair and other shoe services 440130 Alteration, repair, tailoring of apparel and accessories 440150 Watch and jewelry repair
Delivery Services	340120 Delivery services
Babysitting Services	340210 Babysitting or other home care for children
Housekeeping Services	340310 Housekeeping service, such as housekeeping, cooking, maid service, and carpet and upholstery cleaning services 340410 Gardening and lawn care services, such as mowing, tree services, fertilizing, and yard work 340510 Moving, storage, and freight express 340520 Household laundry and dry cleaning, not coin operated 440210 Apparel laundry and dry cleaning, not coin operated
Personal Care Services	650110 Personal care services for females, including haircuts 650210 Personal care services for males, including haircuts

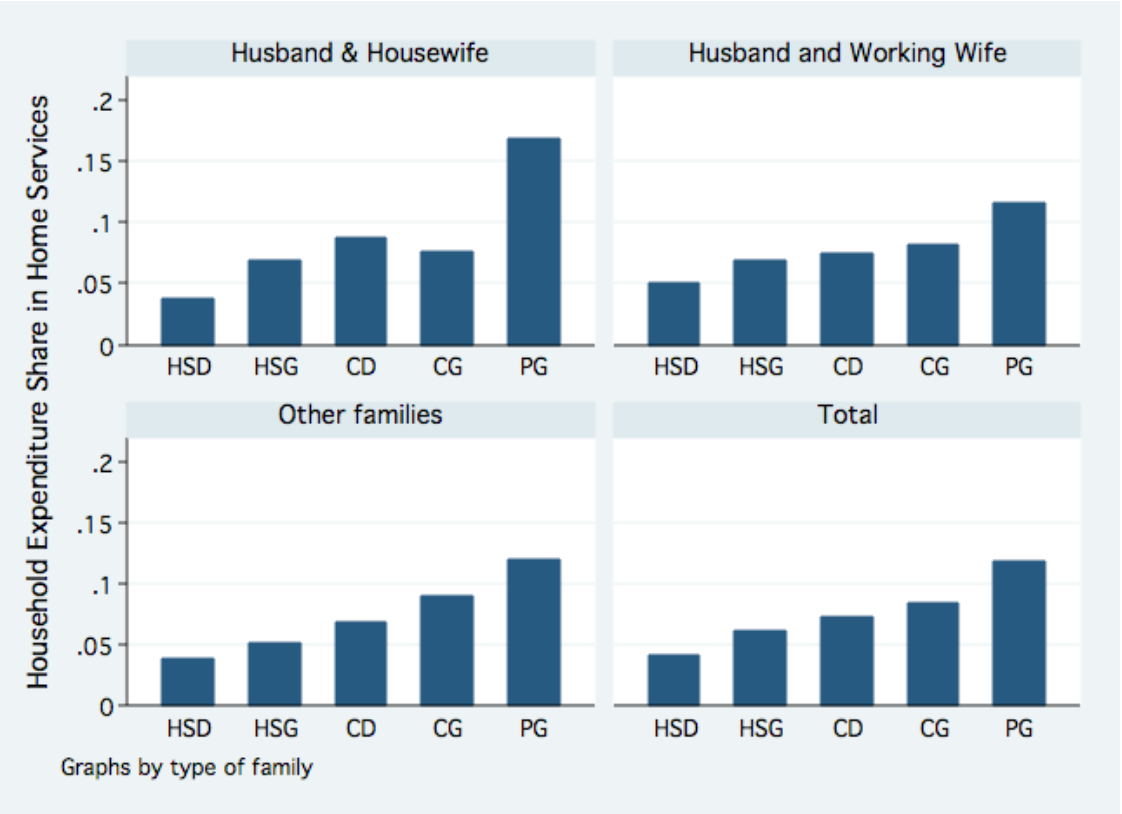
Notes: The classification is based on the Universal Classification Code (UCC) Titles in the 2004 Consumer Expenditure Diary Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure A1

Household expenditure share of home production substitutes and head's highest educational attainment, by family type; 2004

Family head fixed to be the female in all husband/wife families.



Notes: This graph plots similar figures to the ones reported in Figure 1. The only difference is that the family head is conventionally fixed to be the *female* in all husband/wife families, while in Figure 1 it is fixed to be the male.

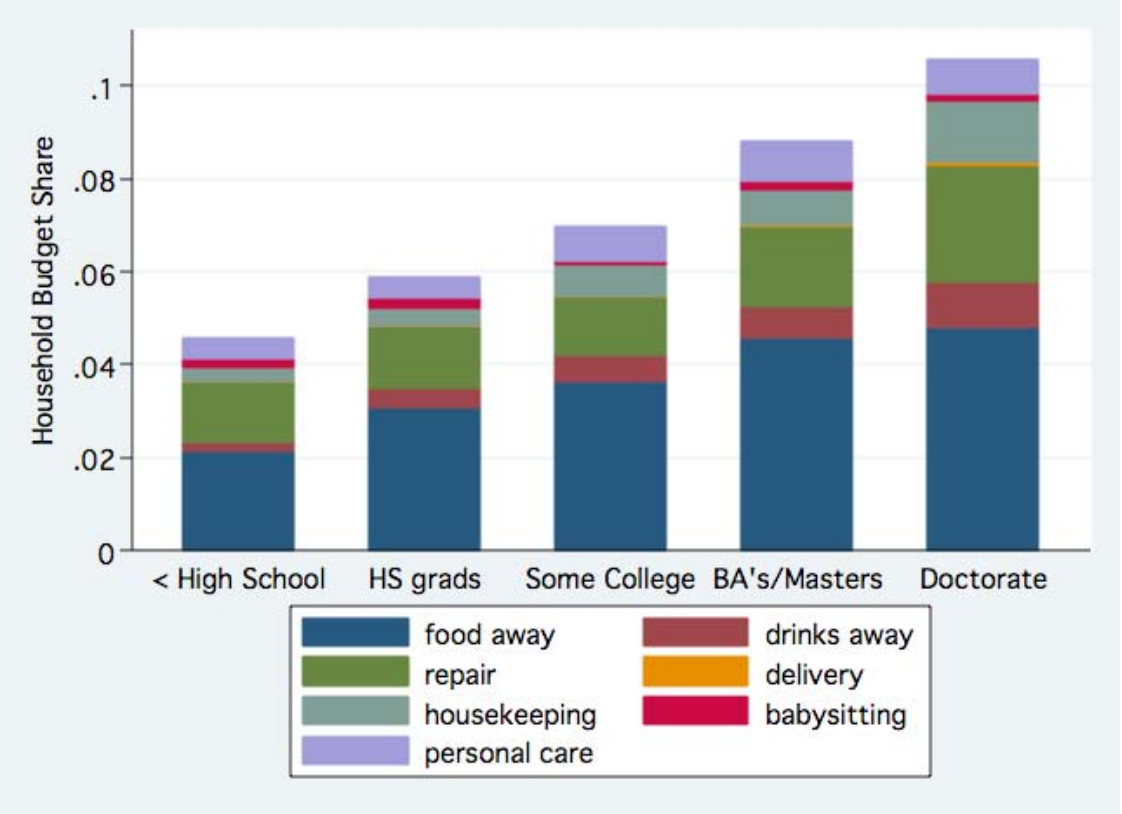
Source: 2004 Consumer Expenditure Diary Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure A2

Household expenditure share of home production substitutes and head's highest educational attainment; 2004

Assessing the contribution of specific service categories.



Notes: See notes to Figure 1. For details on specific expenditure categories, see Table A1.
Source: 2004 Consumer Expenditure Diary Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

NOT FOR PUBLICATION

APPENDIX B
Employment and Wage data

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table B1
Identifying Sectors of Employment that deliver services that substitute for home production activities

Category (IPUMS variable IND1990)	Codes	Classification
Agriculture, Forestry and Fisheries	10-32	TR
Mining	40-50	TR
Construction	60	CO
Manufacturing	100-392	TR
Transportation	400, 410-432	WT
Except: **Bus service and urban transit**	**401**	**other NT**
Taxi and limousine service	**402**	**other NT**
Communications	440-442	WT
Utilities and Sanitary Services	450-472	WT
Wholesale Trade	500-571	WT
Retail Trade	**580-691**	**other NT**
Except: **Eating and Drinking Places**	**641**	**HP sub's**
Finance, insurance and real estate	700-712	FI
Business and Repair Services	721, 731-732, 741	BS
Except: **Services to buildings**	**722**	**HP sub's**
Detective and Protective Services	**740**	**other NT**
Automotive Rental and Leasing	**742**	**other NT**
Automotive Parking and Carwashes	**750**	**HP sub's**
Automotive & Other Repair Service	**751-760**	**HP sub's**
Personal Services	**761, 771-791**	**HP sub's**
Except: Hotels and other lodging places	761-762	Hotels
Entertainment and Recreation services	**800-810**	**other NT**
Health and Social Services	**812-40,852, 861, 870-81**	**other NT**
Except: **Child Care Services**	**862-863**	**HP sub's**
Legal Services	841	BS
Educational Services	842-851, 860	ED
Engineering, Management & Professional Services	882-893	BS
Public Administration	900-932	PA

Notes: The codes refer to the IPUMS variable IND1990, which is a modified version of the 1990 Census Bureau industry classification scheme and provides a consistent set of industries codes for 1980, 1990 and 2000 Censuses, and for the American Community Surveys (Ruggles et al. 2004). IND1990 was created in the IPUMS using a series of technical papers (published by the Census Bureau) that provide detailed analyses of how the industrial coding scheme for each census year differed from the scheme used during the previous census year. These industrial "crosswalks" are based on samples of cases that are "double coded" into the industrial schemes of the current and previous census year. The original Census Bureau crosswalks are available via links, at http://usa.ipums.org/usa/chapter4/chapter4.shtml#crosswalks

Legend: HP sub's: home production substitutes; other NT: other clearly non-traded sectors; TR: clearly traded sectors; CO: construction; WT: wholesale, transport and utilities; FI: financial services; BS: business services; PA: Public Administration; ED: education.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table B2
Employment shares in different sectors by wage decile and year, 1980-2005

	1980	1990	2000	2005	1980	1990	2000	2005
Wage decile	*First decile*				*Second decile*			
HP substitutes	**0.16**	**0.21**	**0.23**	**0.25**	**0.13**	**0.15**	**0.17**	**0.18**
Other non-traded	0.29	0.33	0.31	0.32	0.32	0.33	0.33	0.33
Traded industries	0.20	0.15	0.14	0.12	0.21	0.18	0.15	0.14
Services in hotels	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.03
Construction	0.04	0.04	0.05	0.06	0.03	0.05	0.06	0.08
Wholesale trade et al.	0.07	0.07	0.07	0.07	0.07	0.09	0.09	0.08
Financial Services	0.05	0.05	0.04	0.04	0.07	0.07	0.05	0.04
Business Services	0.03	0.04	0.05	0.04	0.03	0.04	0.05	0.04
Public Administration	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.02
Education	0.07	0.06	0.07	0.06	0.07	0.06	0.07	0.06
Wage decile	*Third decile*				*Fourth decile*			
HP substitutes	**0.09**	**0.10**	**0.12**	**0.12**	**0.06**	**0.07**	**0.09**	**0.09**
Other non-traded	0.30	0.31	0.32	0.32	0.27	0.28	0.29	0.31
Traded industries	0.22	0.18	0.16	0.14	0.24	0.19	0.17	0.15
Services in hotels	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01
Construction	0.04	0.05	0.06	0.08	0.04	0.05	0.06	0.08
Wholesale trade et al.	0.09	0.10	0.10	0.10	0.10	0.11	0.12	0.11
Financial Services	0.10	0.09	0.07	0.06	0.09	0.09	0.08	0.08
Business Services	0.04	0.05	0.05	0.05	0.04	0.05	0.06	0.06
Public Administration	0.05	0.04	0.03	0.03	0.06	0.05	0.05	0.05
Education	0.06	0.06	0.07	0.07	0.07	0.06	0.08	0.08
Wage decile	*Fifth decile*				*Sixth decile*			
HP substitutes	**0.05**	**0.06**	**0.07**	**0.07**	**0.04**	**0.04**	**0.05**	**0.05**
Other non-traded	0.25	0.25	0.27	0.28	0.22	0.23	0.24	0.25
Traded industries	0.26	0.21	0.17	0.15	0.28	0.22	0.18	0.16
Services in hotels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Construction	0.05	0.06	0.06	0.07	0.05	0.06	0.07	0.07
Wholesale trade et al.	0.12	0.12	0.13	0.12	0.13	0.14	0.14	0.14
Financial Services	0.08	0.09	0.09	0.08	0.07	0.09	0.08	0.09
Business Services	0.05	0.06	0.07	0.06	0.04	0.06	0.08	0.07
Public Administration	0.08	0.07	0.06	0.06	0.08	0.07	0.07	0.07
Education	0.07	0.07	0.08	0.09	0.08	0.08	0.09	0.09

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

(Table B2 continue)

	1980	1990	2000	2005	1980	1990	2000	2005
Wage decile	*Seventh decile*				*Eighth decile*			
HP substitutes	**0.03**	**0.03**	**0.04**	**0.04**	**0.02**	**0.02**	**0.03**	**0.03**
Other non-traded	0.19	0.21	0.22	0.23	0.15	0.19	0.20	0.21
Traded industries	0.31	0.23	0.18	0.15	0.33	0.25	0.20	0.16
Services in hotels	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
Construction	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07
Wholesale trade et al.	0.16	0.17	0.16	0.15	0.21	0.18	0.15	0.14
Financial Services	0.06	0.08	0.08	0.08	0.05	0.07	0.08	0.09
Business Services	0.04	0.07	0.09	0.09	0.04	0.07	0.10	0.10
Public Administration	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.09
Education	0.07	0.08	0.09	0.11	0.07	0.08	0.10	0.10
Wage decile	*Ninth decile*				*Tenth decile*			
HP substitutes	**0.01**	**0.02**	**0.02**	**0.02**	**0.01**	**0.01**	**0.02**	**0.02**
Other non-traded	0.11	0.16	0.18	0.19	0.11	0.14	0.18	0.19
Traded industries	0.34	0.26	0.21	0.18	0.32	0.25	0.20	0.19
Services in hotels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.07	0.06	0.06	0.05	0.07	0.06	0.04	0.04
Wholesale trade et al.	0.20	0.17	0.13	0.13	0.16	0.15	0.13	0.12
Financial Services	0.05	0.07	0.08	0.09	0.08	0.12	0.12	0.15
Business Services	0.04	0.07	0.12	0.13	0.07	0.11	0.16	0.17
Public Administration	0.08	0.08	0.09	0.10	0.08	0.06	0.06	0.07
Education	0.09	0.10	0.10	0.11	0.09	0.10	0.08	0.07

Notes: Each entry represents the fraction of the workforce in a given decile of the hourly wage distribution in a given year employed in a given sector. So, entries within a decile and year sum vertically to one.
The *home production (HP) substitutes* sector include the following three-digit industries: eating and drinking places, services to buildings, detective and protective services, automotive rental and leasing, taxi and limousine service, other repair services, personal services, entertainment services, child care services. Traded industries include agriculture, mining and manufacturing. Wholesale trade et al. include transportation and utilities. For the detailed mapping of three-digit industry codes into the above categories, see Table B1.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA). Earnings percentiles based on hourly wages, defined as annual wages divided by annual labor supply (the product between number of weeks worked and usual number of hours worked per week).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table B3.a: *First-stage regressions of the decadal change in the top decile wage bill share in a city on predicted changes in the wage bill of top wage earners*.

