The Effect of Household Appliances on Female Labor Force Participation: Evidence from Micro Data*

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Abstract

We estimate the effect of household appliance ownership on the labor force participation rate of married women using micro-level data from the 1960 and 1970 U.S. Censuses. In order to identify the causal effect of home appliance ownership on married women's labor force participation rates, our empirical strategy exploits both time-series and cross-sectional variation in these two variables. To control for endogeneity, we instrument a married woman's ownership of an appliance by the average ownership rate for that appliance among single women living in the same U.S. state. Single women's labor force participation rates did not increase between 1960 and 1970. We find evidence in support of the hypothesis that the diffusion of household appliances contributed to the increase in married women's labor force participation rates during the 1960's.

Keywords: Female labor supply, household appliances, home production.

JEL Classification: J22.

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1 Introduction

In the last few decades women's labor force participation rates have increased dramatically, especially for married women. In 1950, about 25 percent of married women participated in the workforce; by 2000, nearly 60 percent of married women participated. An extensive literature has investigated the possible causes of this increase.[1] Greenwood, Seshadri, and Yorukoglu (2005) [from now on GSY] argue that the diffusion of home appliances such as washing machines, freezers, etc. played an important role in "liberating" women from housework and in propelling them into the workforce. According to GSY, the adoption of time-saving technologies occurred because of a surge in the rate of technological progress in the home durable goods sector. Consequently, the quality-adjusted relative price of home appliances declined. Building on Becker (1965) and Gronau (1977), GSY develop a dynamic equilibrium model in which a household jointly determines female labor force participation and home appliance purchases. GSY calibrate a version of their model and show that the observed decline in the relative price of home appliances can explain about 50 percent of the increase in married women's labor force participation rates between 1900 and 1980.

Despite the intuitive appeal of GSY's story and the quantitative results of their model, there is little independent empirical evidence in favor of their hypothesis. Moreover, from a theoretical perspective, improvements in the productivity of home durable goods could lead married women to increase rather than decrease their time allocated to housework. The sign of this effect depends on the elasticity of substitution between home and market goods in the household's utility function (Jones, Manuelli, and McGrattan, 2003).

[1] In addition to the "liberation hypothesis" discussed in this paper, other explanations for the increase in women's labor force participation include: 1. A reduction in fertility (Evans and Angrist, 1998) 2. The diffusion of the oral contraceptive (Goldin and Katz, 2002; Bailey, 2006; and Wong, 2008) which reduced the pregnancy-related uncertainty faced by young women enrolling in professional programs. 3. The indirect effect of WWII on men's attitudes toward working women (Fernandez, Fogli, and Olivetti, 2004) 4. The reduction in the gender wage gap (Smith and Ward, 1985; Jones, Manuelli, and McGrattan, 2003; Gayle and Golan, 2006). Albanesi and Olivetti (2007) develop a variant of the "liberation hypothesis", emphasizing the role of medical advances and the introduction of infant formula as catalysts that enabled married women to increase their participation in the workforce. Goldin (1990) provides a detailed historical account of women's experience in the labor market.

The goal of this paper is to empirically test GSY's hypothesis using micro-level data on female labor force participation and household appliance ownership. The data comes from the 1960 and 1970 U.S. Census of the Population. In only those years, households were asked to provide information on their ownership of some home appliances (freezers, washers, and dryers) in addition to the standard demographic variables. Women's labor force participation rates and households' ownership of appliances both increased significantly during the 1960's. The labor force participation rate for white married women increased by 10 percentage points, and the fraction of households with all three of the appliances mentioned above increased from 11 to 28 percent (see Table 1).

In order to identify the causal effect of home appliance ownership on married women's labor force participation rates, our empirical strategy exploits time-series and cross-sectional variation in these two variables. Ordinary least squares (OLS) will not, in general, provide consistent estimates of the causal effect of appliance ownership on women's labor force participation because of the endogeneity of home appliance ownership. Instead, we employ an instrumental variable (IV) strategy by using the state-level ownership rate of an appliance among *single* women as an instrument for a *married* woman's ownership of that appliance.

We assume that the observed temporal and cross-sectional variation in single women's ownership of home appliances is driven by the (unobserved) appliance costs rather than by changes in women's labor force participation rates. Two key observations corroborate this assumption. First, differently from married women, the labor force participation rate of single women did not change appreciably from 1960 to 1970 (see Table 2). Second, the instruments based on single women's appliance ownership rates at the state level do not explain differential changes in *single* women's labor force participation rates across states and over time.

Our estimates, based on the identification strategy described above, provide strong empirical support for GSY's hypothesis. According to our results, the diffusion of home appliances in the decade between 1960 and 1970 contributed to the increase in married women's labor

force participation rates.

As far as we know, this paper is the first to use microdata on appliance ownership and female labor force participation to provide evidence on GSY's hypothesis. There is related work in both economics and sociology. In the economics literature, Cavalcanti and Tavares (2008) use country-level panel data for OECD countries for the period 1975–1999 to show the existence of a statistically significant relationship between the relative price of home appliances and female labor force participation rates across countries. Dinkelman (2008) considers the employment effects of household electrification in rural South Africa in the late 1990's. She uses a community's land gradient as an instrument for its treatment status and finds a positive effect of electrification on female employment. Cardia (2008) regresses county-level changes in female labor force participation rates between 1940 and 1950 on county-level adoption rates of bathtubs and refrigerators using data from the U.S. Census. She finds a positive association between the adoption of indoor plumbing facilities and female labor force participation rates.[2] In addition to adopting a different identification strategy relative to these papers, our approach is based on microdata, and allows us to control at the individual level for the standard determinants of female labor force participation, such as experience, household income, a woman's education, etc.

Sociologists have also studied the relationship between home technology and women's allocation of time to housework, sometimes reaching different conclusions than GSY. For example, Cowan (1983) considers the relationship between household technology and women's housework during the last two centuries in the U.S. and argues that the amount of time spent by the average American woman in housework in 1965 and at the beginning of the twentieth century are comparable in magnitude (see Cowan, 1983, page 199, for example). The lack of representative time-use data for the earlier part of the twentieth century makes

[2]Cortes and Tessada (2007) focus on increased immigration, as opposed to declining prices of home appliances, as a determinant of female labor supply. They observe that immigrants' labor often substitutes for female labor in home production (e.g. child care and housekeeping services) and find evidence that immigration affects the labor supply of high-skill native women.

such comparisons difficult. Recent research by Roberts and Rupert (1995), Bianchi et al. (2000), and Aguiar and Hurst (2006) based on time-use surveys and the Michigan Panel Study on Income Dynamics clearly shows that the time allocated by women, and especially married working women, to home production has fallen considerably in the last 40 years. This trend is consistent with GSY's hypothesis.[3]

The rest of the paper is organized as follows. In Section 2 we describe the Census data and present our main econometric results. Section 3 details several robustness checks and the results from alternative specifications. Section 4 concludes.

2 Data and Main Results

Next, we describe the data. Then, in Section 2.2 we introduce the benchmark regression equation and discuss the OLS estimates. Section 2.3 contains the results based on the IV approach.