	(1)	(2)	(3)	(4)	(5)
Predicted Δ wage bill of	0.378***	0.326***	0.326***	0.214**	0.214**
top 10% of wage earners	(0.093)	(0.088)	(0.087)	(0.092)	(0.092)
1990-2000 dummy	-0.000	0.015**	0.016**	0.003	0.003
	(0.003)	(0.007)	(0.007)	(0.003)	(0.003)
2000-2005 dummy	-0.037***	-0.022*	-0.020	-0.015	-0.015
	(0.012)	(0.013)	(0.013)	(0.012)	(0.012)
Δ Female labor force		0.126**	0.118**		
participation		(0.060)	(0.059)		
Δ Noncollege foreign-born		0.396***	0.396***		
share of workforce		(0.082)	(0.082)		
Δ 16-24 share of		-0.016	0.001		
workforce		(0.081)	(0.078)		
Δ 65+/pop share		0.457***	0.432***		
		(0.134)	(0.138)		
Δ College graduates share		0.030	0.069		
of workforce		(0.057)	(0.061)		
Δ log median wage			-0.039		
			(0.026)		
Female labor force				0.036	0.035
participation in 1980				(0.037)	(0.038)
Noncollege foreign-born				0.120***	0.123***
share in 1980				(0.044)	(0.046)
16-24 share in 1980				-0.024	-0.021
				(0.074)	(0.078)
65+/pop share in 1980				0.025	0.036
				(0.048)	(0.055)
College share in 1980				0.058*	0.064*
				(0.031)	(0.039)
Emp. sh. HP sub's in 1980					-0.079
					(0.157)
Emp. sh. in routine					-0.044
occup. in 1980					(0.153)
Constant	0.020***	-0.005	-0.006	-0.020	-0.016
	(0.001)	(0.009)	(0.009)	(0.025)	(0.025)
Region dummies	No	No	No	Yes	Yes
R^2	0.09	0.18	0.19	0.19	0.19

Note: Three periods (1980-1990, 1990-2000, 2000-2005) and 242 MSA's are considered, for a total of 726 observations. The instrument is a weighted sum of nationwide decadal growth of wages of workers in different occupations, where the weights are city-specific employment shares in those occupations among top wage earners in 1980. Estimates weighted by the average share of national workforce in each MSA between 1980 and 2005. Standard errors (in parentheses) adjusted for heteroskedasticity and clustering across MSA's. * significant at 10% ** significant at 5% *** significant at 1%.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Table B3.b: *Additional First-stage regressions*

Dependent variable:	(1) Δ 90-10 wage gap	(2) Δ 90-50 wage gap	(3) Δ 90th wage percentile	(5) Δ 10th wage percentile
Predicted Δ in wage bill of top 10% of wage earners	0.784***	0.389***	0.618***	-0.166
	(0.180)	(0.120)	(0.144)	(0.169)
1990-2000 dummy	-0.033**	0.002	0.039***	0.073***
	(0.013)	(0.007)	(0.011)	(0.018)
2000-2005 dummy	0.010	0.034*	0.043*	0.033
	(0.030)	(0.018)	(0.023)	(0.024)
Constant	0.065***	0.036***	0.024***	-0.041***
	(0.009)	(0.005)	(0.008)	(0.010)
R^2	0.27	0.28	0.33	0.10

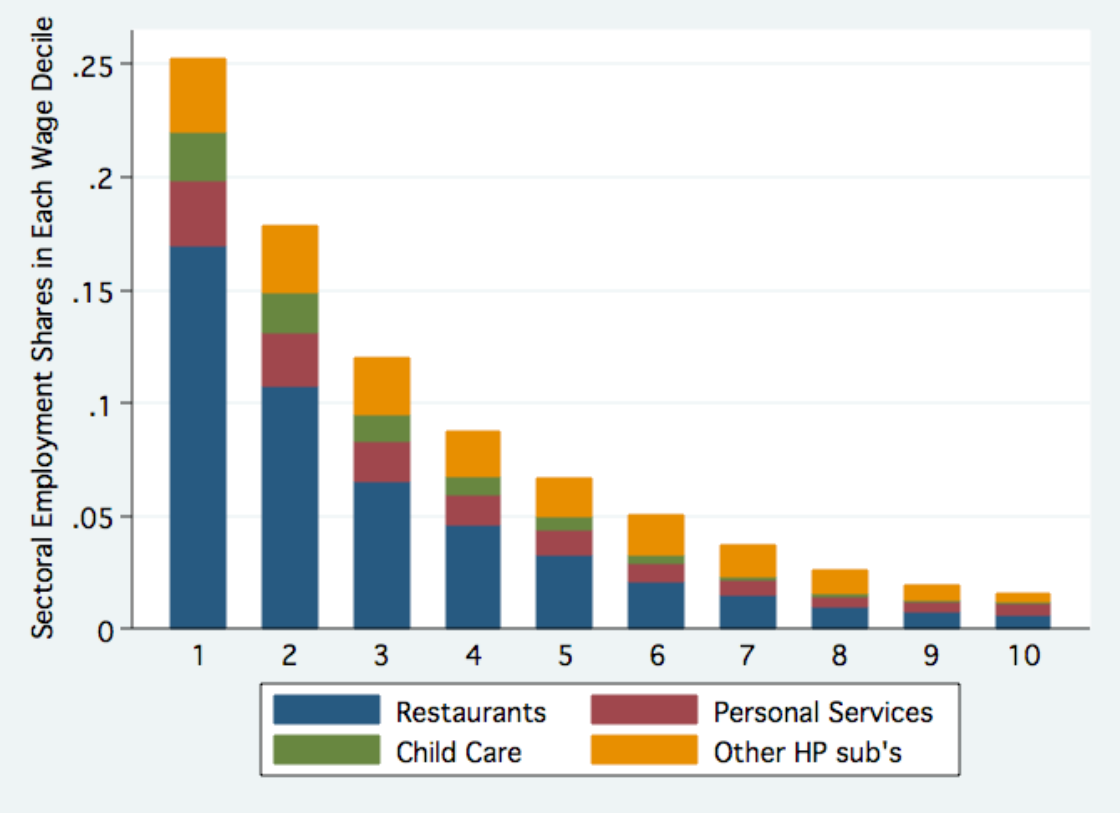
Note: Three periods (1980-1990, 1990-2000, 2000-2005) and 242 MSA's are considered, for a total of 726 observations. The prediction of the change in the wage bill of the top 10% of wage earners is a weighted sum of nationwide decadal growth of wages of workers in different occupations, where the weights are city-specific employment shares in those occupations among top wage earners in 1980. Estimates weighted by the average share of national workforce in each MSA between 1980 and 2005. Standard errors (in parentheses) adjusted for heteroskedasticity and clustering across MSA's. * significant at 10% ** significant at 5% *** significant at 1%.
Source: IPUMS extracts from 1980-1990-2000 censuses and 2005 American Community Survey.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure B1

Employment shares in the sector of services that substitute for home production by decile of the hourly wage distribution; 2005

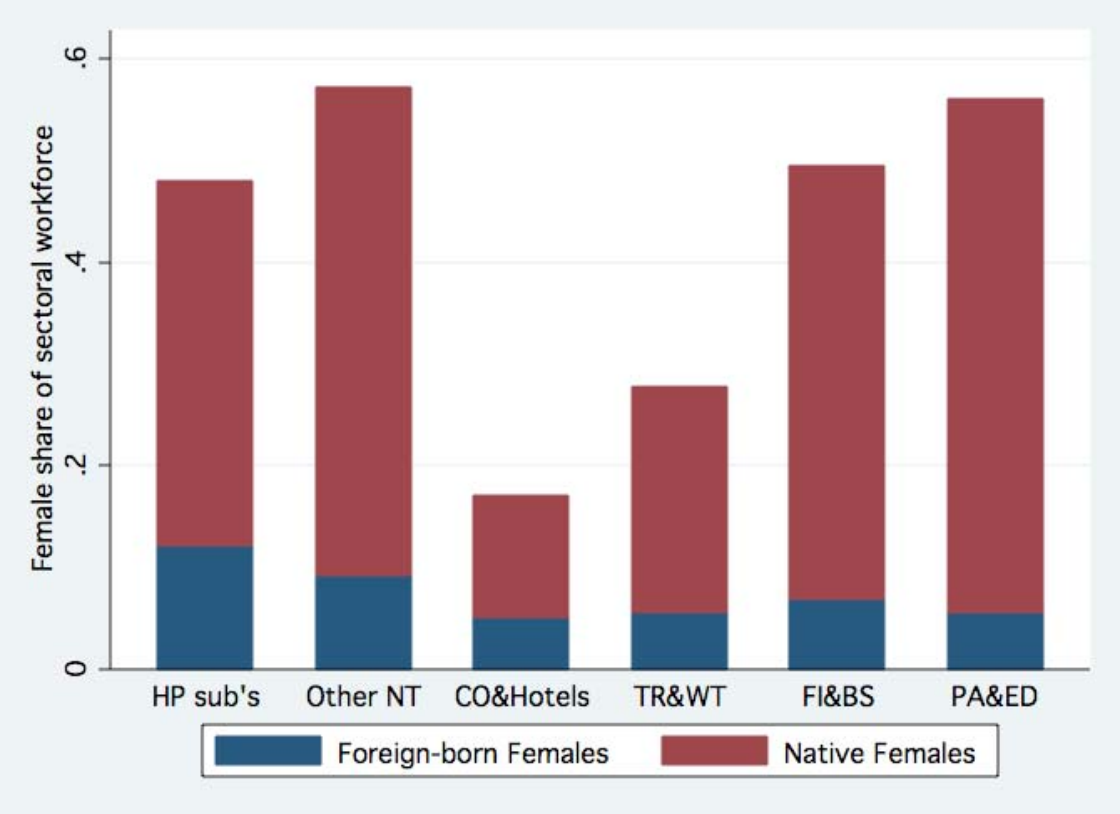
Assessing the contribution of specific service categories.



Notes: Each bar represents the fraction of the workforce in each decile of the hourly wage distribution employed in the sector of home production substitutes in 2005.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure B2
Female share in the workforce, by sectors; 2005

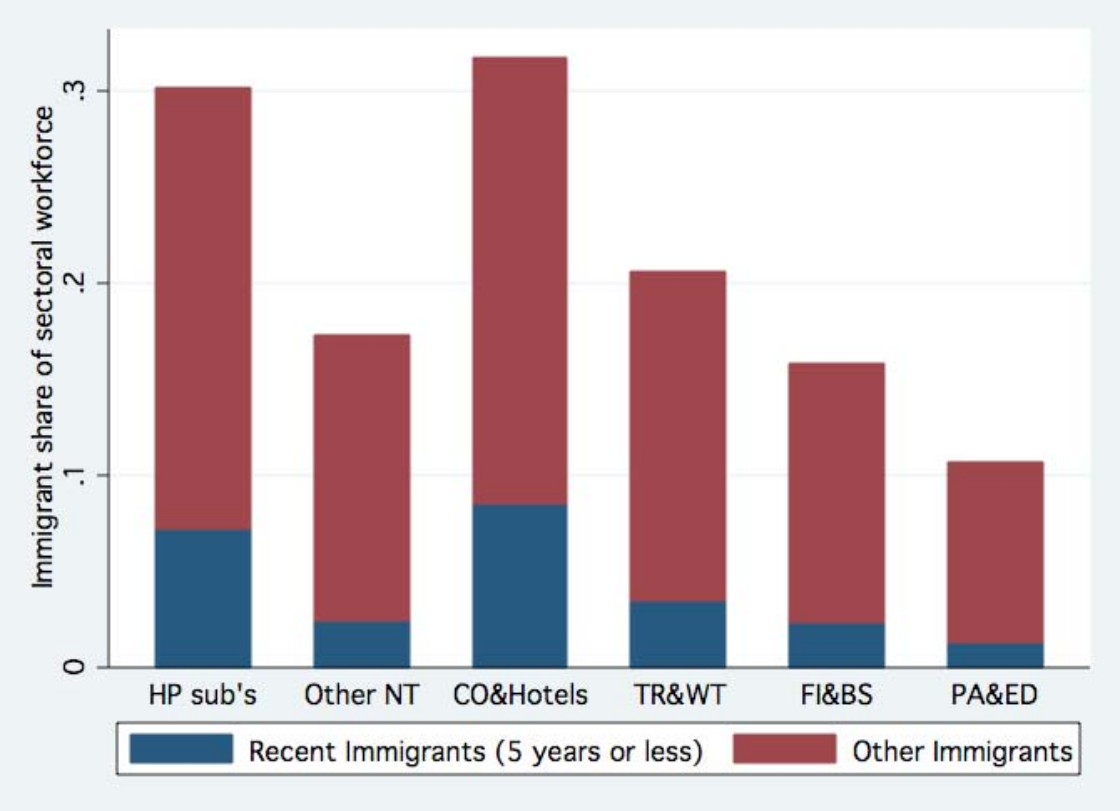


Notes: Each bar represents the fraction of females in the total workforce in a given sector in 2005. Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: 2005 American Community Survey file.

Review of Economics and Statistics Just Accepted MS.
doi:10.1162/REST_a_00234

Figure B3

Immigrant share in the workforce, by sectors; 2005



Notes: Each bar represents the fraction of foreign-born individuals in the total workforce in a given sector in 2005.
Sample restricted to individuals aged 16 through 65 who were employed in the civilian labor force at the time of the survey, were not unpaid family workers, who did not live in group quarters and who resided in a Metropolitan Statistical Area (MSA).
Figures are weighted by the product of IPUMS weights and annual labor supply.
Source: 2005 American Community Survey file.

FROM EMPTY PEWS TO EMPTY CRADLES: Fertility Decline Among European Catholics[1]

Eli Berman
University of California San Diego
National Bureau of Economic Research

Laurence R. Iannaccone
Chapman University

Giuseppe Ragusa
LUISS Guido Carli University

May 2012

[1] Contact: Eli Berman, Department of Economics, UC San Diego, elib@ucsd.edu. We appreciate the comments of Alicia Adsera, Evelyn Lehrer, seminar participants at the NBER Labor Studies meetings, George Mason University, USC, UC Irvine, the Southern California Applied Economics workshop at UCLA, Duke NIH demographic meetings at UCLA, Brown, UCLA, the European Economic Association meetings, UC Santa Barbara, the Society of Labor Economics meetings, UC San Diego, Population Studies at Michigan, the Harris School, University College London, an ASSA session, and a session of the Association for the Study of Religion, Economics and Culture (ASREC). Tiffany Chou and Liang Choon Wang provided expert research assistance. We acknowledge the support of National Science Foundation grant 0520188 through the National Bureau of Economic Research.

Abstract

Catholic countries of Europe pose a demographic puzzle –fertility is unprecedentedly low (total fertility=1.3) despite low female labor force participation. We model three channels of religious effects on demand for children: through changing norms, reduced market wages, and reduced costs of childrearing. We estimate their effects using new panel data on church attendance and clergy employment for thirteen European countries from 1960-2000, spanning the Second Vatican Council (1962-65). Though Catholic theology is uniform across countries, service provision, (measured by nuns/Catholic) varied considerably across countries and over time, reflecting differences in Church provision of education, health, welfare and other social services. Declining service provision predicts falling fertility within the same country, controlling for secular trends. Reduced religiosity (measured by church attendance) has no effect for Protestants, but predicts fertility decline for Catholics. The data suggest that service provision and religiosity complement each other –a finding consistent with preferential provision of services to church attendees. Nuns outperform priests in predicting fertility, suggesting that social services dominate theological services. Nuns seem to increase fertility by reducing the costs of childrearing, at 300 to 400 children per nun.

1. Introduction

Birth rates fell so rapidly in the 1970s and 1980s in Southern Europe that in a generation it went from Europe's highest fertility region to its lowest. Unless total fertility (now below 1.4 children per woman) increases substantially, the native-born population is destined to further age and shrink. This phenomenon has been noted by many scholars (Munoz-Perez, 1989, studies fertility in Italy, Greece, Portugal and Spain in detail.) An aging and shrinking population has major economic implications, generating demand for young immigrant workers and threatening the solvency of "pay as you go" social insurance funds. Italy and Spain, for instance, are projected to have one retiree for each working age person by the year 2050. Increased morbidity implied by an aging population will also strain the funding of publicly provided health care.