2.1 Data Sources and Descriptive Statistics

Data

We use the Integrated Public Use Microdata Series (IPUMS) from the U.S. Census of the Population for 1960, one-percent sample, and 1970, Form 1 State, one-percent sample (Ruggles et al., 2004).[4] This data has several advantages. The 1960 and 1970 (Form 1) Censuses collected information on household ownership of washing machines, dryers, and freezers.[5] As far as we know, the Census samples are the only large microdata set containing

[3] In the sociology literature, also see the work by Bittman, Rice, and Wajcman (2004) who use a cross-section of micro-level time-use data from Australia in 1997 to study the association between time spent in different homework activities by men and women and their ownership of household appliances. We are unaware of engineering studies that directly measure the amount of time saved by household appliances in the performance of household chores.

[4] The Census samples can be found at http://usa.ipums.org/usa.

[5] The 1970 Census also asked about dishwashers, but the 1960 Census did not. For this reason we do not use the dishwasher variable in our analysis.

appliance ownership information over a period of rapid increase in the labor force participation of married women. Also, the Census samples provide demographic, employment, and income details. Unfortunately, individual observations cannot be linked across years. We focus on U.S. states because the smallest identifiable geographic region in the 1960 sample is a state.[6]

Married Women

Our primary sample includes white, U.S.-born, married women of prime working age (18–55 years old), with non-missing information on state of residence and appliance ownership, not living in group quarters and with working husbands. The 1970 sample contains 269,939 observations. In the 1960 Census instead only 20 percent of the households in the one-percent sample were surveyed about appliance ownership, leaving 52,373 married women that satisfy our selection criteria. The *relative* size of each state is basically the same in the 1960 and 1970 samples. The rank correlation coefficient between a state's share of married women (out of the U.S. population of married women) in 1960 and the corresponding share in 1970 is 0.996 with a p-value of 0.00001. In Section 3.2 we conduct robustness checks to assess whether the differences in sample sizes matter for our results.

Summary statistics for married women can be found in Table 1. The labor force participation rate of married women increased from about 33 percent in 1960 to 43 percent in 1970. Labor force participation is our main outcome variable. Employment (share of married women in the labor force and holding a job), full-time employment (share of married women working at least 35 hours in the past week), and year-round employment (share of married women working at least 48 weeks in the past year) also indicate a large increase in female labor supply during the 1960's. These alternative outcome variables are used to verify the robustness of our results in Section 3.3. Notice, the average hours worked by a married

[6] We exclude from our analysis the District of Columbia and the State of Hawaii. The former is dropped because of its extremely large fraction of single women in the population in both 1960 and 1970 (about 50 percent against an average of 12 percent for the other states in 1970). Including the District of Columbia in the analysis does not affect our estimates. Hawaii is dropped because of lack of observations for constructing the instrument in 1960.

woman in the labor force did not change appreciably from 1960 to 1970, suggesting that most of the observed gains in labor supply were due to the change in labor force participation, our main outcome variable.

The appliance ownership dummies are the explanatory variables of interest. We recoded these appliance variables as binary indicators. For example, the WASHER variable in the Census takes on 0 (no washer), 1 (yes - automatic washer), or 2 (yes - separate spinner). We collapsed the last two categories into one category. Aggregate appliance ownership rates for freezers and dryers increased substantially for married women between 1960 and 1970. Ownership of washing machines stayed roughly constant during this period most likely because this appliance had already reached a relatively high degree of diffusion in 1960.[7] The share of married women owning all three appliances increased by 17 percentage points, from 10.9 percent to 27.8 percent, between 1960 and 1970.

Table 1 also summarizes the other individual-level covariates used in our analysis. Annual wage and family total incomes were adjusted for top-coding by multiplying the censored values by 1.4. We converted all dollar figures to 1970 dollars with the consumer price index (CPI All Urban Consumers series CUUR0000SA0). Household income net of female earnings is defined as family total income minus a woman's wage income. Hours worked per week and weeks worked during the previous year were imputed as the mid-points of the intervals reported by the Census.

In order to analyze the relevant trends more closely, Table 2 presents the percentage point increase in married women's labor force participation and ownership of all three appliances by household income and by the woman's education level. Women from households with relatively higher income had a higher increase in appliance ownership and the lowest increase in labor force participation during the 1960's. The data by education show a less clear pattern. Women with only a high school degree and women with a college degree display relatively large gains in labor force participation; however, married women with a college

[7] The appliance ownership rates reported in Table 1 and Table 2 agree with those reported in GSY and Lebergott (1976).

degree display a smaller increase in appliance ownership than other women.

Single Women

The sample we use to construct our instruments includes white, U.S.-born, single women of prime working age (18–55 years old) who are household heads according to the Census.[8] Table 3 reports summary statistics for single women. Unlike married women, the labor force participation rate of single women did not increase in the 1960's. However, appliance ownership rates for single women did increase in a way similar to the appliance ownership rates for married women. Figure 1 presents a scatterplot of the share of single women in each state in 1970 against the share of single women in 1960. The 45 degree line is also represented for convenience. Two features of the data stand out. First, while there is some cross-state dispersion in the share of single women in each year, in most states the share of single women lies between 7 and 12 percent in 1960 and 10 and 15 percent in 1970. Second, there is a tendency for the share of single women to increase for all states between 1960 and 1970. The rank correlation between the 1960 and 1970 shares of singles is 0.67 and highly significant, suggesting a rather uniform increase in this share over time.

State-Level Information and Controls

Table 4 provides details on appliance ownership rates by year and for selected states. For both married and single women, the change in appliance ownership rates varies widely across states. As detailed in the next section, we exploit this variation in our estimation strategy. Since the instrument we employ to estimate the effect of appliance ownership on female labor supply varies only at the state level, we cannot include state-by-year dummies in our regression equation. We try to control for potential confounding effects by including in the regression a set of covariates that varies over time at the state level. Specifically,

[8] We use the term "single" to include both women who are single because they never married and women who were married at a previous point of their life and who are now either divorced or widows. Using only observations on women who were singles and never married gives rise to similar point estimates as the ones reported in Tables 6–8, but the smaller sample size tends to increase their standard errors and reduce their statistical significance.

in order to control for increased urbanization which would presumably lead to both higher appliance ownership and female labor supply, we include the share of a state's population living in urban areas according to the U.S. Statistical Abstracts.[9] Bailey (2006) argues that the diffusion of the oral contraceptive (the pill) during the 1960's reduced the fraction of women giving birth before age 22 and increased young women's labor force participation. In order to control for systematic cross-state effects associated with the diffusion of the pill, we use Bailey (2006, Table 1)'s data on the number of years (as of 1970) for which the pill had been available to women under 21 years of age in a given state. We include in our regressions the pill data as a full set of "years since first access" dummy variables, where each dummy takes a value of one if in 1970 early legal access to the pill had been available to a young woman for a given number of years varying from zero to ten.[10] The following state-level controls, computed using the Census microdata, are also included in all the regression equations: the share of a state's workforce employed in the service sector to proxy for shifts in the demand for women's work; average wage income, including both male and female workers; the gender wage gap computed using data on full-time year-round workers (Jones, Manuelli, and McGrattan, 2006); and the ownership rate of televisions among households in a given state. This last variable is meant to control for other trends associated with the diffusion of household appliances that might be correlated with married women's labor supply. Table 5 contains summary statistics on these variables.