Should Europe's experience reflect general consequences of economic development and social change, then understanding why fertility declined in Southern Europe is important for projecting global population. The consequences of policies concerning immigration, education, health and retirement all depend upon population trends. Yet credible demographic projections require reliable models, and demographers remain puzzled by the causes of European fertility decline. Particularly surprising is that Southern European fertility has declined since 1960 *without* a rapid increase in female labor force participation (Bettio and Villa, 1998; Ahn and Mira, 2002), so that Southern Europe currently has historically low rates of *both* fertility *and* female participation. In Spain and Italy, total fertility has fallen below 1.3 and female labor force participation remains under 40% – both well below European averages. This pattern defies the standard economic fertility model of Becker and Lewis (Becker and Lewis, 1973; Becker, 1991), is unprecedented in the history of fertility transition, and is not resolved by considering plausible economic factors such as housing prices or women's education (Del Boca, 2002).

Our approach to this puzzle involves religion, and in particular the effects of Catholic service provision on fertility. For an indication of Catholicism's possible relevance, Figure 1 plots the development of total fertility rates (TFR) for three categories of Western European nations: the Catholic countries (with more than 70% of the population Catholic – Belgium, Ireland, Italy, Luxembourg, Portugal, Spain,); the Protestant (with 70% or more Protestants – Denmark, Norway, Sweden and the UK); and other countries (with neither religion dominant or with a history of strong separation between religious and national institutions – France[2], Germany, Greece, Netherlands and Switzerland). The strongly Catholic countries had fertility *almost a half child per woman higher* than the other countries in the 1970s. Yet fertility in those countries declined so rapidly in the 1970s and 1980s that by the 1990s they averaged the lowest fertility in Europe, about *half a child less* than that of the Protestant countries.

Why did fertility decline so rapidly in those very Catholic countries? A general decline in religiosity cannot be the explanation. Since the 1960s Protestant countries have experienced a more rapid decline in Church attendance than Catholic. Nor can the explanation be a change in

[2] Since the French Revolution, French governments have repeatedly limited the activities of the Catholic Church, particularly the service provision most relevant to this study. Hence, "by the end of the nineteenth century, the Church had lost all connection to the French state, religious instruction was forbidden, and religious orders were forbidden to teach in private schools" (Warner 2000: 62, c.f. Lee and Piveteau 1967). Wilde (2007) emphasizes that French Bishops at the Second Vatican Council were strongly allied with the Northern European ecumenical reformers rather than with the conservatives from the other majority Catholic countries.

Catholic theology about birth control, or a reduction in personal compliance with that theology. We will argue that there was no such change, and even if there were, it would have been common to Catholics.

We will offer an alternative explanation: that the Catholic Church retreated in the mid 1960s from providing a set of family-friendly services that had previously lowered the cost of raising children for Catholic families. Attrition of nuns in the aftermath of the Second Vatican council resulted in the decline of those services, raising the cost of childrearing and thus reducing fertility.

Consistent with this theory are empirical results showing that cross-country variation in the decline in nuns per Catholic is a strong predictor of fertility decline in European countries between 1960 and 2000. Declining religiosity, as measured by church attendance, does not predict declining fertility for Protestants but does predict declining fertility for Catholics. Among Catholics, the effect of reduced religiosity seems to be particularly strong when service provision is high, suggesting complementarity. That is consistent with the predictions of a club model, in which services are provided preferentially to members who display religiosity. Services provided by priests are a poorer predictor of fertility than those provided by nuns, suggesting that social services dominate theological services. Nuns seem to increase fertility by a remarkable 300 to 400 children per nun.

These results have strong implications for public policy, as they indicate that the availability of relatively inexpensive, family-friendly services has sharp effects on fertility, with each additional service provider predicting hundreds more children born.

The paper proceeds as follows: Section 2 briefly survey the literature on religion, economics, and fertility, and sets out our conjectures in detail. Section 3 describes institutional aspects of the Catholic Church, including the Second Vatican Council. In Section 4 we provide a simple framework for estimation which allows religious institutions to affect fertility through both theological and service provision channels. Section 5 describes our data, Section 6 reports estimation results and Section 7 concludes.

2. Literature

Our approach assimilates insights from two literatures: economic demography, and religious approaches to fertility. The classic contributions to economic demography explain the importance of childhood mortality and female labor force participation (Becker and Lewis, 1973; Becker, 1991). Becker's quality-quantity theory emphasizes the role of rising female earnings in increasing the cost of raising numerous children relative to that of child "quality" (education, health, etc.), inducing mothers to give birth to fewer children while investing more resources invested in each child. Yet female labor force participation is now associated with relatively *high* fertility across countries in Europe, contradicting the prediction of the Becker model. Childhood mortality rates are low and stable in Europe so they cannot explain falling fertility either.

Bongaarts (1999) suggested that uniquely low European total fertility rates in the 1990s may underpredict eventual fertility, and that women will compensate later in life for the low fertility of their 20s. Yet we have not observed any recovery in total fertility rates as those

women have reached their 50s, making a subsequent fertility increase unlikely. Daniela Del Boca (2002, 2003) has argued that Southern European labor market institutions are very unfavorable to working mothers, with poor provision of child care and few part time jobs available with benefits. She argues that rather than work *or* raise children, young women wait (typically living with parents) until they obtain a job that accommodates motherhood. de Laat and Sevilla-Sanz (2004) offer an analogous explanation based on norms, arguing that Southern European fathers are less willing to care for children, increasing the shadow cost of child rearing for potential working mothers and augmenting the substitution effect of rising women's wages on fertility. Giuliano (2007) links the gender role attitudes of Southern Europeans to low labor force participation in both Europe and the U.S. Given the Catholic Church's historic role in providing institutional and normative support for fertility and childrearing, our theory offers an alternative but complementary set of explanations.

Multiple studies have linked religiosity and fertility (Stolzenberg, Bair-Loy, et al. 1995), with particular attention to Southern Europe (Lehrer 1995; Lehrer 1996). Differential fertility changes among Catholics and Protestants in the U.S. have been studied extensively. Westoff and Jones (1979) showed that Catholics experienced an amplified baby boom – higher completed fertility in the 1950s (by about a child per family), followed by rapid fertility decline in the 1960s and 1970s which eliminated the Catholic / Non-Catholic fertility differential by the mid 1970s. They also report that among Catholics, religiosity, (as measured by communion) was associated with higher fertility in the 1950s and 1960s but not in the 1970s. Rosenzweig and Schultz (1985) found that Catholics have more children even after adjusting for other socioeconomic factors, such as maternal education. Sander (1992) takes issue with a causal interpretation of the effect of Catholicism on fertility, reporting evidence that couples who prefer large families are more likely to remain Catholic or convert to Catholicism.

Research by Adsera (2004) examines the role of religion and religiosity in Spain. Using data from the 1985 and 1999 Spanish Fertility Surveys, she finds that practicing (i.e., observant) Catholics had no higher fertility than non-practicing Catholics in the mid-1980s. Yet by the late-1990s, after 15 years of decline in practice, the remaining practicing Catholics *do* have higher fertility. A companion paper using International Social Survey Program (ISSP) data shows that Spain in 1985 may be an anomaly (Adsera, 2006). In the thirteen OECD countries surveyed by the 1994 ISSP, higher church attendance is associated with significantly higher desired fertility in all countries for women and in all but two countries for men. This leaves open the possibility that a decline in religiosity has contributed to declining fertility in highly Catholic countries besides Spain.

Club-theoretic models drawn from the economics of religion predict that communally-oriented "sectarian" religions will tend to have high fertility even in the absence of explicit pronatalist theology because they induce women to voluntarily adopt a set of religious prohibitions which allow the group to effectively provide a set of local public (club) goods. Those prohibitions turn out to be pronatalist because they distance women from secular consumption and labor markets, lowering the opportunity cost of childrearing.[3] Catholicism is certainly not a sectarian religion, but

[3] That argument starts with Iannaccone's (1992) model of religious sects as clubs that provide quasi-public services to members. To limit free-rider problems, such groups impose prohibitions, so-called "stigmas," that indirectly tax

3. The Second Vatican Council and Fertility

The Social Consequences of Communal Religion

Most religious groups endorse fertility, so cross-group variation might come more from the ability to implement high fertility norms. Scholars have long recognized that collective activities (in addition to supernatural beliefs) underpin a religion's capacity to constrain behavior and maintain institutions. They have also recognized that some religions are more strongly collective than others. Adam Smith (1965: 748-750) observed that "strict or austere" systems of morality are far more common in "little religious sects" than in government-regulated "established churches." Subsequent generations of scholars developed insights like these into a full-blown theory of religious organization. The famous sociologist Emile Durkheim (1965: 62) argued that collectivity explained how "religion,"but never "magic," could sustain "moral communities" governed by "unified systems of beliefs and practices."

For European sociologists of the 19th and early-20th centuries, a stronger communal orientation likewise distinguished Catholicism from mainstream (state-church) Protestantism. The social consequences of this difference ranged from lower rates of suicide among Catholics (Durkheim, 1965) to more rapid economic development among Protestants (according to Weber (1946)). Despite lingering debate over the these particular inferences, most religious researchers broadly agree that the Catholic Church traditionally promoted stronger group identity and sustained a broader array of institutions than any Protestant State Church.

The scholarly consensus about Catholicism, communalism, and behavioral constraints suggests that fertility might well be another behavior sustained more effectively by Catholicism than Protestantism. Official Catholic doctrine favors fertility (and opposes all forms of birth control and abortion) and Catholicism traditionally was associated with large family size.

The Second Vatican Council and Declining Catholic Religious Activity

The Second Vatican Council (Vatican II) trigged broad-based decline within Catholicism. The losses included reductions in the number of people becoming (or remaining) priests, even larger

---

(non-group) market activities. At the margin, members respond by shifting hours away from the labor force and into non-market activities which benefit the club. Because of the positive externalities associated with club activities, those prohibitions actually benefit club members. The club model provides a coherent rational-choice theory that explains otherwise puzzling behavior of strict sectarian denominations. It also rationalizes more mild prohibitions characteristic of merely "conservative" churches such as contemporary evangelical Protestants, traditional Catholics and Orthodox Jews. Berman (2000) marries the club approach to Becker's (1991) theory of fertility, showing that prohibitions increase the effective tax on market labor, thereby reducing real wages. The effect of these prohibitions for women is to make investments of market resources in child "quality" more difficult to achieve while making quantity more attainable, with a resulting increase in fertility. (For a formal derivation, see Berman (2000) or Berman and Stepanyan (2003). High fertility is in fact associated with sectarianism among Christians, Ultra-Orthodox Jews (Berman, 2000), and Radical Islamists (Berman, 2009). This could be due to mechanisms at either the individual or the group level. Berman (2000) shows that increased subsidies to the *group* induced dramatic fertility increases of one or two children per woman over a decade among Israeli Ultra-Orthodox Jews. This suggests a group-level mechanism as predicted by the club model, particularly since this rapid fertility increase occurred *without* any change in Orthodox Jewish theology regarding births or birth control. The point is not that European Catholics are a sect. Nevertheless, if religiosity can have large effects on fertility among sects through social service provision, it should not be surprising to see fertility effects of religiosity even in a mainstream religion with less strict prohibitions and practices.

reductions in the number of nuns, reduced mass attendance among the Catholic laity, and increased willingness among Catholics to question official doctrine, including prohibitions on divorce and birth control (Hout and Greeley 1987; Greeley 1989; Schoenherr and Young 1993: 10-12; Stark and Finke 2000: 169-190). Although scholars continue to debate why Vatican II had these effects, the decline itself is universally acknowledged.

Vatican II is generally viewed by scholars as the massive *exogenous* shock, more consequential (and unanticipated) than any other change to Catholicism in the past several centuries.[4] Both contemporaneous and historical accounts stress its radical and surprising character – particularly for parish priests, nuns, and ordinary Catholics (Dolan 1985: 421-454; Hoge and Wenger 2003: 7-12). The Pope who initiated Vatican II was 77 years old when elected in 1958 and widely regarded as an interim "caretaker" (he indeed died less than five years after election). Only one other general council had ever been called – in 1870 – and its effect had been to resist change and reaffirm Church tradition. Thus, even those who applauded Pope John XXIII's decision to convene the Council in 1962 could not have known that his call for "updating" would eventually affect scores of doctrines and practices that for hundreds of years had distinguished Catholicism from Protestantism.

The architects of Vatican II did not anticipate the *consequences* of their reforms. Catholicism had been growing for a hundred years or more, and the 1946-1965 post-war period had witnessed especially rapid growth: in total number of Catholics, in church attendance rates, in the numbers of priests and nuns, and in Catholic schools and hospitals. To the great surprise and dismay of Catholics everywhere (and especially the Catholic hierarchy), *all* these growth trends reversed *immediately* after Vatican II. Among the hundreds of historians, sociologists, and religious scholars who have analyzed the Vatican II era with methods ranging from textual analysis to survey research, we encounter nearly unanimous agreement that the decline was unanticipated and precipitated primarily by changes initiated by the Church hierarchy, rather than by external events or changes (such as trends in income, education, or female employment, or changes in the secular culture).

Liberals and conservatives within the Catholic Church disagree strongly over the mechanism by which Vatican II caused attrition of clergy from the Church. Liberals argue that by convening the Council the Church created an expectation of even broader reforms, which might include allowing clergy to have families and payment for their services –more in line with Protestant practice. When those expectations were dashed, goes the argument, nuns, priests brothers and prospective clergy decided that the awaited reforms would not happen in their lifetimes, and reacted by either leaving the fold or declining to join in the first place.

Conservatives have a very different explanation for the attrition of clergy. They claim that before the Second Vatican Council clergy were placed on a theological pedestal, recognized for their holy work. The Council, in an ecumenical expression of tolerance and inclusion, now recognized everyone performing social services such as education, care for the sick and care of the poor, as those are all valuable services. The pedestal for secular providers was not as high as that of nuns and priests, but the effect was to reduce the theological premium that clergy had over secular providers of many of the same services. So it is not surprising that nuns, brothers

[4] Wilde (2007) provides a fascinating account of how "progressive" bishops managed to outmaneuver conservatives in order to engineer an unexpected and revolutionary change in Catholic practice.

and priests effectively jumped pedestals, trading off a reduced theological premium against the value of having families and, for the nuns and brothers, earning wages. Whichever explanation one accepts, the conservative or the liberal, the key to what follows is that both explanations are exogenous to fertility.

Official Church statistics provide detailed evidence of institutional losses following Vatican II. These diminished the Church's labor force, undermined its capacity to provide traditional services (most notably Catholic schools, day care, and hospitals), and reduced its visible presence in community life.[5] Starke and Finke (2000), using data from the *Official Catholic Directory,* report that the number of nuns in the U.S. rose steadily from about 140,000 in 1948 to 180,000 in 1966, the concluding year of Vatican II. Steady growth then immediately turns into precipitous decline, dropping to about 90,000 by 1995 and continuing downwards thereafter. Similar mid-to-late 1960s turning points have been extensively documented in the U.S., for the number of priests, average rates of mass attendance, contribution rates, and respect for Church doctrine.

Post-Vatican II declines do not follow identical paths in all countries, but in every developed Western country the number of priests and nuns began to decline dramatically within five years after 1965, as we will see below for Western Europe.

Catholic Social Services

Before Vatican II the Church played an important role in providing social services in strongly Catholic countries and communities. Nuns were instrumental in that provision. In Italy, for example, "until 1966 virtually all [pre-schools] were private [and] seventy percent of nursery and kindergarten children were cared for by religious sisters." (Lee, et al, 1967: 165). In pre-Vatican II America, about 50% of Catholic children attended Catholic schools in the 1950s, and Catholic hospitals provided about one-fifth of all hospital beds (while Catholics accounted for about one-fourth of the U.S. population) (Fialka 2003: 3). Social life in Catholic communities routinely revolved around the Catholic parish and Catholic organizations.

The number of nuns provides the best single index of Catholic social services, since nuns have traditionally provided the primary labor supply staffing Catholic schools, hospitals, and other Church-related institutions. Table 1 reports on nuns per 10,000 Catholics in various countries in Europe, showing that the level of clergy-provided services varied widely across countries in the 1960s. (Data sources are documented in Section 5 below.) Examining the ten countries with more than a third Catholics in the population in the 1960s, the number of nuns per 10,000 Catholics ranged from 6.5 in Poland and 7.0 in Portugal to 60 in Ireland and 77 in the Netherlands. By the year 2000 that range had narrowed considerably as the number of nuns per 10,000 declined to 32 in Ireland and to 18 in the Netherlands.