[9] In our empirical analysis we cannot use information regarding the urban/rural location of the household or whether the household was located in a metropolitan area because, due to confidentiality concerns, this information is not available for all states in the 1960 and 1970 samples.

[10] The earliest year of early legal access is 1960. We also experimented with an alternative specification of the pill variables by introducing in the regression a single dummy that equals one if a woman had early legal access to the pill in her 1970 state of residence when she was age 21. The results associated with this alternative specification are very similar to the benchmark results and are omitted.

2.2 OLS Estimates

The causal relationship of interest is captured by the following regression equation:

$$\text{lfp}_{ist} = \beta \text{appl}_{ist} + x'_{ist}\gamma + z'_{st}\theta + \delta_s + \delta_t + \varepsilon_{ist}. \quad (1)$$

For each woman i observed in state s at time t, the dependent variable lfp_{ist} is a binary indicator for labor force participation.[11] The vector x_{ist} includes standard individual-level demographic characteristics such as education, potential experience, household income, and number of children. The vector z_{st} represent the state-level covariates described in the previous section. The dummy variables δ_s and δ_t represent state-of-residence and Census year main effects, respectively; ε_{ist} is a disturbance term; and the dummy variable appl_{ist} captures the presence of household appliances.

The variable appl_{ist} is the key regressor of interest. We experiment with three alternative specifications of this regressor. First, we include one appliance dummy at a time in equation (1). Second, we simultaneously include all three appliance dummies (washing machines, dryers, and freezers). Third, we use a single dummy that takes a value of 1 if the household owns all three appliances and zero otherwise. Our preferred specification is the one that employs the binary indicator of ownership of all three appliances. This variable conveniently summarizes the information on appliance ownership by implicitly assigning the same degree of importance to each appliance for which information is available.

Table 6, columns 1–5, reports the OLS estimates of the parameter β in equation (1). Labor force participation for married women has a negative correlation with the ownership of washers and freezers and a positive association with the ownership of dryers. The signs of these correlations are the same whether all three appliance regressors are included in the regression equation at the same time or separately. Ownership of all three appliances is positively associated with female labor force participation, but the relationship is statistically

[11] In Section 3.3 we provide results using alternative measures of labor supply.

insignificant in the OLS case. Estimates of the marginal effects implied by a probit model (reported in Table 6, column 6) are slightly larger than the OLS results, but still insignificant. Taken together, the estimates in Table 6 do not lend much support to GSY's hypothesis. The estimated magnitude of β is relatively small and sometimes of the wrong sign.

As argued in the Introduction, caution must be exercised in interpreting the OLS results because the appliance regressor is likely to be endogenous. At least three potential sources of bias exist. First, households with a working woman are more likely to purchase appliances. Reverse causation could induce a positive bias in the estimate of β. Second, households with strong tastes for home-produced goods might invest heavily in both inputs of home production, namely household work (traditionally carried out by the wife) and household appliances. A similar effect occurs if households have unobserved heterogeneity in wealth. Both unobserved preference shifters and unobserved wealth may induce a negative correlation between appliance ownership and female labor participation, creating a downward bias in the OLS estimate of β. Third, in the presence of measurement error in appl_{ist} the OLS estimator of its coefficient will be attenuated toward zero.

2.3 IV Estimation and Main Results

Identification

Given the endogeneity problems described in the previous section, we turn to an IV approach. An appealing approach to identification would be to use exogenous cross-sectional and time-series variation in the price of appliances. However, to the best of our knowledge, detailed information on appliance prices is not available, especially for the period of interest, 1960–1970. We instead proceed by constructing an instrument for a married woman's ownership of appliances from appliance ownership rates among single women. Specifically, we use the average observed value of appliance ownership among *single* women in a given state as an instrument for ownership of appliances by a *married* woman living in that state. Notice, the endogenous regressor is household-specific, while the instrument varies only at the

state-year level.[12] Thus, identification of the parameter β comes from differential variation in singles' ownership of appliances across states over time.

In selecting this instrument we think that state-year variation in the prices and operation and maintenance costs of appliances, possibly induced by differences in sales taxes, transportation costs, competition in the local durable goods market, and electricity prices, generates similar variation in appliance ownership among households with married women and households of only single women. A lower price of appliances should lead to higher demand for appliances by both single and married women.

Additionally, we view our instrument as unlikely to be affected by unobserved determinants of the participation decision of married women. We make this assertion because the labor force participation rates of single women remained literally constant during the 1960's, while their appliance ownership rates increased in a similar way to those of married women.[13] These facts suggest that single women's labor supply around 1960 was close to its upper bound, so the diffusion of appliances did not affect their labor force participation decisions. Instead, single women purchased new home technologies when their relative price declined. Even though we cannot directly observe time-series and cross-sectional variation in relative prices of appliances, we interpret the changes in appliance ownership among single women as reflecting those trends. We perform falsification and robustness exercises in Section 3 in order to evaluate the validity of our approach.

Results

To consistently estimate the parameter β in equation (1) we need a variable that is correlated with appl_{ist} but not with the error term ε_{ist}. As mentioned above, we instrument the endogenous regressor appl_{ist} with the state-year mean appliance ownership rate among *single* women, denoted by appl-sin_{st}. Table 7 displays estimates of the first-stage regression

[12] We account for the fact that the instrument is an aggregate variable by applying state–year clustered standard errors in our analysis.

[13] This point is documented in Table 3. Also, the marked differences in participation trends between married and single women continued after 1970.

models:[14]

$$\text{appl}_{ist} = \pi \text{appl-sin}_{st} + x'_{ist}\varphi + z'_{st}\psi + \lambda_s + \lambda_t + u_{ist}. \quad (2)$$

In all specifications, we find a sizable, positive, and statistically significant relationship between appl_{ist} and its corresponding instrumental variable appl-sin_{st}. For example, the entry in the first column of Table 7 indicates that a 10 percentage point increase in ownership of washers among single women is associated with a 2.61 percentage point increase in the fraction of married women owning washers. The F-statistics for the significance of the estimated coefficients on the instruments are 15 or higher in all cases; this strong first-stage dispels any concerns about serious finite-sample bias problems in the IV estimates (Bound, Jaeger, and Baker, 1995).

The two-stage least-squares (2SLS) estimates of equation (1) represent our main results (see Table 8). The findings are generally consistent with the existence of a positive statistically and economically significant causal effect of appliance ownership on female labor force participation of married women. For example, the 2SLS estimate reported in Table 8, column 5 (our preferred specification) implies that owning all three appliances raises the likelihood of labor force participation by married women by about 27 percentage points, with a standard error of 6.8 percentage points.[15]

The share of married women owning all three appliances increased by 17 percentage points from 1960 to 1970 (see Table 1). Therefore, our results suggest that higher ownership of appliances accounts for up to a 4.6 percentage point (0.27×0.17) increase in the labor force participation rate of married women during the 1960's. The other estimates in Table 8 confirm this benchmark result. Using only the variable "freezer" as a measure of appliance ownership produces a smaller effect relative to the benchmark.[16] Instead, using the estimated

[14] Recall that when all three appliances are included in the regression at the same time, π is a three-dimensional vector.

[15] The results are nearly identical (the estimated β is 0.267 with a standard error of 0.065) if the endogenous regressor of interest takes a value of one if both a dryer and a freezer are present in the household and zero otherwise. Thus dropping washers from the analysis does not alter our estimates.

[16] Notice that the estimated coefficient on the variable "washer" is not statistically different from zero in column 1 of Table 8. As can be inferred from Table 1, there has not been an increase in ownership of that

coefficient for dryers or the estimates obtained from jointly including all the three appliances in the regression leads to a larger effect.[17] In all these specifications, the largest effects obtain if all married women are affected in the same way by the diffusion of household appliances. A more reasonable interpretation, which is consistent with a smaller impact of household appliances, is that the estimates in Table 8 refer to a sub-population of married women. We return to this important point more extensively in the following sub-section.

Discussion

The 2SLS approach generates uniformly larger estimates for the parameter β than the OLS estimates of Table 6. This discrepancy does not seem to be due to a reverse causation argument (i.e. higher labor force participation of married women leading to higher appliance ownership), which would have led to the opposite ranking of these estimates. Measurement error in the endogenous regressor appl_{ist} is known to generate downward-biased OLS estimates. However, as Kane et al. (1999) show, when the endogenous regressor has a categorical nature and is measured with error, the IV estimator may be upward-biased.

At least two explanations for the discrepancy between the OLS and 2SLS estimates exist. First, the OLS estimates might be downward-biased due to omitted variables such as unobserved household tastes or wealth, which are positively correlated with the ownership of appliances and negatively correlated with married women's labor force participation. In this case the IV results uncover the "true" effect of appliance ownership on married women's labor force participation.

Second, the effect of household appliances on female labor supply may not be the same for all married women. In this case, the 2SLS estimator will not identify an average treatment effect. Angrist and Imbens (1994) have shown that under a monotonicity assumption and in a simpler setting where both the instrument and the endogenous regressor are binary variables the 2SLS estimator identifies a *local* average treatment effect - i.e., the causal effect of interest

appliance among married women in the 1960's.

[17] In these two cases, the predicted increase in married women labor force participation is 10.7 and 11.6 percentage points, respectively.

for those married women who would not have purchased all three appliances in the absence of a decline in relative appliance prices.[18] The LATE interpretation of the results could then rationalize why the estimate of β based on our IV procedure exceeds the one obtained by applying OLS. For this to be the case married women who are more sensitive to the decline in appliance prices should also be more likely to enter the workforce when endowed with household appliances. Who are these women and why would they be more likely to enter the workforce in response to the increased availability of appliances? Unfortunately, this subpopulation of married women cannot be determined because in the data we observe whether or not a married woman owns all three appliances for only one value of the instrument. One possibility is that these women belong to relatively wealthier households. To assess this hypothesis we introduce an interaction term of the instrument and household income in the first-stage regression, equation (2). The estimated interaction coefficient is positive implying that a higher value of the instrument - a larger decline in relative appliance prices according to our interpretation - produces a larger increase in ownership of appliances for relatively wealthier households.[19] The marginal treatment effect might be higher for women from wealthier households because they have higher human capital on average. For example, the Census data shows that they tend to have more years of education. In turn, higher human capital might facilitate a married woman's entry into the workforce conditional on the adoption of household technologies. In summary, it is possible that the marginal effect of appliance ownership on married women's labor force participation is higher for women from wealthier backgrounds, where it has to be recognized that only a portion of household wealth is observed in the Census data. In this scenario, multiplying the estimate of β by

[18] Note that in our setting the interpretation of the estimated value of β is further complicated by the fact that the instrument is continuous rather than binary. In the continuous instrument case, the 2SLS estimator identifies a weighted average of marginal treatment effects, but the range of population to which the estimate applies is less transparent than in the binary instrument case. See Aavick, Heckman, and Vytlacil (2005) for another application in which the outcome variable and treatment status are binary while the instrument is continuous.

[19] The interaction coefficient is bordeline significant when we use the level of household income and highly significant when we use the logarithm of household income. In the benchmark model we use the level of income because the sample includes households with negative income. In both cases, the estimate of β obtained using the interaction term as an additional instrument is higher than in the benchmark specification.

the observed increase in appliance ownership among *all* married women would overstate the effect of the diffusion of appliances on labor force participation by the average woman.

3 Alternative Specifications and Robustness Checks

In this section, we describe the results from robustness checks and falsification exercises. The purpose is to show the consistency of the findings reported in Table 8 and to provide support for our IV strategy.

3.1 Falsification Exercises

This section presents two falsification exercises. The first exercise checks whether our instrument (appl-sin$_{st}$) also predicts changes in labor force participation by single women. The concern is that unobservable state-year specific shocks might lead to higher labor force participation by both married and single women, leading both married and single women to purchase more appliances. In this case our instrument would be correlated with the residual in equation (1) violating the fundamental condition for its validity. Table 9, columns 1–5, displays the 2SLS estimates of the parameter β in the regression (1) obtained using data on single women only. The instrument for single women appliance ownership is built using appl-sin$_{st}$, as before. The estimate of β is not statistically significant in any of the different specifications of this regression, supporting the assertion that reverse causation is unlikely to account for our findings.

Admittedly, this falsification exercise only rules out interpretations of our results based on unobserved state and year specific shocks that cause women - both single and married - to join the workforce and, *through* this channel, decide to purchase more appliances. The falsification exercise does not address situations in which unobserved state and year specific shocks have a positive independent effect on both a woman's incentive to join the labor force and on her decision to own appliances. In this case, the fact that single women's labor force

participation did not increase jointly with their ownership of appliances could simply reflect the fact that in 1960 their rates of participation were already relatively high. We cannot rule out the existence of shocks that have an independent effect on each of these two margins; however, it is difficult to think of an example capable of explaining the contemporaneous rise in married women's labor force participation and their ownership of appliances.[20]

The second falsification exercise checks whether including a non-productive appliance, a television, to our set of endogenous regressors generates additional predictive power. The existence of such an effect induced by a non-productive appliance would diminish the plausibility of interpreting our main results as evidence of a *causal* link between ownership of home appliances and married women's labor force participation. Table 9, columns 6–11, presents the 2SLS estimates from this exercise; ownership of a television at the household level is instrumented, as above, by the state-year specific ownership rate by single women.[21] Television ownership is not significantly associated with the dependent variable in any of the different versions of our regression equation, including one in which we do not include any of the original productive appliances in the regression.

Neither of the two falsification exercises invalidates our IV approach.

3.2 Robustness Checks

In this section we discuss the results of other robustness checks. These are summarized in Table 10. In order to limit the number of tables, in Tables 10 and 11 we focus on the results of our preferred specification in which the endogenous regressor is the indicator variable "ownership of all three appliances".

[20] A candidate shock would be a change in preferences for the home-produced good. Preferences directly affect both a household's decision to purchase appliances and a married woman's decision to participate in the labor force. However, this kind of shock cannot rationalize the simultaneous increase in appliance ownership and female labor supply observed in the data. A lower weight on home goods in the utility function increases women's labor force participation but decreases their willingness to own consumer durables. An increase in appliance ownership by married women might occur but it would be the result of increased participation, instead of a direct implication of the underlying shock. Our falsification exercise already rules out this possibility.