How important could these nuns be as social service providers? For comparison, for each 10,000 people in the U.S. there are 97 teachers (pre-kindergarten through elementary), 86 nurses and 29 social workers. While the number of nuns/Catholic is less than that in these European

[5] The reforms of Vatican II had the effect of further reducing the visibility of clergy. Nuns stopped wearing distinctive habits, popular but mythical saints were dropped from the official catalog, mass was no longer said in Latin, confession became optional [and hence rare], and "meatless" Fridays ceased to be required.

countries, it is of the right order of magnitude, especially considering that we have not counted brothers, priests and volunteers and that a parallel secular workforce exists in these occupations.

In the U.S., extensive survey data on religious activity and religion-specific fertility stretch back to the 1940s. From the mid-1800s through the mid-1900s the Catholic population, about one quarter of Americans, remained visibly distinctive – with its own schools, characteristic ethnicities, low intermarriage to non-Catholics, and a full complement of "parallel" institutions, including churches, social clubs, business associations, civic associations, and academic societies.

The strength and size of Catholic parallel institutions in the U.S. peaked in the 1950s (Greeley, McCready, et al. 1976; Greeley 1977). By the late 1960s, most of these institutions had closed, shrunk, or became non-sectarian. A comprehensive study of religious orders found that between 1962 and 1992, orders of sisters shrank by 42%. The orders shut down 23% of their hospitals, 15% of their universities and colleges, and 42% of their elementary schools. By the end of the century there were fewer than 81,000 sisters in America (compared to the 1968 peak of 180,000) and their median age was sixty-nine (Fialka 2003:17). Overall, 40% of the Catholic high schools and 27% of elementary schools closed between 1964 and 1984. These closure rates underestimate the loss of nuns. In the schools that remained, the share of non-lay teachers rose from under 10% in the 1920s through 1950s to peak at 70% in the mid-1960s, but then declined to 46% in 1970, 26% in 1980, 12% in 1990, and 6% in 2000. Those most familiar with Catholic schooling data claim the decline was almost entirely induced by supply effects, as nuns left, were replaced by (much higher paid) lay teachers, and schools could no longer cover these higher staffing costs (Dolan 1992:442, Bryck and Holland 1993: 52).

Catholic church attendance and fertility in the U.S. also rose before Vatican II and fell afterwards. Catholic fertility did not merely exceed Protestant fertility during the post war "baby boom" it experienced *both* a magnified rise and fall (Westoff and Jones 1979). Since 1965 Catholic fertility has declined by about a child per woman more than Protestant fertility, mirroring the excess decline for Catholics in Europe (Hout and Greeley 1987; Greeley 1989). Our primary concern is to understand why. In the following section we will develop a general framework that allows us to test competing theories.

4. Economic Fertility and Religion: A Framework for Estimation

To summarize the historical setting, we take it as given that the Second Vatican Council caused a sharp decline in clergy per Catholic in Europe, though the timing differed across countries, and that the decline in available clergy reduced services, both spiritual and tangible, provided to Catholic communities. The 1960s also witnessed dramatic changes in the general culture which could have affected fertility norms. This section describes competing theories and draws out their testable implications.

Several mechanisms linking religiosity to fertility are often discussed and plausible: First, religion could affect individual preferences for children or for use of birth control. Second, religion could influence social norms regarding childbearing or women's work. Third, religion could affect a mother's educational attainment and thus change the opportunity cost of raising children. Fourth, religion could affect national politics and thus the provision of child-friendly

social services by government. A fifth alternative, which combines institutions and a Becker-Schultz approach, is that religious communities might reduce the effective price of raising children by providing child-friendly social services such as day care, schools, and medical care. A club model of denominations would generate a variant of that mechanism, in which families that demonstrate more religiosity obtain preferential access to services. Finally, it's possible that religiosity and theology are merely symptomatic of attitudes toward fertility that change for other reasons.

Anticipating the results, the speed of clergy attrition will refute the hypothesis that religious changes are symptomatic of general changes in popular attitudes. That will leave us to examine mechanisms by which religion causes fertility, whether through theological, educational political or service-provision channels.

Religion in a Fertility Model: Preferences and Service Provision

A theoretical framework helps clarify how religion might affect fertility. Assume a family maximizing a joint utility function for two adults and f children by optimally choosing consumption, C, and the number of children f [6] [7],

$$(1) \quad \underset{c,f}{Max}\ U(c,f,\mu),\ where$$
$$U(c,f,\mu) = u(c,f) - \pi(a)(f-\mu)1(f<\mu).$$

Here the family is concerned with consumption per family member $c = \frac{C}{2+f}$, in the tradition of a Becker (1991) quality-quantity model.[8] It also gains direct utility from fertility.

We also allow the possibility that fertility norms enter a family's utility, using a formulation from research on identity (Akerlof and Kranton, 2000, 2010), in which the family experiences disutility associated with the distance between actual fertility, f, and some theological (or ideological) constant, μ, representing norms of desired fertility.[9] In that term, π is the weight associated with a religious identity, which is influenced by religiosity, a. This term could also be understood as reflecting the disutility associated with the use of birth control, to the extent that it affects fertility, the outcome of interest.

Denoting derivatives with subscripts, we assume that u_1, u_2 and π_a are positive, that u_{11}, and u_{22} are non-negative, that fertility and consumption per capita are weak complements, $u_{12} \geq 0$, and that both increasing in all their arguments, that u(.) is concave, and that $u_1(0) = u_2(0) = \infty$.

The family is subject to a budget constraint where a fixed time allocation, T, can be spent either on work hours, H, or raising children λf,

[6] For our purposes this could also be a single-parent family in which choices are made by the mother.
[7] Adding leisure as a use of time will not alter the main results, under the homotheticity assumption we invoke below.
[8] This formulation differs from Becker's (1991) demand for children in three ways: first, goods are per-capitized over all family members, not only children; second, the use of goods per capita is not necessarily interpreted as investment –analytically this makes no difference in a static model; third, we introduce (in (2)) a time-cost of childrearing as in Gronau (1977).
[9] A more general specification might include leisure. That generalization would not affect the derived estimating equations or the analysis that follows.

$$(2) \quad C = wH = w(T-\lambda f) .$$

In terms of consumption per capita, the budget constraint is

$$(2') \quad c = \frac{wH}{2+f} = \frac{w(T-\lambda f)}{2+f} .$$

Religion can enter this budget constraint in three ways. Let q measure the quality of social services provided by church, and assume that both q and a affect the time cost of raising children $\lambda = \lambda(a, q)$. The idea is that low cost schooling, daycare and health services reduce the time required of parents in raising children. One mechanism is through service quality. As service quality improves (through longer hours or more attractive church-provided services) then the time cost of childrearing would decline in quality, $\frac{d\lambda}{dq} < 0$. A variant of that mechanism would be political, with churches successfully lobbying for public policy changes that lower the cost of childrearing. A second effect of religion is through access. If access to social services is preferentially provided to individuals who publicly display religiosity through religiosity, then $\frac{d\lambda}{da} < 0$ when $q > 0$, and $\frac{\partial^2 \lambda}{\partial a \partial q} < 0$. Conditioning service provision on religiosity by a religious institution is rationalized by a club model (Iannaccone 1992, Berman, 2000). A third channel runs through wages. Religious norms and prohibitions tend to reduce the effective wage of women by restricting their access to labor markets and their productivity when working (as in Berman (2000) and Berman and Stepanyan (2003)), so that $w=w(a)$,with $\frac{dw}{da} < 0$.

We solve for the optimal choice of consumption and fertility to derive a demand for fertility. That optimum is illustrated by point A in Figure 2. Note that the budget constraint (2') is downward sloping and convex: $\frac{\partial c}{\partial f} = \frac{-\lambda w(2+f)-w[T-\lambda f]}{(2+f)^2} < 0$; $\frac{\partial c}{\partial f} = \frac{-w[2\lambda+T]}{(2+f)^2}$ so $\frac{\partial^2 c}{\partial f^2} = \frac{2w[2\lambda+T]}{(2+f)^3} > 0.$[10]

Substituting (2') in (1) yields

$$\underset{f}{Max}\ u(\frac{w(T-\lambda f)}{2+f}\ , f)\ - \pi(a)(f-\mu)1(f<\mu).$$

The first order condition is then

$$0 \geq \frac{\partial U}{\partial f} = -u_1 \frac{w(2\lambda+T)}{(2+f)^2} + u_2 + \pi(a)1(f<\mu).$$

[10] An aspect of the quality-quantity model not emphasized by Becker's discussion is that increased childrearing costs increase the convexity of the budget constraint: $\frac{\partial^3 c}{\partial \lambda f^2} = \frac{4w}{(2+f)^3} > 0$, making multiple equilibria more likely. That increase in convexity, in turn results from increases in childrearing costs reducing resources more for high fertility families. In the figure, increased λ squeezes the budget constraint in along the horizontal axis by reducing available time while its' intercept remains unchanged in terms of available consumption. (Increased wages also increase convexity in Becker's treatment of the question.)

The infinite marginal utility assumptions rule out solutions at f=0 or c=0, ($f=T/\lambda$), so that the derivative condition above holds with equality except possibly for a solution where $f=\mu$, the kink in the indifference curve in the Figure.

The second order condition assures that the optimum illustrated at A is a unique maximum for $f\neq\mu$,

$$\frac{\partial^2 U}{\partial f^2} = u_{11}\left[\frac{w(2\lambda+T)}{(2+f)^2}\right]^2 - u_{12}\frac{w(2\lambda+T)}{(2+f)^2} - u_1\frac{2w(2\lambda+T)}{(2+f)^3} + u_{22} < 0\,.$$

Intuitively, this is the result of the indifference curve being more convex than the budget constraint.

Solving for the optimal choice of consumption and fertility yields a derived demand for children in terms of wages, the weight placed on norms of fertility, and the cost of raising children,

$$(3) \qquad f(\, w(a),\, \pi(a)\,,\, \lambda(a,q)\,).$$

Proposition: Fertility increases in the weight on norms (π) when $f < \mu$ and decreases in childrearing costs (λ) when $f\neq\mu$.

Proof: Applying the Implicit Function Theorem,

$$\frac{df}{d\pi} = \left.-\frac{\partial^2 U}{\partial f\partial\pi}\right/\frac{\partial^2 U}{\partial f^2} = \left.-1(f<\mu)\right/\frac{\partial^2 U}{\partial f^2} > 0\,.$$

$$\frac{df}{d\lambda} = \left.-\frac{\partial^2 U}{\partial f\partial\lambda}\right/\frac{\partial^2 U}{\partial f^2}\,,\quad \frac{\partial^2 U}{\partial f\partial\lambda} = -u_{11}\frac{-wf}{2+f}\frac{w(2\lambda+T)}{(2+f)^2} - u_1\frac{2w}{(2+f)^2} + u_{22} < 0\,,$$

$$so\ \ \frac{df}{d\lambda} < 0\,.$$

Figure 2 illustrates this fertility effect of raising childrearing costs, which shifts the budget constraint inward, reducing full income and raising the opportunity cost of each child. The new equilibrium is illustrated at point B. Note that while fertility is unambiguously reduced, the effect on consumption is ambiguous. Likewise, the effect of increased wages on fertility is ambiguous because wages have both income and substitution effects, though the literature has emphasized the substitution effect (Becker and Lewis, 1973)), operating through the opportunity cost of a mother's time.

We do not observe w, λ , or π, but we can restate the demand for children in terms of religiosity, a , and quality of services, q, for which we observe proxies. A reduced form in terms of a, q, and an interaction (explained below) is f*

$$(4) \qquad f(\, w(a),\, \pi(a)\, ,\, \lambda(a,q)) = f^*(a,\, q)\ .$$

This equation implies three interesting predictions about how religiosity and service provision affect fertility. First, examining the terms reveals that fertility likely increases in religiosity *a*, through each of three mechanisms:

$$(4.1)\ \frac{df}{da}\Big|\, q\ = \frac{\partial f}{\partial w}\,\frac{dw}{da} + \frac{\partial f}{\partial \pi}\,\frac{d\pi}{da}\ + \frac{\partial f}{\partial \lambda}\,\frac{d\lambda}{da}\Big|\, q$$

Starting with the rightmost term, if service provision is conditional on demonstrating religiosity, so that religiosity provides preferential access to lower cost childrearing services, as we argued above that a religious club would do, then $\frac{d\lambda}{da} < 0$. Since childrearing costs lower fertility (see the proposition), the rightmost term is positive. The middle term is also positive if high religiosity increases the influence of norms or theology, π, on a woman's fertility behavior, since $\frac{\partial f}{\partial \pi}$ is positive (by the proposition). The first term on the right measures the effect of religiosity on fertility through labor markets. If religiosity shifts a woman's norms away from a lifestyle that encourages human capital formation and active labor force participation, we can think of that as religiosity lowering market wages, $\frac{dw}{da} < 0$. That term has ambiguous sign since the sign of $\frac{df}{dw}$ depends on whether a positive income effect of increased wages is dominated by a negative substitution effect (analogous to a possibly backward-bending labor supply curve). Empirically, the literature has found a dominant substitution effect, so that $\frac{df}{dw}$ <0, leading us to cautiously predict an overall positive effect of religiosity on fertility in (4.1). We have the ability to estimate $\frac{df}{da}\Big|\, q$ holding labor force participation constant, allowing us to isolate the two rightmost terms representing norms and the cost of raising children, which are unambiguously positive.

A second prediction is that service quality, *q*, unambiguously increases fertility by lowering the cost of childrearing. Note that this effect is entirely through the budget constraint -- not through preferences.

$$(4.2)\ \frac{df}{dq}\Big|\, a\ =\ \frac{\partial f}{\partial \lambda}\,\frac{d\lambda}{dq} > 0\ .$$

Third, if access to social services is preferentially provided to individuals displaying at least some religiosity, *a*, as a club would do, then social service quality and religiosity will be complements in fertility,

$$(4.3)\ \frac{\partial^2 f}{\partial a \partial q} = \frac{\partial f}{\partial \lambda}\frac{\partial^2 \lambda}{\partial a \partial q} > 0\ .$$

To test those predictions, we will measure religiosity, *a,* using church attendance – present and past--, allowing us to link observable religiosity to fertility. We will use nuns per Catholic as our measure of *q*, recalling that nuns provided much of the staffing of educational,

health, and welfare services during the heyday of Catholic social service provision. We turn now to a description of data that will allow us to test these predictions.

5. Data

We make use of data from three sources: administrative data from the Vatican, the International Social Survey Program (ISSP) and the World Development Indicators (WDI).

The Vatican collects data for each diocese in the world, including the number of priests (diocesan and regular), nuns, churches, schools, hospitals, other institutions, Catholics and new baptisms. These data are available dating back to 1959 on an annual basis.[11] Figure 3 reproduces a page from the 1960 *Annuario Ponteficio* describing entries for Agra in India and Agrigento in Sicily (the birthplace of one of the authors).

The ISSP provides standard household survey data comparable across countries (31 in the 1998 wave).[12] Critically, it includes a retrospective question on the religious participation of the respondents and their parents. The question asks "[W]hen you were around 11 or 12, how often did you/your parents attend religious service?" We use that as a measure of religiosity.

The ISSP is also our source for church attendance rates. Church attendance trends are those calculated by Iannaccone (2002) using the same retrospective questions we used to build the religiosity measure. Using the 1991 and 1998 wave of the ISSP-the only two waves to ask the retrospective questions- Iannaconne builds a time series of church attendance rates for the 31 countries sampled by the ISSP. That time series covers the 1940s through the 1990s. By careful analysis and crossvalidation, Iannaccone (2002) finds that the patterns of attendance built from the retrospective questions are reliable and remarkably consistent.

From the WDI we obtain Total Fertility Rates, population, education and female labor force participation.[13]

6. Estimation

Before turning to estimates, a preliminary look at these data are instructive. Figure 4 reports on the absolute number of nuns in France, Germany, Italy and Spain between 1960 and 2000, illustrating that the European pattern of attrition after Vatican II mimics that described in the literature for the U.S. In Italy and Germany the number clearly peaks in 1965, the last year of Vatican II, then declines sharply afterwards. France shows a peak in nuns in 1960 after a

[11] Unfortunately, the *Annuario Ponteficio*, dating back to 1959, reports data only at the disaggregated diocesan level, without regional or national aggregation. In 1970 the Vatican began publishing aggregates in the *Annuarium Statisticum Ecclesiae*.