[21] The first-stage regression equation for household ownership of a television yields a correlation with the instrument (singles' ownership rate) that is significant at the one percent level.

Changing School Enrollment

In 1960, the female college enrollment rate among 16–24 year-olds was 37.9 percent. A decade later, this statistic had increased to 48.5 percent. The increase in schooling could pose a problem for our identification strategy. Differential trends in school enrollment rates can mechanically affect labor force participation rates (through an "incapacitation effect") and make the use of single women as an instrument potentially problematic. To address this concern, we re-estimate our main regressions excluding college-age women. The first column of Table 10 reports 2SLS estimates with the sample restricted to 24–55 year-olds. The estimated coefficient β is close to the value obtained using the benchmark sample of women.

Differential selection into the labor force due to changing college enrollment could also undermine our first falsification exercise. In particular, if the single young women in our sample are more likely to be full-time students in 1970 than a decade earlier, we would expect this "incapacitation effect" to have mechanically reduced the observed labor force participation of single women in 1970. A reduction in labor force participation by single women attending college could have masked any increases in the participation of non-college-going single women between 1960 and 1970. Our estimates in Table 10 would be biased downwards, rendering our first falsification exercise uninformative. However, excluding 18–23 year-olds does not change the results of the falsification exercise.[22] The 2SLS estimate of β when the labor force participation of single women is used as the dependent variable is -0.10 with a standard error of 0.14, further reinforcing our conclusion that reverse causality cannot explain our main results.[23]

Single Men

We have constructed our instrument for the endogenous regressor "ownership of all three

[22] These estimates are not reported in Table 10.

[23] Unlike college enrollment rates, marriage rates were similar in 1960 and 1970. In a previous version of the paper we controlled for potential selection effects related to marriage by using Hunt (2002)'s selection correction procedure. We found that this procedure had negligible effects on our results.

appliances" by a married woman as the ownership rate of all three appliances among single women living in the same state. However, unobserved state-year shocks might affect both the appliance ownership rate of single women and the labor force participation decision of married ones. This concern might be mitigated by constructing the instrument as the ownership rate of all three appliances among single *men* living in a state. The results are presented in Table 10, column 2. The estimate of β is still positive but smaller than in our benchmark of Table 8, column 5. The 95 percent confidence interval of the estimate that uses single men as an instrument ranges from -0.25 to 0.38 and contains our benchmark estimate.

We do not interpret these estimates as necessarily contradicting our results of Table 8, because the correlation between the instrument and the endogenous regressor in the first-stage regression is much lower than in our benchmark specification. The F-statistic in Table 7, column 7 is about 88, while the F-statistic in Table 10, column 2, is just above 10. The latter figure may not convincingly rule out the possibility that the instrument constructed using single men is weak, in which case it is known that 2SLS is biased in the direction OLS. This observation begs the question of why the instrument constructed using single women is more highly correlated with the endogenous regressor than the instrument based on single men.[24] We offer two explanations. First, single men's demand for household appliances during the 1960's might have been less sensitive to declining relative prices than demand by both single and married women. The data supports this idea of demand differences. Single men had significantly lower ownership rates in 1960 and 1970 than single women.[25] More importantly, single women increased their ownership of appliances by more than single men during the 1960's. For example, ownership of dryers increased by almost 22 percentage

[24] One explanation would be reverse causality: women's labor force participation increased for unobserved reasons, leading them to purchase more appliances. However, single women's labor force participation did not increase in the 1960's and the falsification exercise of Section 3.1 shows that the instrument constructed using single women's ownership of appliances does not account for differential trends in single women's labor force participation across U.S. states and over time.

[25] For example, the ownership rate of dryers was 10 percent for single women in 1960 but only 6 percent for single men.

points among single women and by only 13 percentage points for single men. Our binary indicator of ownership of all three appliances increased by almost 7 percentage points for single women but only 4 percentage points for single men. Accordingly, single women's appliance ownership rates make a better instrument for the endogenous regressor than an instrument constructed using men's data.

The second explanation for the poor performance of the instrument built using data on single men is mechanical: the sample of single men satisfying all our selection criteria is much smaller than the sample for single women. The latter has about 44,000 observations (see Table 3) while the former only 26,000, so the appliance ownership rate constructed using single men might be less reliable. The sample size is especially relevant to our situation because the instrument varies only at the state level and the 1960 sample is about one fifth the size of the 1970 sample.[26] Thus, we view the estimate of β obtained with the instrument based on single men as less informative than the benchmark estimate.

Weights

As just mentioned, our sample size for 1970 is about five times larger than the sample size for 1960; only 20 percent of households were asked appliance questions in 1960. The difference in sample size may overemphasize some states' change in appliance ownership relative to others in our benchmark analysis, so we re-ran the regressions on data aggregated into state means. Table 10 column 4 presents the estimate of β from a regression in which each state's weight is kept constant at its 1970 level and column 5 provides the results from the same regression in which a state's weight is allowed to be different in 1960. The estimated values of β are close to one another and to the estimate from the benchmark regression of Table 8. Differences in sample sizes between 1960 and 1970 do not drive our results.[27]

[26] For example, there are only about 3,000 single men in our sample in 1960, but more than 5,000 single women.

[27] As a further check we also ran the benchmark regression on individual-level data by reweighting each observation in 1960 by a state-specific constant. The latter was such that the total number of married women in each state would be the same in 1960 as in 1970. The estimated value of β in this case is 0.266 with a p-value of 0.000.

Single Women in the Labor Force

In our benchmark specification, we construct the instrument for the endogenous regressor "ownership of all three appliances" as the ownership rate of appliances among singles who are household heads. To further control for reverse causation, we also tried restricting the sample of single women to those who are in the labor force. Column 3 of Table 10 reports the results. The estimated value of β in this case is similar to the benchmark, although the standard errors increase due to the smaller sample size.

3.3 Alternative Outcome Variables

Until now we have focused on female labor force participation as the outcome variable of interest; next, we evaluate the effect of appliance ownership on alternative measures of labor supply. We have estimated four additional versions of the basic model. The dependent variable is either a woman's employment status (1 if employed, 0 otherwise), or whether she is working full-time (1 if working 35+ hours per week), or whether she is working year-round (1 if working 48+ weeks per year). We also use total hours worked by a married woman in the year prior to the Census (with a value of 0 if she did not work in the market) as a dependent variable. OLS and 2SLS results are reported in Table 11. In all the 2SLS specifications, appliance ownership has a positive and statistically significant impact on female labor supply. Taken together these results confirm the findings of the baseline model in Table 8.

4 Conclusions

We use microdata from the U.S. Census to evaluate the contribution of household appliances to the increase in female labor force participation during the 1960's. According to our estimates, household appliances account for about forty percent of the actual increase in participation by married women during this period of time.

The key to our approach is the observation that single women's labor supply did not increase during the 1960's. We therefore use single women's ownership of an appliance in a given state as an instrument for a married woman's ownership of that appliance. An implicit assumption of the identification strategy is that the relative price of appliances in a given state is independent of married women's labor supply decisions. If this assumption is false, then independent shifts in married women's labor supply might lead to changes in the relative price of appliances and affect the appliance purchasing decisions of singles as well. We cannot rule this channel out. However, for this argument to account for the patterns of participation and appliance ownership observed in the data, the higher demand for appliances by married women who recently joined the workforce must have *decreased* appliance prices to induce an increase in adoption by singles. If appliance prices went up in states with higher demand, as standard demand/supply models would suggest, then the quantity of appliances demanded by singles would decline. Such a pattern is inconsistent with the data. Of course, the possibility of increasing returns to scale in the shipping and delivery of capital goods or the dependence of price mark-ups on the size of the local market generating downward sloping supply curves for appliances can not be ruled out. More generally, a similar criticism can be addressed at the GSY story altogether. The observed negative time-series association between female labor supply and the relative price of home appliances that GSY emphasize might be driven by changes in participation by married women, rather than by prices.

Absent data on appliance prices, alternative approaches to identification in this area might rely on cross-sectional and time-series variation in variables associated with the cost of operating an appliance unit, e.g. electricity prices. State-level data on electricity prices is available for 1960 and 1970, but unfortunately during this decade the cost of electricity has changed proportionately across states, limiting the variation to exploit in a first-stage regression.[28] While the electrification of the U.S. was largely completed by 1960 (see Bailey and Collins, 2006), the current experience of some developing countries can provide a more

[28] Naturally, the assumption of exogeneity of electricity prices to married women's labor supply would have to be entertained to justify this instrument's validity.

data-rich testing ground for GSY's theory, as exemplified by Dinkelman (2008)'s work cited in the introduction. Her results are qualitatively consistent with ours, despite referring to a different country and a different time period.

In conclusion, we do not regard changes in home durable goods prices to be the only or even the most important driver of female labor supply in recent U.S. history. Our results imply that a significant portion of the increase in the labor supply of married women during the 1960's is due to reasons other than the diffusion of home appliances, as has been well documented in the literature. However, our results do point to technological progress as a potentially important factor in economic and social change. Recent research by Greenwood and Guner (2008) argues that technological progress in the household sector can also help explain the increase in the divorce rate and the decline in the marriage rate after WWII. Our findings confirm that this represents a fruitful area to be further explored in future research.

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Figure 1: Share of Single Women in Each State in 1960 vs. 1970

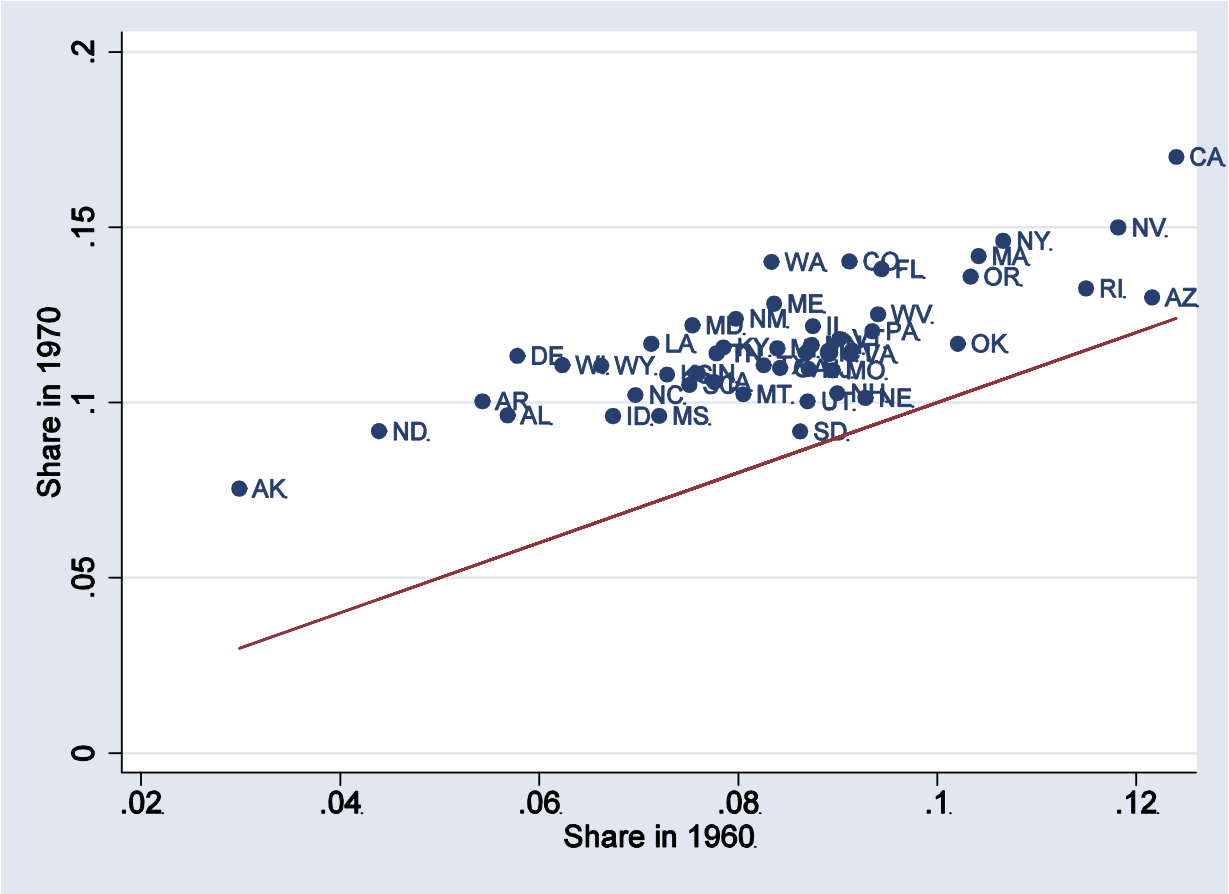

Table 1: Summary Statistics for Married Women Aged 18-55

Variables	All	1960	1970
		Outcome Variables	
Participation Rate	0.410	0.327	0.427
	(0.492)	(0.469)	(0.495)
Employment Rate	0.391	0.311	0.407
	(0.488)	(0.463)	(0.491)
Share Working Full-Time	0.253	0.214	0.261
(35+ Hours/Week)	(0.435)	(0.410)	(0.439)
Share at Work Year-Round	0.238	0.181	0.250
(48+ Weeks in Prior Year)	(0.426)	(0.385)	(0.433)
Hours Worked per Week	34.1	34.9	34.0
(Conditional on Working)	(10.5)	(10.6)	(10.5)
		Endogenous Regressors of Interest	
Washer Present	0.854	0.871	0.851
in the Household	(0.353)	(0.335)	(0.356)
Dryer Present	0.565	0.293	0.618
in the Household	(0.496)	(0.455)	(0.486)
Freezer Present	0.351	0.254	0.370
in the Household	(0.477)	(0.435)	(0.483)
All 3 Appliances Present	0.251	0.109	0.278
in the Household	(0.434)	(0.312)	(0.448)
		Covariates	
Age	36.8	36.9	36.8
	(10.2)	(9.7)	(10.3)
Number of Children Under	0.44	0.55	0.41
Age 5	(0.73)	(0.84)	(0.70)
Number of Children Over	1.43	1.31	1.45
Age 5	(1.48)	(1.35)	(1.51)
Potential Experience	19.1	19.7	19.0
(Years)	(10.7)	(10.2)	(10.8)