[12] For details see www.issp.org .

[13] For validation of WDI fertility figures, we also used the ISSP to obtain an approximate measure of completed fertility, using a series of questions about the number of children living in the household. To assess its quality, we compared the ISSP fertility measure with that from obtained by using data from the 1998 wave of the Survey of Italian Households' Income (SIHIW) run by Bank of Italy. The ISSP reported 1.31 children at home whereas the SIHIW reported 1.29 children, both of which are very close to the Italian TFR of 1.19 in 1998. The two surveys also give very similar results in a regression of children on years of education and other personal characteristics, suggesting that the fertility measure and the ISSP sample altogether are remarkably consistent.)

previous increase (not shown) and a sharp decline following 1965. In Spain, rapid growth through 1965 is followed by deceleration and then decline after 1970.

Figure 5 reports on both nuns per capita and fertility per capita for Ireland, foreshadowing the estimation results below. Ireland shows a clear peak in nuns per capita in 1965 (mirroring Italy and Germany in the previous figure), which corresponds to a peak in total fertility rates (shown in the right panel).

Note how rapid the onset of clergy attrition is in Italy, Spain, Germany and Ireland, changing from persistent growth to rapid decline between 1965 and 1970 (Figures 4 and 5). We see this as evidence that Vatican II had an immediate effect, over and above any broad trend in the general culture's attitude towards clergy.

Figure 6 reports on church attendance rates, our measure of religiosity, for the same three categories of countries reported in Figure 1 of the introduction, between 1960 and 1990. Note that all European countries have experienced declines in church attendance (and in other indicators of religiosity –not shown). Figure 2 reports declining Church attendance in European countries between 1960 and 1990. While attendance fell by over twenty percentage points in the Protestant countries, the decline in the Catholic countries was only ten percentage points over that 30 year period. Explanations for declining Catholic fertility, relative to that of Protestants, must come from some mechanism other than declining religiosity.

Estimating Equation

We begin by constructing an estimating equation for the demand for fertility derived in Section 4, then aggregate it to correspond to the country level data we observe.

For an individual woman, i, we posit a linear version of (4), the demand for fertility,

$$(5) \qquad f_{it} = \alpha_s + \beta^r a_{it} + \theta^r q_{st} + \gamma^r a_{it} q^r_{st} + \delta_t + \eta_{it}$$

where the superscript r and the subscript s index religious groups, in our case Catholics and non-Catholics: $r \in (C,NC)$. , $s \in (C,NC)$. Attendance is an individual characteristic, while quality of service provision is common to coreligionists.

Restating the predictions of our framework in terms of estimated coefficients for Catholics, we have three items of interest. The attendance effect on fertility includes the effect of religiosity through opportunity costs, the effect of religiosity through norms, and the effect of religiosity through preferentially reduced costs of raising children for church attendees. We posit that it is positive, assuming that substitution effects dominate income effects in the wage term.

$$(4.1) \quad \frac{df}{da}\Big|_q = \frac{\partial f}{\partial w}\frac{dw}{da} + \frac{\partial f}{\partial \pi}\frac{d\pi}{da} + \frac{\partial f}{\partial \lambda}\frac{d\lambda}{da} = \beta^r + \gamma^r q > 0 .$$

The nuns per capita effect on fertility includes both neutral reduced costs of raising children for nonattendees, and the preferentially reduced costs for attendees,

$$(4.2)\quad \frac{df}{dq}\Big|a \;=\; \frac{\partial f}{\partial \lambda}\frac{d\lambda}{dq} = \;\theta^r \;+ \gamma^r a \;>\; 0\,.$$

The interaction coefficient, which captures the fertility increase due to preferentially reduced costs of raising children for attendees,

$$(4.3)\quad \frac{\partial^2 f}{\partial a \partial q} = \frac{\partial f}{\partial \lambda}\frac{\partial^2 \lambda}{\partial a \partial q} = \;\gamma^r > 0\,.$$

We seek estimates of β^C, γ^C and θ^C, which will capture, respectively, the effects of norms and theology, service provision, and preferential service provision for attendees.

Aggregating (5) for Catholics in a particular country, c, is straightforward,

$$(5')\qquad f_{Cct} = \alpha_{Cc} + \beta^C a_{Cct} + \theta^C q_{Cct} + \gamma^C a_{Cct}\, q_{Cct} + \delta_t + \eta_{Cct}\,.$$

Turning now to measurement, our proxy for religiosity, a, is church attendance rates, as is standard in the literature. Social service provision for Catholics is, q_C, is proxied by nuns per Catholic, recalling the discussion above of the critical role that nuns played in staffing hospitals day care centers, schools and welfare services.

Unfortunately, we lack estimated fertility rates for Catholics by country, and the ISSP does not provide precise estimates of church attendance rates for Catholics separately, forcing us to use aggregate fertility as a left hand side variable and to approximate religion specific church attendance rates with national church attendance rates.

National fertility rates can be expressed as the weighted average of Catholic and Non-Catholic specific rates, where P_c is the Catholic proportion of the population (this proportion is well approximated as time-invariant during the relevant period), i.e., $f_{ct} = P_c f_{Cct} + (1\text{-}P_c) f_{NCct}$.

Substituting in (5') and the equivalent equation for non-Catholics yields

$$\begin{aligned} f_{ct} = {} & P_c\,[\alpha_{Cc} + \beta^C a_{Cct} + \theta^C q_{Cct} + \gamma^C a_{Cct}\, q_{Cct} + \delta_t + \eta_{Cct}\,] \\ & + (1\text{-}P_c)\,[\alpha_{NCc} + \beta^{NC} a_{NCct} + \theta^{NC} q_{NCct} + \gamma^{NC} a_{NCct}\, q_{NCct} + \delta_t + \eta_{NCct}\,]. \end{aligned}$$

Assuming $a^C{}_{ct} = a^{NC}{}_{ct} = a_{ct}$, and substituting, we get

$$f_{ct} = \alpha_c + \beta^{NC} a_{ct} + (\beta^{NC} - \beta^C) P_c a_{ct} + \theta^C P_c\, q_{Cct} + \gamma^C a_{ct}\, P_c q_{Cct} + \delta_t + \varepsilon_{ct}\,,$$

where all the time-invariant terms are captured in a country effect $\alpha_c = P_c\,\alpha_{Cc} + (1\text{-}P_c)\,\alpha_{NCc}$, and the error term includes all terms involving unmeasured quality of non-Catholic social services, $\varepsilon_{ct} = (1\text{-}P_c)\,[\,\theta^{NC} q_{NCct} + \gamma^{NC} a_{NCct}\, q_{NCct}\,] + \eta_{Cct} + \eta_{NCct}$. These omitted variables will cause a bias in a fixed effects specification only if the changes in family-friendly services available to non-Catholics are correlated with changes in the number of nuns per Catholic.

Denoting nuns per capita as n_{ct} and noting that $n_{ct} = P_c\, q_{Cct}$, we simplify our estimating equation to

$$(6)\qquad f_{ct} = \alpha_c + \beta^{NC} a_{ct} + (\beta^C - \beta^{NC}) P_c a_{ct} + \theta^C n_{ct} + \gamma^C a_{ct}\, n_{ct} + \delta_t + \varepsilon_{ct}\,.$$

Estimates

Table 2 contains summary statistics for the variables included in equation (6). We estimate in first differences in order to allow for nonstationarity in the error (ε_{ct}) so means are reported in first differences. We use five year intervals to reduce measurement error. Total fertility declined by an average of 0.14 children per woman over each five year interval from 1960 through 2000, a cumulative decline of 1.12 lifetime children. Nuns per capita, church attendance and their interaction all showed declines, but with considerable variation across countries.

Table 3 reports estimated effects of religiosity and service provision (partial derivates (4.1) and (4.2)) for a panel of 14 European countries between 1960 and 2000. Religiosity alone, as proxied by current church attendance, does not significantly predict fertility, when we pool across countries with different mixes of Catholics and Protestants, as reported in column (1). That result changes when we allow a separate coefficient for Catholics, which yields a statistically significant point estimate of 0.02 (column (2)). That's a large estimate, suggesting that in a (hypothetical) entirely Catholic country, a ten percentage point decline in church attendance predicts a TFR reduction of 0.2 children. That result is not altered by including a measure of female labor force participation (column (3)), which suggests that the effect of religiosity through raising opportunity costs of work is negligible.

Referring back to equation (4.1) in the framework section, estimates in these first three columns provide strong evidence against any effect of religiosity on fertility for Protestants, either through norms and theology ($\frac{\partial f}{\partial \pi}$) or through service provision and the cost of raising children ($\frac{\partial f}{\partial \lambda}$). For Catholics, on the other hand, the sum of those effects is large and positive, though the analysis does not allow us to distinguish between mechanisms. That difference between the estimated effects for Protestants and Catholics is therefore consistent with either stronger pronatalist norms among Catholics or stronger service provision among Catholics, or both.

One caveat is the possibility of reverse causality: church attendance might be affected by fertility if parents attend church because they feel it benefits their children[14]. If so, it would be hard to explain why that mechanism appears for Catholics but not for Protestants.

What about service provision? The right three columns of the table report estimates of the derivative in (4.2), showing very strong evidence of an effect of service provision (as proxied by nuns/capita) on fertility. Each nun per capita yields a large and statistically significant coefficient ranging from 383 to 408 children, a result that is robust across specifications. These coefficients can be interpreted as children per nun since both fertility and nuns per capita are normalized by population. Of course these are only estimates and should be treated with caution. The standard error on the children per nun estimate in column (4) is 124 children. Nevertheless, the magnitude

[14] The ISSP data provides an excellent resource to further test for this endogeneity bias, because it provides retrospective church attendance data dating back many years. A lag would allow some time for religious human capital accumulation, religious social capital accumulation, and fertility preference formation by individuals so that fertility in the childbearing years can be influenced by attendance in childhood. The same regression using church attendance (as children) with 10 or 15 year lags also yields statistically insignificant coefficients (Table 4). The results are also robust to adding years of education for women aged 15+ (from the Barro-Lee data) as an alternative measure of the economic opportunities of women. The estimated coefficient is positive but insignificant.

is remarkably large if we were to hazard a causal interpretation (more on that below). Apparently the vows that nuns took not to bear their *own* children are more than compensated for by their effect on the fertility of others!

Before proceeding, a comment on statistical inference is necessary. Calculating standard errors and statistical significance is complicated by the small number of countries in the sample (14) so that asymptotic approximations rely on the NxT rather than N. We report standard errors clustered by country over time, corrected for the possibility of poor asymptotic approximation of a normal distribution by the jacknife-equivalent procedure proposed by Bell and McCaffrey (2002), which corresponds to the "CR3" standard errors of Cameron, Gelbach, and Miller (2008). Critical values used to denote statistical significance are those of a t-distribution with thirteen (the number of countries minus one) degrees of freedom. We have validated the statistical significance of these results using the alternative "wild bootstrap" procedure of Cameron, Gelbach and Miller (2008), which is designed to treat the same small-sample problem, but has lower power. Rejection probabilities (p-values) using that procedure are quite similar in general. (The two cases in which they differ are noted in footnotes below.)

Having established that both attendance and service provision predict increased fertility, we now turn to attempting to distinguish between mechanisms by estimating equation (6), which includes an interaction term. The positive religiosity effect ($\beta^C + \gamma^C q$) could be due to either norms β^C or conditional service provision, $\gamma^C q$ (recalling that the opportunity cost term in (4.1) had been removed by conditioning on labor force participation). The pronatalist service provision effect ($\theta^C + \gamma^C a$) could be either unconditional, θ^C, or conditional, $\gamma^r a$.

Table 4 reports on our attempts to test the conjecture of conditional service provision by estimating equation (6), which includes as a regressor the interaction of nuns/capita with our estimate of Catholic attendance. The theory of conditional service provision provides no guidance as to *when* in one's life a member of a congregation signals religiosity in order to gain access to services. Is it current religiosity that matters for a mother, or perhaps religiosity signaled at the age of communion, or in between? We remain agnostic on this point and report interactions of nuns/capita with current attendance, attendance lagged ten years, and attendance lagged fifteen years. The first column repeats the specification in Table (3) for comparison (383 children per nun). Columns (2) through (4) report that we unfortunately lack sufficient precision to estimate both a service provision coefficient, θ^C, and an interaction, γ^C when using current attendance as our measure of religiosity. While the interaction terms persistently have positive signs, suggesting conditional service provision, none of the three are statistically different from zero. Unfortunately, in this specification the "main" effects of service provision and religiosity also yield statistical zeros as estimates, so that nothing can be learned.

Further inference requires a compromise. Estimates of attendance are available only through 1990, so that dropping current attendance rates from the regression allows two more five year periods to be added to the estimation panel, 1990-95 and 1995-2000. If we drop the current attendance term from the regression, replacing it with lagged attendance, then we can gain some precision in estimating the interaction coefficient. That exercise is pursued in columns (5) through (7), using the full sample of five-year differences between 1960 and 2000 (eight differences x thirteen countries for a total of 104 observations). Column (5) reports the baseline

regression for the full panel, reporting a statistically significant coefficient on nuns/capita of 296 children per nun. That estimate is a little smaller than the estimates in Table 3 using the shorter sample period, but not statistically different.

The next column reports coefficients on nuns per capita, attendance lagged ten years, and the interaction of nuns/capita and lagged attendance. In this case the interaction has a large and statistically significant coefficient of 17.7. The main effect of nuns per capita is large and negative[15], and that of attendance is also statistically negative. To put the interaction coefficient in context, at an attendance rate of 82% (the Catholic average in 1960), each nun would account for (82x17.7 - 1032) = 419 children, which is consistent with previous estimates.

At the fifteen year lag the interaction term is also statistically significant, at 10.8, though the two main effects (nuns and attendance) are not. We conclude that service provision may well have been conditional on attendance, as the evidence from the longer sample period indicates.[16] If we concentrate on that longer sample period, mindful of the compromise of dropping the current attendance term, the negative estimated coefficient on nuns per capita in columns (6) and (7) provide evidence against a positive unconditional fertility effect of service provision, forcing us to conclude that $\theta^C = 0$ in (4.2).

While this table provides no evidence to refute the conjecture of an effect of norms or theology on fertility, a parsimonious explanation for all the results would simply be that service provision is both fertility increasing and conditional on observed religiosity, i.e., that $\gamma^C > 0$ in (4.3).

An alternative way of looking at these results is to ask how much of unexplained decline in European fertility a decline in Catholic service provision can account for. Column (8) of Table 4 reports on the explanatory power of female labor force participation, which is a well established predictor of reduced fertility. The constant in that regression predicts a decline in fertility of -0.101 per five year period once increased labor force participation by women is accounted for, or an unexplained reduction of 0.808 lifetime children over the eight five-year intervals between 1960 and 2000. These figures can only provide a rough estimate, as the constants in these regressions are not precisely estimated, but comparing the constant in column (5) to that in column (8) indicates that about 30 percent of that unexplained reduction [(0.101-0.071)/0.101], or 0.24 predicted children per woman, is accounted for by reduced service provision by the Catholic Church. Given the likely attenuation bias in our estimates –due to noisy measures of the change in nuns/Catholic, that predicted fertility reduction due to a decline in service provision may well be an underestimate.

Are these results heavily influenced by particular countries? Figure 7 illustrates scatterplots of changes in fertility against changes in the key variable, nuns/capita interacted with

[15] The null hypothesis that the coefficient on nuns/capita (estimated as -1032) is zero is rejected at 5% using CR3, but has a p value of only 0.098 using the "wild bootstrap." See Cameron, Gelbach and Miller (2008) for details.
[16] As before, these results are virtually unchanged by removing female labor force participation from the right hand side, suggesting that the religious norms and prohibitions mechanism operating through effective wages (in the model outlined above) is relatively unimportant.

lagged church attendance, with a regression line reporting the slope of the coefficient on nun/capita in Table 3, column (6). (These are "leverage" plots from the Frisch-Waugh regression). The figure labels observations by the final year of the five year difference, showing that the variation driving the regression is indeed that which occurred in the period immediately after the Second Vatican Council, from 1965-70 and from 1970-75. Figure 8 illustrates the same data, with the observations labeled by country, showing that while Ireland is important, Spain, Portugal and the Netherlands also contribute to the positive coefficient. As a further check on the importance of particular countries we have rerun the regressions omitting one country each time, and found that the results are essentially the same. (The regression coefficient on nuns/capita omitting Ireland is 365 (p=0.01).

A key assumption in our model is that nuns proxy for social service provision rather than influencing preferences for fertility through theological service provision. That assumption is difficult to test directly and cannot be literally true. An alternative way to gauge the relative importance of theological versus social services is to compare the influence on fertility of priests, as opposed to nuns. The division of labor in Catholic communities is such that a disproportionate amount of theological services are provided by priests, while most social services are provided by nuns. Attrition of priests and attrition of nuns since the Second Vatican Council is highly correlated, but not perfectly so, allowing the possibility of estimating separate coefficients for priest/capita and nuns/capita, in (4.2).

The results of that exercise are reported in Table 5. Column (1) reports the baseline specification from Table 3. Column (2) shows the same specification with priests per capita replacing nuns per capita. The coefficient is positive, like that for nuns, but very imprecisely estimated. The positive coefficient is not surprising as the correlation of these two variables is quite high, so priests could easily proxy for the omitted variable "nuns." A third specification runs a "horserace," estimating the partial regression coefficient of priests/capita with nuns/capita included in the equation. The coefficient on the nuns is large (508 children), and positive, but not statistically significant, while that on priests is negative and also statistically insignificant. Columns (4) through (6) of the Table repeat these specifications, but make use of the entire sample of observations through 2000 by dropping the current attendance rate variable (which is available only through 1990), as in Table 4.[17] The results remain qualitatively the same: nuns strongly predict fertility while priests do not, though the coefficient on priests is very imprecisely estimated. In column (3) the nun and priest coefficients are not statistically different, while in column (6) they are at $p < .1$.[18] These results are not conclusive but again suggest that the social service provision mechanism is more important than the theological mechanism in affecting fertility.

The results in Table 5 also provide evidence against the political mechanism we conjectured in Section 4. It seems unlikely that nuns are more effective than priests in lobbying for increased public spending on low cost childrearing programs.

[17] The null hypothesis that the coefficient on nuns/capita (estimated as -1032) is zero rejected at 10% using CR3, but has a p value of only 0.13 using the "wild bootstrap." See Cameron, Gelbach and Miller (2008) for details.
[18] A test for equal coefficients in column (6) yields a p value of 0.61 using CR3 and 0.49 using the wild bootstrap.

Is the estimate too large?

Four hundred children per nun appears to be an unreasonably large estimate. We provide two possible explanations, one from the theory of fertility transitions and another from an organizational theory of religious institutions.

Consider a Becker (1991) style quality-quantity model, which is designed to explain rapid fertility transitions. A natural way to illustrate the logic is to augment the household budget constraint in section 4 above by adding home production, as in Gronau (1977). For instance, meals could be cooked at home rather than purchased, or household maintenance could be self-provided with home work hours rather than subcontracted to hired help. Assume a home production function $g(H_h)$ which is increasing and concave, and that work hours are now split between two home and market categories, $H = H_h + H_m$. This extension is solved by maximization in stages: the household first chooses how much to work at home by setting market wages equal to the marginal product of the last hour of home work, $w=g'(H_h^*)$, to define the optimal budget constraint (should $T > H_h^*$, otherwise $H_m=0$). In the second stage the household optimally chooses consumption and fertility, as in Section 4 above.

Figure 9 illustrates the resulting budget constraint, which has a concave portion at the lower right, reflecting home production, and a convex portion at the upper left due to per-capitization of consumption. As the Figure illustrates, this budget constraint admits multiple equilibria, at both A and B on the same indifference curve, since it has a range between those two points in which the marginal cost of an additional child in foregone consumption per capita (quality) decreases. Though they share the same utility level, families at A and B enjoy very different lifestyles, with the mother in A choosing low fertility and work in the market, while the mother in B chooses high fertility and work at home.

The Figure provides a clear illustration of Becker's approach to fertility transition. As wages increase, the budget constraint stretches vertically to higher intercept along the y-axis, allowing higher consumption to working mothers. As that process continues, should children not be a luxury good, at some high wage all optima B for working mother would be dominated.

Now consider the effect of increasing the time costs of childrearing, λ, for families in the midst of a fertility transition, indifferent between equilibria at A and B. The utility cost of increasing λ at B are much higher than those at A, since they apply to more children. Both families would respond by shifting to the unique optimum at C, at low fertility. The formerly high fertility family shifting from B to C would experience a sharp decline in fertility due to a very small change in the cost of raising children.

In summary, a society experiencing the fertility transition as modeled by Becker would have a high proportion of families close to indifferent between high and low fertility lifestyles. For those families, small changes in childrearing costs due to the removal of the subsidy that nuns provided could have triggered a sharp reduction in fertility.

An alternative explanation for the large fertility decline might come from the important role nuns played managing, as well as staffing, faith-based social service provision. These institutions typically include a permanent staff of clergy, often supervising lay employees and

volunteers. The sudden loss of these experienced managers might have sharply reduced the quality of services provided by schools, health care facilities and other social service providers. We think of this as a complementary explanation.

Discussion

A clear conclusion from these estimates is that the service provision model of European fertility decline is strongly supported by the data. Declining religiosity may play a role, though only for Catholics, and even so the evidence for a religiosity effect might alternatively be interpreted as evidence that family-friendly social services were preferentially provided to families demonstrating religiosity.

The evidence for preferential service provision is strong in the 40 year sample, though not statistically significant in the shorter sample, yet it does provide a parsimonious explanation for all the results. Referring back to the literature, a decline in Catholic service provision, preferentially provided to church attendees, is also capable of explaining the anomaly in Adsera (2004) for Spain, where religiosity is uncorrelated with fertility, and the level of nuns/catholic has always been relatively low. That interaction effect might also explain the why Westoff and Jones (1979) find that communion and fertility are positively correlated in the 1950s and 1960s for U.S. Catholics, but not in the 1970s, by which time inexpensive service provision by the Catholic Church had declined in the U.S. (Stark and Finke 2000). Taken together, it seems likely not only that family friendly Catholic services were fertility enhancing, but also that these services were preferentially provided to families of churchgoers, creating an attendance-fertility correlation.

7. Conclusions

We have proposed a novel resolution to the Southern European fertility puzzle - the unprecedented and rapid transition to low fertility despite low female labor force participation. Our review of past research on social service provision in communal religions and our empirical results indicate that declining social service provision by the Catholic Church since the Second Vatican Council induced substantial decline in fertility among European Catholics. Declining religiosity also predicts fertility decline –though only among Catholics. That pattern seems to be particularly strong when church social service provision was extensive, suggesting that religiosity (i.e., church attendance) affected fertility by allowing preferential access to family-friendly social services.

The evidence suggests that this fertility effect is due less to changing preferences or norms –the conventional wisdom-- than it is to an institutional decline which withdrew family-friendly social services traditionally provided to Catholic communities. Otherwise it is hard to explain why the withdrawal of social service provision, as measured by nuns/capita, predicts so strongly the fertility decline among European Catholics. That interpretation is consistent with the literature linking low fertility to the lack of family-friendly institutions for the children of working mothers in contemporary Italy and other Southern European countries (Del Boca 2002,2003). It may be that receding Church services left a vacuum in family-friendly social service provision long since filled by government in northern European countries.

Supporting evidence for this interpretation comes from Chou (2011), which studies second generation immigrants in the US: those from Catholic majority countries in Europe experienced a fertility decline well predicted by declining fertility in their parents' country of origin. Tellingly, that trans-Atlantic correlation exists even though the fertility decline in Europe occurred after their mothers' emigration.

Understanding how social service provision affects fertility may be critical to understanding fertility trends among European Catholics and to projecting European demographics over the next generation. Moreover, the implications extend beyond the half-billion residents of Europe or even the billion Catholics worldwide. The populations and leaders of less developed countries look to Europe and wonder whether prosperity and greatly increased female labor market participation inevitably imply graying populations and demographic decline. These inferences may not be warranted if, as we find, rapid fertility decline in Catholic Europe is not so much due to economic development, female labor force participation, or even secularization, as it is due to the loss of Church-provided family-friendly social services. That finding has important public policy implications. Religious groups may strongly support social service provision in some times and places, but very different institutional arrangements may be required to support their continued provision in changing or different cultures. Our conclusions might therefore be important for any society facing rapid economic and social change, and especially for societies in which women are increasingly torn between labor market opportunities and the high shadow cost those impose on child care. That tension may be much greater the less support is available from religious communities, other social networks, markets, or governments.

References

Adsera, Alicia, (2006). "Religion and Changes in Family-Size Norms in Developed Countries," *Review of Religious Research*, 47:3, 271-286, (March).

_____, (2006). "Marital Fertility and Religion in Spain," *Population Studies*, 60:2, 205-221, (July).

Ahn, N., and Mira P., (2002), "A note of the relationship between fertility and female employment rates in developed countries" *Journal of the Population Economics*, 14 (Spring).

Akerlof, George A., and Rachel E. Kranton, (2000). "Economics and Identity," *Quarterly Journal of Economics, 115:3, 715-53*.

Akerlof, George A., and Rachel E. Kranton, (2010). *Identity Economics*, Princeton: Princeton U. Press.

Barrett, David B**.** *World Christian Encyclopedia*. Nairobi: Oxford University Press, 1982.

Becker, Gary. (1991). *A Treatise on the Family*, Harvard University Press, Cambridge, MA.

Becker, Gary, and Lewis, H.G., (1973), "On the Interaction between the Quantity and Quality of Children_, *Journal of Political Economy,* 81

Becker, Gary, and Kevin M. Murphy. (2000). *Social Economics: Market Behavior in a Social Environment*. Cambridge, Mass. ; London: Belknap Press of Harvard University Press.

Bell, R. M. McCaffrey, D. F.. (2002). "Bias Reduction in Standard Errors for Linear Regression with Multi-Stage Samples," *Survey Methodology*, 28(2), pp. 169-182.

Berman, Eli. (2000). Sect, Subsidy and Sacrifice: An Economist's View of Ultra-Orthodox Jews. *Quarterly Journal of Economics* 115 (3):905-953.

_____. (2009). *Radical, Religious and Violent: The New Economics of Terrorism*, Cambridge: MIT Press.

Berman, E. and Stepanyan A. "How Many Radical Islamists? Indirect Evidence from Asia and Africa," UCSD mimeo, 2003.

Bettio, F., Villa, P., (1998), "A Mediterranean Perspective on the Break-down of the Relationship between Participation and Fertility" *Cambridge Journal of Economics*, 22, 137-171.

Bongaarts, J., (1999) "Fertility Decline in the Developed World: Where will it end?," *American Economic Review*, *Papers and Proceedings*, 89(2), 256-260.

Bryk, Anthony S.; Lee, Valerie E. and Holland, Peter Blakeley. *Catholic Schools and the Common Good*. Cambridge, Mass.: Harvard University Press, 1993.

Cameron, A. Colin, Jonah B. Gelbach and Douglas L. Miller, 2008. "Bootstrap-Based Improvements for Inference with Clustered Errors," *The Review of Economics and Statistics*, 90(3), pp. 414-427.

Chou, Tiffany (2011) "Is Fertility Decline Contagious? Trans-Atlantic norm shifts and fertility in the post-Vatican II period," UC San Diego mimeo.

de Laat, J., and A. Sevilla-Sanz, (2004) "Working Women, Husband's Home Time, and Lowest-Low Fertility in Europe," Brown U. mimeo, January.

Del Boca, D., (2002), "The Effect of Child care and Part Time on Participation and Fertility of Italian Women", *Journal of Population Economics*, 14.

_____, S. Pasqua, and C. Prozanto, (2003), "Analyzing Women's Employment and Fertility Rates in Europe: differences and similarities in Northern and Southern Europe," CHILD mimeo.

Dolan, Jay P. (1985). *The American Catholic Experience: A History from Colonial Times to the Present*. 1st ed. Garden City, N.Y.: Doubleday.

Durkheim, Emile. [1915] 1965. *The Elementary Forms of the Religious Life*. Translated by J. W. Swain. New York, NY: Free Press.

Fialka, John J. *Sisters : Catholic Nuns and the Making of America*. New York: St. Martin's Press, 2003.

Froehle, Bryan and Gautier, Mary. *Global Catholicism : Portrait of a World Church*. Maryknoll, N.Y.: Orbis Books, 2003.

Giuliano, Paola (2007). Living Arrangements in Western Europe: Does Cultural Origin Matter? *Journal of the European Economic Association*, 5(5): 927-952.

Grant, Mary A. and Hunt, Thomas C. Catholic School Education in the United States : Development and Current Concerns. New York: Garland Pub., 1992.

Greeley, Andrew M. (1977). *The American Catholic: A Social Portrait*. New York: Basic Books.

———. (1989). *Religious Change in America*. Cambridge, MA: Harvard University Press.

Greeley, Andrew M., William C. McCready, and Kathleen McCourt. (1976). *Catholic Schools in a Declining Church*. Kansas City: Sheed and Ward.

Gronau, Reuben (1977). "Leisure, Home Production, and Work –the Theory of the Allocation of Time Revisited," Journal of Political Economy, 85(6), 1099-1123.

Hoge, Dean R., and Jacqueline E. Wenger. (2003). *Evolving Visions of the Priesthood : Changes from Vatican Ii to the Turn of the New Century*. Collegeville, Minn.: Liturgical Press.

Hout, Michael, and Andrew M. Greeley. (1987). "The Center Doesn't Hold: Church Attendance in the United States, 1940-1984." *American Sociological Review* 52 (3):325-345.

Hunt, Thomas C.; Joseph, Ellis A. and Nuzzi, Ronald James. *Handbook of Research on Catholic Education*. Westport, Conn.: Greenwood Press, 2001.

Iannaccone, Laurence R. (1992). Sacrifice and Stigma: Reducing Free-Riding in Cults, Communes, and Other Collectives. *Journal of Political Economy* 100 (2):271-292.

———. (1999). "Religious Extremism: Origins and Consequences." *Contemporary Jewry* 20:8-29.

Iannaccone, Larry (2007), Looking Backward: A Cross-National Study of Religious Trends, Working Paper presented at the Association for the Study of Religion, Economics and Culture, Tampa.

Lee, James Michael and Piveteau, Didier J. *Catholic Education in the Western World*. Notre Dame: University of Notre Dame Press, 1967.

Lehrer, Evelyn. (1995). The Effects of Religion on the Labor Supply of Married Women. *Social Science Research* 24:281-301.

Lehrer, Evelyn L. (1996). "Religion as a Determinant of Marital Fertility". *Journal of Population Economics* 9 (2):173-196.

Munoz-Perez, F. (1989) "The Decline of Fertility in Southern Europe," *Population: An English Selection*, 44(1), pp. 261-290.

Rosenzweig, M.R. and T. Paul Schultz, (1985) "The Demand and Supply of Births," *American Economic Review*, 75 pp. 992-1015.

Sander, W. (1992) "Catholicism and the Economics of Fertility." *Population Studies* 46, p.477-489.

Secretaria Status, Rationarium Generale Ecclesiae, The Vatican (various years) *Annuarium Statisticum Ecclesiae*, Tipografia Poliglotta Vaticana, Vatican City.

_____ *Annuario Pontificio*, 1912-1976, Tipografia Poliglotta Vaticana, Vatican City

_____ *Annuario Pontificio*, 1977-2002, Libreria Editrice Vaticana, Vatican City

Schoenherr, Richard A., and Lawrence A. Young. (1993). *Full Pews and Empty Altars: Demographics of the Priest Shortage in United States Catholic Dioceses*. Madison: University of Wisconsin Press.

Smith, Adam. (1965). *An Inquiry into the Nature and Causes of the Wealth of Nations*. New York: Modern Library. [Original edition, 1776.]