Table 1 (continued): Summary Statistics for Married Women Aged 18-55

Variables	All	1960	1970
Share with 0-11 Years of Schooling	0.324 (0.468)	0.432 (0.495)	0.303 (0.460)
Share with 12 Years of Schooling	0.467 (0.499)	0.398 (0.489)	0.480 (0.500)
Share with 13-15 Years of Schooling	0.124 (0.329)	0.109 (0.312)	0.127 (0.333)
Share with 16 or More Years of Schooling	0.085 (0.279)	0.061 (0.239)	0.090 (0.286)
Household Income (minus own earnings)	10,706 (8,050)	8,674 (6,459)	11,100 (8,266)
		Instruments	
Share of Single Women in State Owning a Washer	0.581 (0.077)	0.586 (0.102)	0.580 (0.071)
Share of Single Women in State Owning a Dryer	0.285 (0.115)	0.100 (0.070)	0.321 (0.084)
Share of Single Women in State Owning a Freezer	0.147 (0.062)	0.084 (0.041)	0.159 (0.057)
Share of Single Women in State Owning All Three Appliances	0.084 (0.044)	0.026 (0.025)	0.095 (0.038)
Number of Observations	322,312	52,373	269,939

Notes: Entries are means with standard deviations reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. Dollar amounts are in 1970 dollars.

Table 2: Change in Married Women Labor Force Participation and Appliance Ownership by Quartiles of Household Income Distribution and Woman's Education

	Variables	Change from 1960 to 1970	1960	1970
Income				
Quartile One	Participation Rate	0.108	0.371	0.479
	Own All 3 Appliances	0.118	0.058	0.176
Quartile Two	Participation Rate	0.111	0.357	0.468
	Own All 3 Appliances	0.169	0.076	0.245
Quartile Three	Participation Rate	0.084	0.322	0.406
	Own All 3 Appliances	0.198	0.110	0.308
Quartile Four	Participation Rate	0.097	0.256	0.353
	Own All 3 Appliances	0.191	0.195	0.386
Education				
HS Dropout	Participation Rate	0.078	0.305	0.383
	Own All 3 Appliances	0.157	0.071	0.228
HS Degree	Participation Rate	0.101	0.333	0.434
	Own All 3 Appliances	0.170	0.124	0.294
Some College	Participation Rate	0.086	0.350	0.436
	Own All 3 Appliances	0.155	0.158	0.313
College Graduate	Participation Rate	0.120	0.403	0.522
	Own All 3 Appliances	0.124	0.192	0.316

Notes: Entries are means. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. The income quartiles represent family income excluding the woman's labor income. Education is the married woman's highest education attainment.

Table 3: Summary Statistics for Single Women Aged 18-55

Variables	All	1960	1970
		Outcome Variables	
Participation Rate	0.784	0.780	0.785
	(0.411)	(0.414)	(0.411)
Employment Rate	0.755	0.745	0.757
	(0.430)	(0.436)	(0.429)
Share Working Full-Time	0.605	0.624	0.603
(35+ Hours/Week)	(0.489)	(0.484)	(0.489)
Share at Work Year-Round	0.556	0.536	0.559
(48+ Weeks in Prior Year)	(0.497)	(0.499)	(0.497)
Hours Worked per Week	37.7	38.2	37.6
(Conditional on Working)	(7.8)	(7.6)	(7.9)
		Endogenous Regressors of Interest	
Washer Present	0.574	0.579	0.573
in the Household	(0.494)	(0.494)	(0.495)
Dryer Present	0.292	0.099	0.318
in the Household	(0.454)	(0.299)	(0.466)
Freezer Present	0.144	0.081	0.153
in the Household	(0.351)	(0.273)	(0.360)
All 3 Appliances Present	0.084	0.0259	0.092
in the Household	(0.278)	(0.159)	(0.290)

Table 3 (continued): Summary Statistics for Single Women Aged 18-55

Variables	All	1960	1970
		Covariates	
Age	39.5	41.9	39.2
	(11.0)	(9.8)	(11.1)
Number of Children Under Age 5	0.14	0.13	0.15
	(0.45)	(0.44)	(0.46)
Number of Children Over Age 5	0.96	0.85	0.97
	(1.35)	(1.21)	(1.37)
Potential Experience (Years)	21.7	24.7	21.3
	(11.8)	(10.5)	(12.0)
Share with 0-11 Years of Schooling	0.357	0.471	0.341
	(0.479)	(0.499)	(0.474)
Share with 12 Years of Schooling	0.372	0.309	0.381
	(0.483)	(0.462)	(0.486)
Share with 13-15 Years of Schooling	0.143	0.116	0.146
	(0.350)	(0.320)	(0.354)
Share with 16 or More Years of Schooling	0.128	0.105	0.131
	(0.334)	(0.306)	(0.338)
Household Income (minus own earnings)	1,979	1,927	1,986
	(3,728)	(3,660)	(3,738)
Number of Observations	43,783	5,220	38,563

Notes: Entries are means with standard deviations reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, single women of prime working age (18 to 55 years old) who are household heads, and with state information. Dollar amounts are in 1970 dollars.

Table 4: Mean State Appliance Ownership Rates by Demographic Group, 1960-1970

	Married Women Aged 18-55		Single Women Aged 18-55	
Variables	1960	1970	1960	1970
Percent with Clothes Washer in Household:				
Overall Average	0.879 (0.057)	0.858 (0.036)	0.594 (0.141)	0.596 (0.077)
Lowest State Average	0.703 [AK]	0.743 [AK]	0.000 [AK]	0.281 [AK]
Highest State Average	0.981 [VT]	0.919 [LA]	0.867 [WV]	0.708 [WY]
Percent with Clothes Dryer in Household:				
Overall Average	0.275 (0.132)	0.610 (0.116)	0.092 (0.086)	0.322 (0.086)
Lowest State Average	0.069 [AZ]	0.376 [AZ]	0.000 [AR, VT, NV, SD, ME]	0.185 [NV]
Highest State Average	0.559 [OR]	0.805 [WA]	0.444 [ND]	0.488 [OR]
Percent with Freezer in Household:				
Overall Average	0.291 (0.099)	0.417 (0.119)	0.087 (0.061)	0.186 (0.071)
Lowest State Average	0.095 [MA]	0.162 [RI]	0.000 [VT, RI, NV, DE, WY, AK]	0.061 [MA]
Highest State Average	0.562 [ND]	0.675 [ND]	0.225 [OR]	0.397 [MS]
Percent with All 3 Appliances in Household:				
Overall Average	0.115 (0.072)	0.307 (0.113)	0.027 (0.038)	0.110 (0.053)
Lowest State Average	0.031 [AZ]	0.118 [RI]	0.000 [AK, AR, DE, FL, KS, LA, MA, ME, NC, NH, NJ, NV, OK, RI, SC, SD, VT, WY]	0.033 [MA]
Highest State Average	0.300 [OR]	0.571 [ND]	0.222 [ND]	0.250 [ND]
Number of Observations	49	49	49	49

Notes: Entries are means with standard deviations reported in parentheses. See notes to Tables 1 and 2.