Stark, Rodney, Daniel P. Doyle, and Lori Kent. (1980). "Rediscovering Moral Communities: Church Membership and Crime." In *Understanding Crime: Current Theory and Research*, edited by T. Hirschi and M. Gottfredson. Beverley Hills, CA: Sage.

Stark, Rodney, and Roger Finke. (2000). *Acts of Faith: Explaining the Human Side of Religion*. Berkeley: University of California Press.

Stolzenberg, Ross M., Mary Bair-Loy, and Linda J. Waite. (1995). "Religious Participation in Early Adulthood: Age and Family Life Cycle Effects on Church Membership". *American Sociological Review* 60 (1):84-103.

Warner, Carolyn M. *Confessions of an Interest Group: The Catholic Church and Political Parties in Europe*. Princeton, N.J.: Princeton University Press, 2000.

Weber, Max, (1946). "The Protestant Sects and the Spirit of Capitalism," in Max Weber, *From Max Weber: Essays in Sociology*, trans. and ed. by H.H. Gerth and C. Writght Mills. New York: Oxford University Press.

Westoff, Charles F., and Elise F. Jones. (1979). The End of "Catholic" Fertility. *Demography* 16 (2):209-217.

Wilde, Melissa J., (2007). *Vatican II: A Sociological Analysis of Religious Change*. Princeton: Princeton University Press.

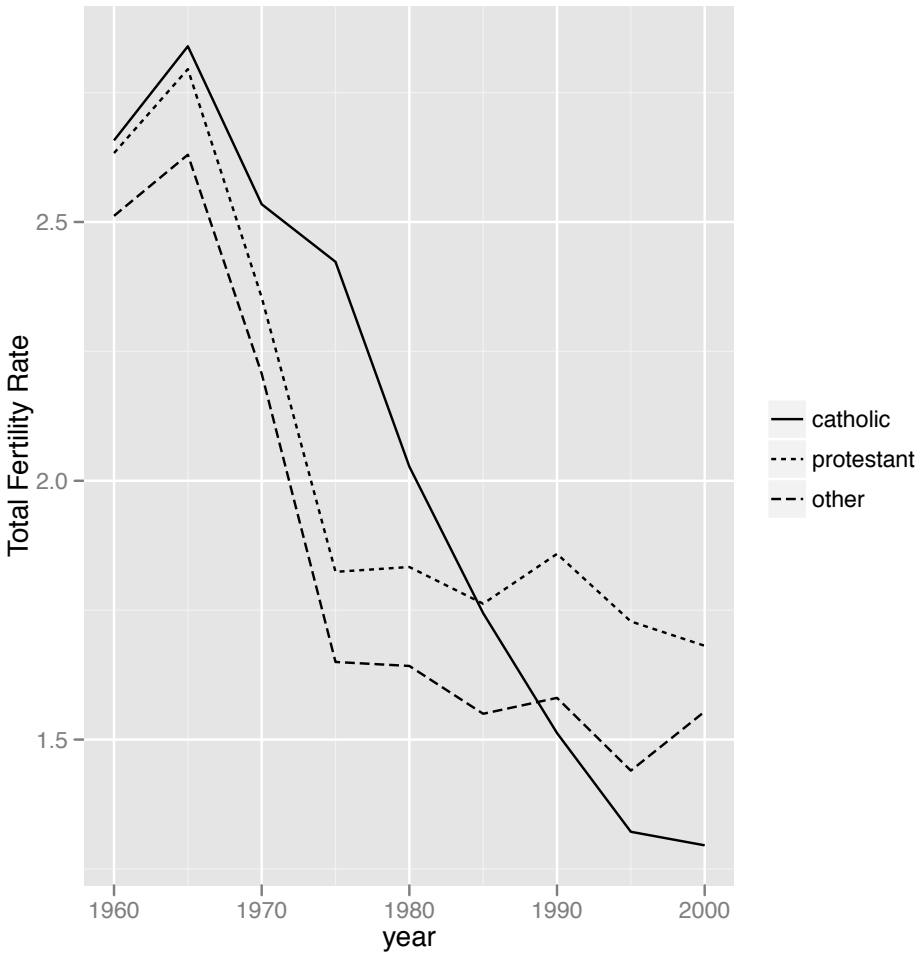


Figure 1: Western European fertility

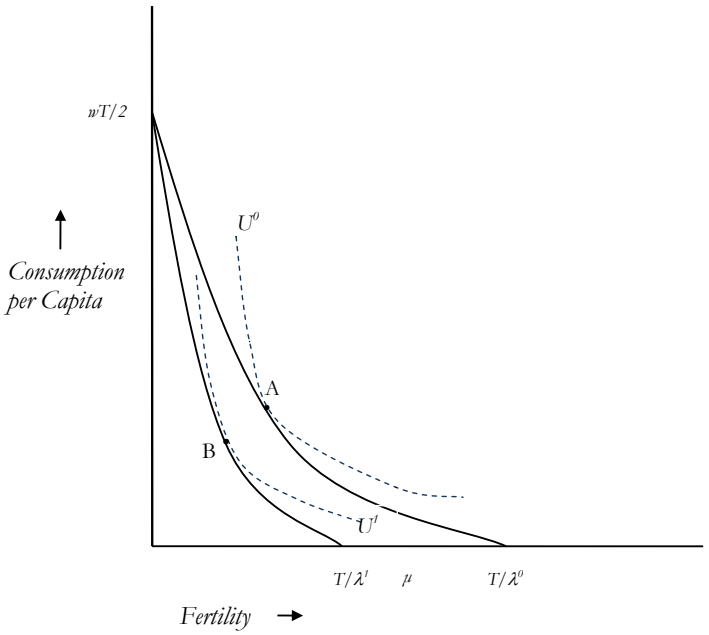


Figure 2: Fertility and childbearing costs

** **Agra** (1 sett. 1886), *Agraen(sis)* – Metr. – *Ord. d'app.:* Dehli – (Indirizzo: Archbishop's House, Agra, India).

Ch. 11; parr. 6; sac. d. 3; sem. 1; sac. r. 8; sac. n. . . .; crm. 1-3; crf. 4-36; iem. 7-1.436; ief. 7-1.317; iac. 5-247; catt. 3.205; ab. 11.000.000; sup. 62.160 (a. 1959).

✠ DOMINIC ROMUALD BASIL **Athaide,** dei Frati Minori Cappuccini, n. in Bandra, arcid. di Bombay, 7 febb. 1909; ord. 26 mar. 1932; el. 29 febb. 1956; cons. 20 magg. 1956.

Vicario Generale: R. P. Lawrence Colaso, O. F. M. Cap.

Agram, *v.* Zagreb.

Agria, *v.* Eger.

Agrigento (sec. 1), *Agrigentin(us)* – suffr. di Monreale – (Indirizzo: Vescovado, Agrigento, Italia).

Ch. 388; parr. 154; sac. d. 320; sem. 48; sac. r. 83; sac. n. 9; crm. 26-115; crf. 68-730; iem. 22-1.250; ief. 28-1.600; iac. 54-1.538; catt. 467.520; ab. 469.864; sup. 3.042 (a. 1955).

✠ GIOVANNI BATTISTA **Peruzzo,** dei Passionisti, n. in Molare, dioc. di Acqui, 14 lu. 1878; ord. 13 genn. 1901; el. alla Ch. tit. di Eurea 18 genn. 1924; cons. 10 febb. 1924; tr. a Oppido Mamertina 19 ott. 1928 ed a q. s. 15 genn. 1932; con titolo personale di Arciv. 29 mar. 1952 (Ass. al Soglio).

Coadiutore « sedi datus »: S. E. R. Mons. Francesco Fasola, Vesc. tit. di Vartana.

Vicario Generale: Mons. Calogero Cumbo.

Figure 3: Excerpt from the Vatican Statistical Annual (1960)

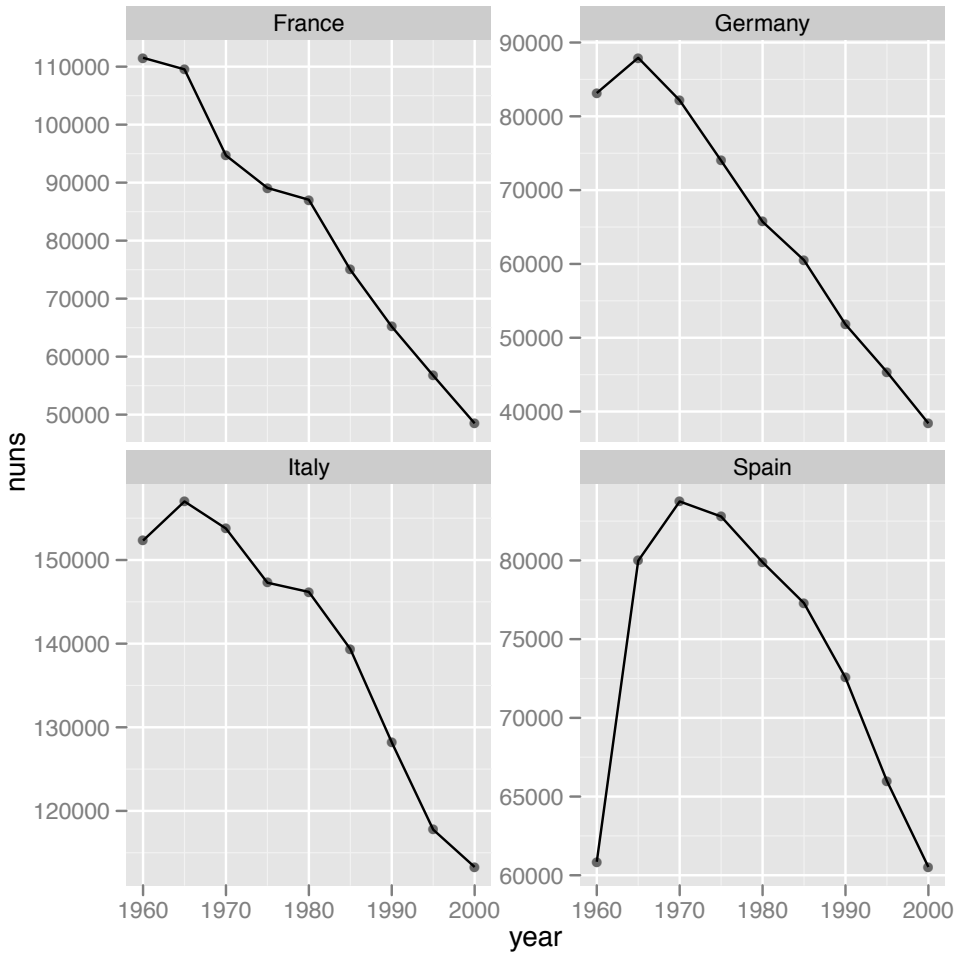


Figure 4: Nuns in France, Germany, Italy and Spain (1960-2000)

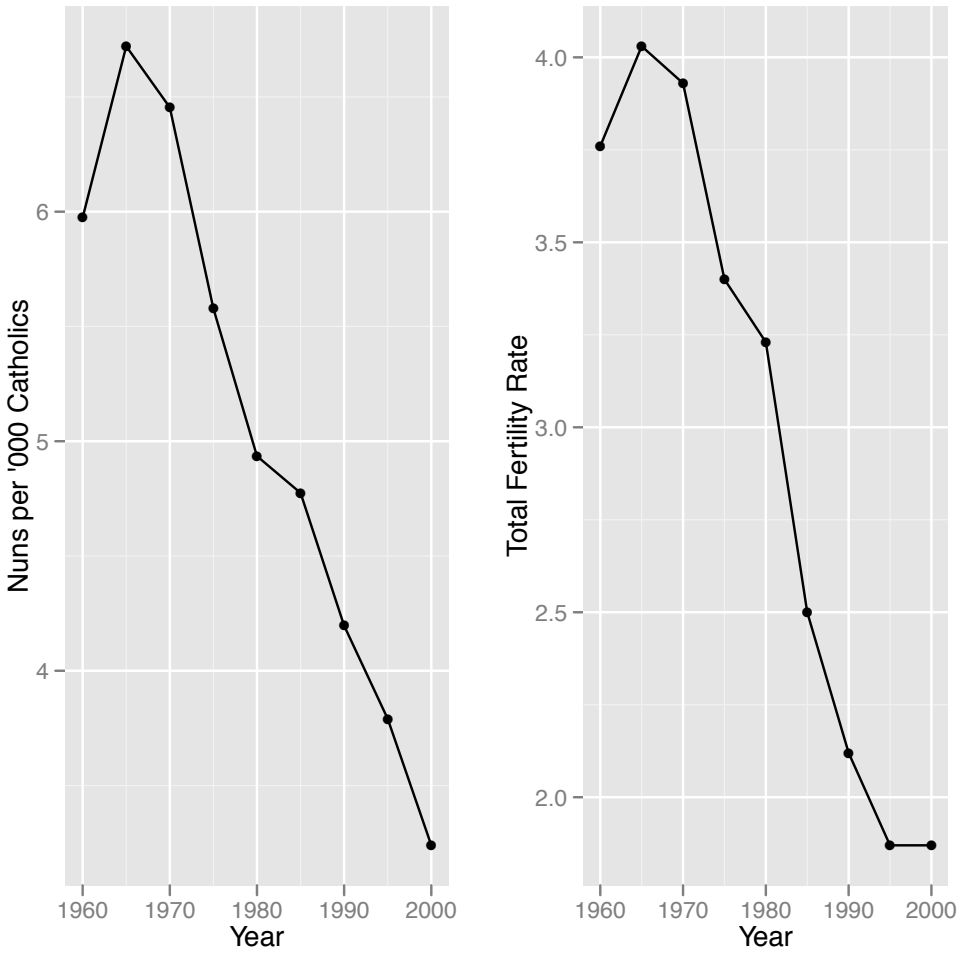


Figure 5: Fertility and Nuns/Catholic, Ireland 1960-2000

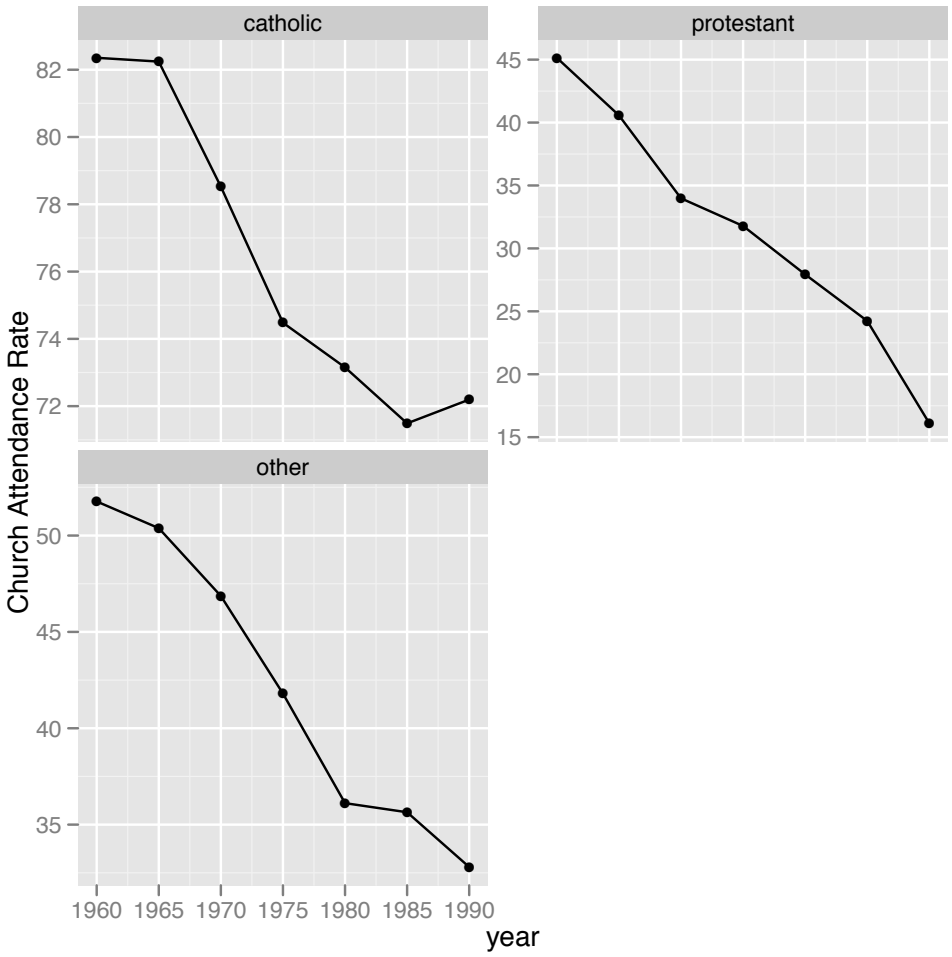


Figure 6: Church attendance by main religion: Catholic, Protestant and Other European countries

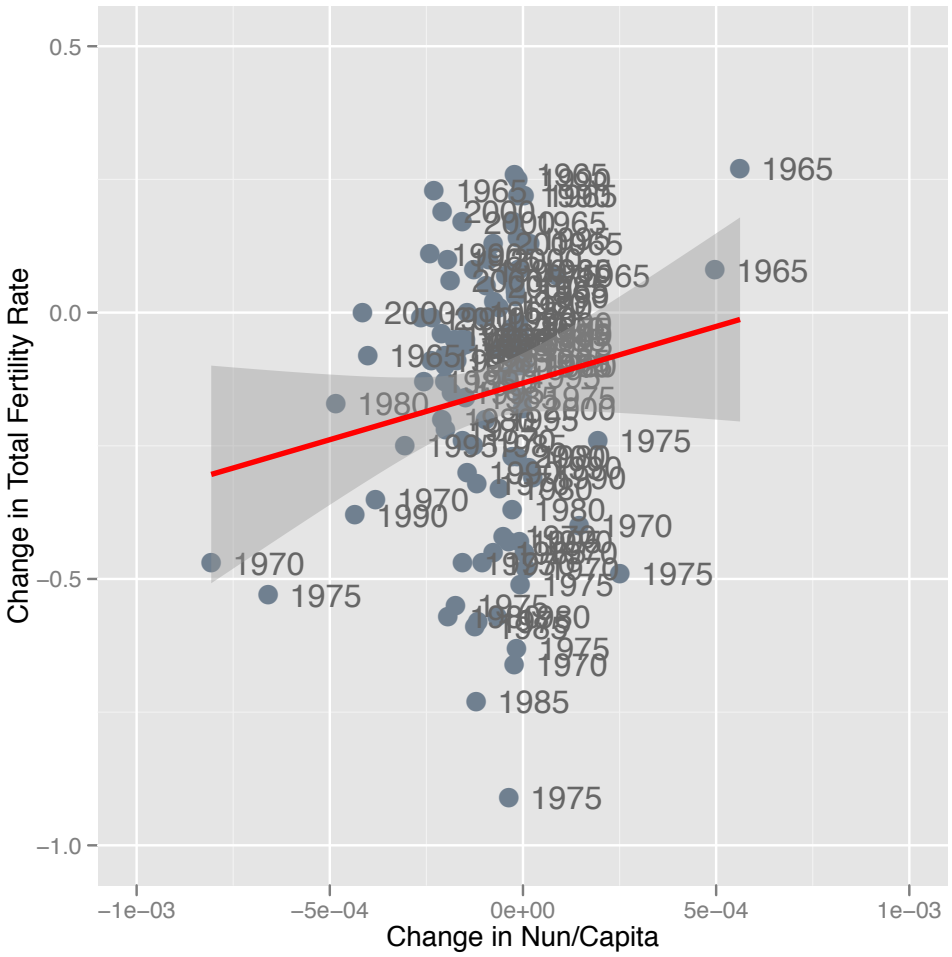


Figure 7: Change in Nun/Capita and change in Total Fertility Rate, 1960-2000

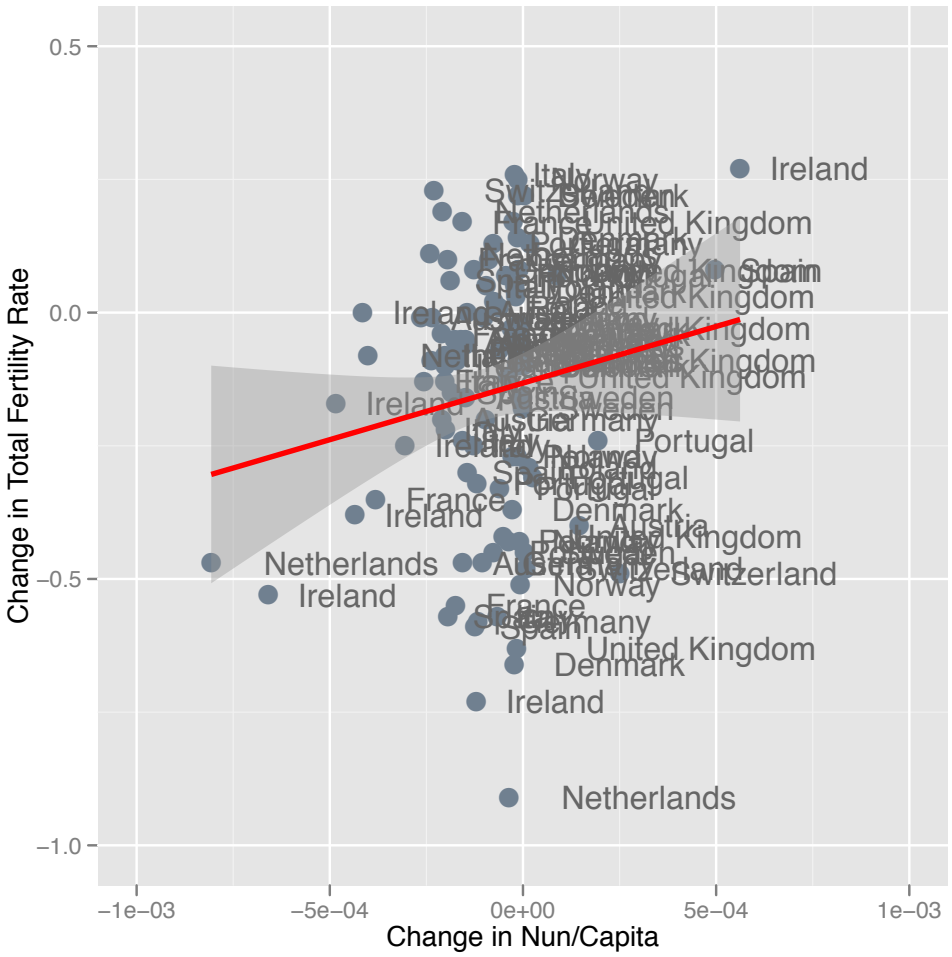


Figure 8: Change in Nun/Capita and change in Total Fertility Rate, 1960-2000

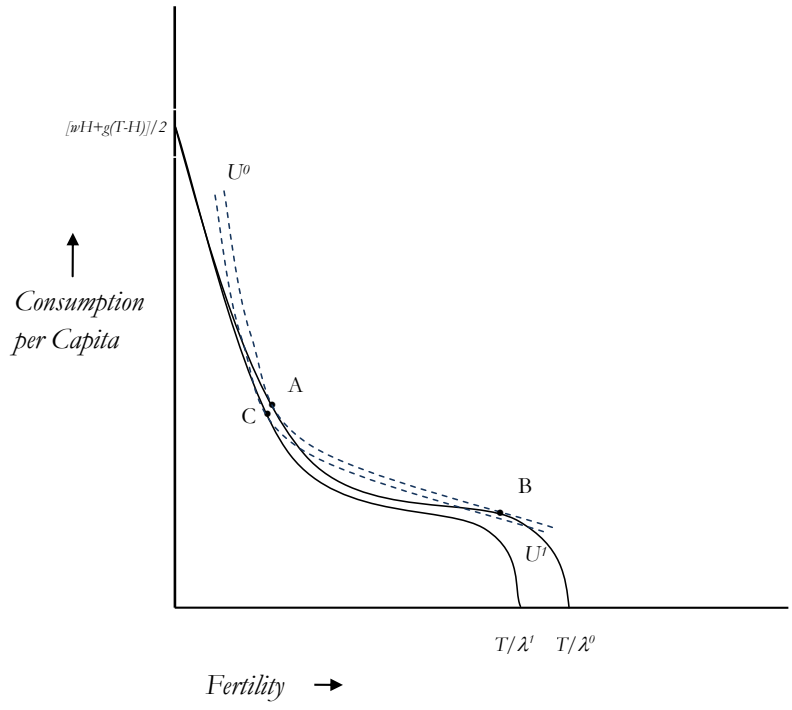


Figure 9: Fertility, childbearing costs and household production

Tables

	% Catholics (1960-2000) Avg.	Nuns/ 10000 Cath 1960	Nuns/10000 Cath 2000
Italy	98	31	20
Spain	97	21	15
Portugal	94	7	7
Poland	94	8	7
Austria	85	22	9
France	82	30	10
Ireland	75	60	32
Switzerland	47	36	18
Netherlands	39	77	18
Germany	36	32	13
United Kingdom	9	37	15
Norway	8	16	5
Sweden	1	15	19
Denmark	1	302	76
United States (1990)	23	22 (in 1990)	

Table 1: **Nuns per Catholic in European Countries, 1960-2000.** Number of Nuns and Catholics are from the Annuarium Statisticum Ecclasiae and from the Annuario Ponteficio. The proportion of Catholic is averaged over the period 1960-2000. U.S. figures from the Catholic Directory and ARIS, www.adherents.com.

	Mean	Std. Dev.	Min	Max	Obs
Δ Total Fertility Rate	-0.14	0.24	-0.91	0.27	104
Δ Nuns per 10000	-1.01	1.24	-8.07	5.62	104
Δ Attendance rate (AR)	-2.93	4.17	-15.00	17.00	78
$\Delta(AR)\times$ Proportion Catholic (PC)	-1.54	2.92	-12.23	6.58	78
$\Delta(AR)\times$ Nuns per 10000 (NC)	-89.13	124.45	-633.07	488.84	78
$\Delta(AR)_{t-15}$	-2.66	3.52	-15.00	5.00	104
$\Delta(AR)_{t-15} \times (PC)$	-1.45	2.65	-12.23	4.71	104
$\Delta(AR)_{t-15} \times (NC)$	-89.22	112.23	-681.66	550.68	104
Δ Female LFP	2.24	2.03	-2.79	13.42	104

Table 2: **Changes in Fertility, Attendance and Nuns.** Summary statistics 1960, 5 year intervals. Population weighted. Fertility and female labor force participation are from the World Bank. Nuns, and Catholics are from the Vatican Statistical Annual (1970-2000) and from the Annuario Pontificio (1960-1970). The proportion Catholic is averaged over the period 1960-2000. The 14 countries included are those listed in Table 1 above, except for the U.S. Church attendance rates are calculated using the ISSP data retrospectively, as in Iannaccone (2003). Contemporaneous attendance rates are available only through 1990.

	(1)	(2)	(3)	(4)	(5)	(6)
Nuns per capita				407.90***	365.05***	383.24***
				(123.69)	(119.28)	(117.02)
Church attendance rate	0.00	−0.01	−0.01		−0.01	−0.01
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
Church attendance						
× proportion Catholic		0.02***	0.03***		0.02***	0.02**
		(0.01)	(0.01)		(0.01)	(0.01)
Female						
labor force participation			−0.01			−0.02*
			(0.01)			(0.01)
Constant	−0.156	−0.159	−0.126	−0.134	−0.127	−0.0837
	(0.023)	(0.023)	(0.025)	(0.019)	(0.024)	(0.029)
N	82	82	82	78	78	78

Table 3: **Fertility, Church Attendance and Nuns.** For variable definitions see note to Table 2. Standard errors are clustered by country. Weighted by population. Values in parenthesis are clustered (by country) standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Note: Calculating standard errors and statistical significance is complicated by the small number of countries in the sample (14) so that asymptotic approximations rely on the $N \times T$ rather than N. We report standard errors clustered by country over time. They are corrected by the jacknife-equivalent procedure proposed by Bell and McCaffrey (2002), which corresponds to the $CR3$ standard errors of Cameron, Gelbach, and Miller (2008). Critical values used to mark statistical significance are those of a t-distribution with 13 (the number of countries minus one) degrees of freedom. We have validated the statistical significance of these results using the alternative "wild bootstrap" procedure of Cameron, Gelbach and Miller (2008), which is designed to treat the same problem, but has lower power. Rejection probabilities (p-values) using that procedure are quite similar in general. The two cases in which they differ are noted in footnotes to the text.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Nuns per capita	383^{***}	-106	-629	61	296^{***}	-1032^{**}	-565	
	(106)	(421)	(760)	(527)	(102)	(429)	(370)	
Δ Nuns per capita x attendance current		7.3						
		(5.2)						
Δ Current attendance	-0.008	-0.010	-0.002	-0.008				
	(0.010)	(0.008)	(0.012)	(0.013)				
Δ Nuns per capita $\times$ attendance, $t-10$ years			13.5			17.7^{***}		
			(9.7)			(5.4)		
Δ Attendance, $t-10$ years			-0.007			-0.010^{*}		
			(0.014)			(0.005)		
Δ Nuns per capita $\times$ attendance, $t-15$ years				3.36			10.80^{**}	
				(6.63)			(4.65)	
Δ Attendance, $t-15$ years				0.008			-0.007	
				(0.014)			(0.009)	
Δ Current attendance $\times$ proportion of Catholic	0.019^{***}	0.004	0.011	0.025				
	(0.007)	(0.015)	(0.013)	(0.016)				
Δ Female labor force participation	-0.019^{**}	-0.021^{**}	-0.021^{**}	-0.018^{*}	-0.018^{***}	-0.019^{***}	-0.017^{**}	-0.018^{**}
	(0.009)	(0.009)	(0.009)	(0.011)	(0.007)	(0.007)	(0.008)	(0.006)
Constant	-0.0837	-0.0891	-0.0642	-0.0567	-0.0706	-0.0777	-0.0811	-0.101
	(0.026)	(0.025)	(0.023)	(0.011)	(0.026)	(0.026)	(0.024)	(0.019)
N	78	78	78	78	104	104	104	104

Table 4: **Is service provision conditional? Fertility and attendance interacted.** For variable definitions see note to Table 2. Weighted by population. Values in parenthesis are clustered (by country) standard errors. The calculation of standard errors is explained in the text, and in the note to Table 3. The null hypothesis that the coefficient on nuns/capita (estimated as -1032) is zero is rejected at 5% using CR3, but has a p-value of only 0.098 using the "wild bootstrap." See Cameron, Gelbach and Miller (2008) for details. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

	(1)	(2)	(3)	(4)	(5)	(6)
Δ Priests per capita		556.65	−669.76		146.76	−866.26
		(1012.80)	(1522.36)		(761.30)	(1108.62)
Δ Nuns per capita	383.24***		508.22	296.09***		485.47*
	(117.02)		(314.39)	(111.67)		(260.57)
Δ Female labor force participation	−0.02*	−0.02	−0.02	−0.02**	−0.02***	−0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Δ Current attendance	−0.01	−0.01	−0.01			
	(0.01)	(0.01)	(0.01)			
Δ Current attendance $\times$ proportion of Catholic	0.02**	0.02	0.02*			
	(0.01)	(0.01)	(0.01)			
Constant	−0.0837	−0.11	−0.0876	−0.0706	−0.0975	−0.0723
	(0.029)	(0.025)	(0.024)	(0.028)	(0.028)	(0.024)
N	78	78	78	104	104	104

Table 5: **Which Services Affect Fertility? Priests and Nuns.** For variable definitions see note to Table 2. Weighted by population. Values in parenthesis are clustered (by country) standard errors. The calculation of standard errors is explained in the text, and in the note to Table 3. The null hypothesis that the coefficient on nuns/capita in column (6) (estimated as 485.47) is zero is rejected at 10% using CR3, but has a p value of only 0.13 using the wild bootstrap. See Cameron, Gelbach and Miller (2008) for details. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.