Table 5: Summary Statistics for State-Level Covariates

Variables	All	1960	1970
Share of Population Living in Cities	0.644 (0.148)	0.615 (0.151)	0.654 (0.144)
Share of Workforce in the Service Sector	0.631 (0.085)	0.615 (0.092)	0.648 (0.075)
Average Wage Income	2,841 (847)	2,160 (469)	3,521 (535)
Gender Wage Gap	0.434 (0.069)	0.455 (0.079)	0.413 (0.049)
Ownership Rate of TV	0.912 (0.061)	0.870 (0.060)	0.954 (0.021)
Number of Observations	98	49	49

Notes: Entries are means with standard deviations reported in parentheses. The share of population living in cities is from the U.S. Statistical Abstract. The other variables were constructed from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born workers of prime working age (18 to 55 years old). To compute the gender wage gap we further restrict the sample to full-time full-year workers. Dollar amounts are in 1970 dollars.

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Table 6: OLS and Probit Estimates of the Effect of Household Appliances on the Labor Force Participation of Married Women

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	Probit (6)
Washer Present in the Household	-0.055***			-0.068***		
	(0.003)			(0.003)		
Dryer Present in the Household		0.003		0.025***		
		(0.003)		(0.003)		
Freezer Present in the Household			-0.005*	-0.002		
			(0.003)	(0.003)		
All Three Appliances Present in the Household					0.003	0.010
					(0.002)	(0.006)

Notes: Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. All regressions include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5; a full set of state and year dummies; and the state-level covariates described in the text. Probit entries are estimates of the implied marginal effects on the probability of a positive outcome (labor force participation). The sample size is 322,312. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table 7: First Stage Estimates of the Effect of Mean Appliance Ownership Rates among Singles in the State on the Appliance Ownership of Married Women

	Owns Washer (1)	Owns Washer (2)	Owns Dryer (3)	Owns Dryer (4)	Owns Freezer (5)	Owns Freezer (6)	Owns All Three (7)
Share of Single Women in State Owning a Washer	0.261***	0.260***		0.237***		-0.119**	
	(0.037)	(0.037)		(0.075)		(0.059)	
Share of Single Women in State Owning a Dryer		-0.033	0.433***	0.350***		0.062	
		(0.046)	(0.084)	(0.062)		(0.045)	
Share of Single Women in State Owning a Freezer		0.106		0.291***	0.393***	0.374***	
		(0.064)		(0.109)	(0.092)	(0.102)	
Share of Single Women in State Owning All Three Appliances							1.148***
							(0.122)
F-statistic	50.27	17.84	26.73	30.98	18.40	15.30	87.98

Notes: Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. All regressions include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5; a full set of state and year dummies; and the state-level covariates described in the text. The F-statistic corresponds to the test of joint significance of the coefficients on the endogenous regressors in each model. The sample size is 322,312. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table 8: 2SLS Estimates of the Effect of Household Appliance Ownership on the Labor Force Participation of Married Women

	2SLS (1)	2SLS (2)	2SLS (3)	2SLS (4)	2SLS (5)	IVProbit (6)
Washer Present in the Household	-0.027			-0.396		
	(0.140)			(0.284)		
Dryer Present in the Household		0.330***		0.353**		
		(0.116)		(0.149)		
Freezer Present in the Household			0.241**	-0.053		
			(0.103)	(0.217)		
All Three Appliances Present in the Household					0.274***	0.298***
					(0.068)	(0.063)
F-statistic	0.04	8.05	5.49	3.83	16.22	20.85

Notes: Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. All regressions include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5;a full set of state and year dummies; and the state-level covariates described in the text. The state's contemporaneous mean appliance ownership rates among single women are used as instruments for the endogenous regressors listed on each row. The F-statistic corresponds to the test of joint significance of the coefficients on the endogenous regressors in each model. Probit entries are estimates of the implied marginal effects on the probability of a positive outcome (labor force participation). The sample size is 322,312. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table 9: Robustness Checks: Falsification Exercises

	Outcome variable: Labor Force Participation of Single Women					*Outcome variable: Labor Force Participation of Married Women*					
	2SLS (1)	2SLS (2)	2SLS (3)	2SLS (4)	2SLS (5)	2SLS (6)	2SLS (7)	2SLS (8)	2SLS (9)	2SLS (10)	2SLS (11)
Washer Present in the Household	0.0798 (0.088)			0.082 (0.093)		-0.001 (0.137)			-1.688 (2.356)		
Dryer Present in the Household		0.039 (0.109)		0.030 (0.114)			0.358*** (0.118)		1.155 (1.511)		
Freezer Present in the Household			0.043 (0.132)	0.034 (0.140)				0.095 (0.177)	-1.815 (3.044)		
All Three Appliances Present in Household					-0.101 (0.156)					0.239*** (0.085)	
TV Set Present in the Household						0.563 (0.666)	0.740 (0.717)	0.589 (0.642)	4.803 (7.960)	1.176 (0.794)	0.561 (0.687)

Notes: Entries are estimates of the implied marginal effects on the probability of a positive outcome (labor force participation). Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. The sample size is 43,783 for columns 1–5, and 322,312 for columns 6–10. All regressions include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5; a full set of state and year dummies; and the state-level covariates described in the text. IV models use the state's contemporaneous mean appliance ownership rates among single women as instruments for the endogenous regressors listed on each row. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table 10: Robustness Checks

	24-55 Year Old Women	Single Men	Single Women in the Labor Force	State Averages Constant 1970 Weights	State Averages Actual Weights
	2SLS (1)	2SLS (2)	2SLS (3)	2SLS (4)	2SLS (5)
All Three Appliances Present in Household	0.255***	0.066	0.280***	0.296	0.310
	(0.060)	(0.158)	(0.093)	(0.190)	(0.224)
			First-Stage Regression		
Share of Single Women (or Men) in State Owning All Three Appliances	1.027***	0.564***	0.846***	0.835***	0.828***
	(0.115)	(0.175)	(0.217)	(0.170)	(0.200)
F-statistic	79.57	10.43	15.21	24.11	17.06

Notes: Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old, except in column 1), with state information, and working husbands. All regressions in columns (1)-(3) include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5; a full set of state and year dummies; and the state-level covariates described in the text. The column '24-55 Year Old Women' refers to the case in which the sample of both married and single women only includes women between 24 and 55 years of age. In this case the sample size of married women is 284,861. The column 'Single Men' reports results for the case in which the state's contemporaneous mean appliance ownership rates among single women and men are used as instruments for the endogenous regressor listed in the row. The column 'Single Women in the Labor Force' reports results for the case in which the state's contemporaneous mean appliance ownership rates among single women in the labor force is used to instrument for the endogenous regressor. The sample size of married women in columns (2) and (3) is 322,312. Columns (4)-(5) refer to regressions on state averages rather than individual-level data. In column (4) each state is weighted by its population of married women in 1970, while in column (5) each state is weighted by its population of married women in the relevant year (1960 and 1970). * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table 11: OLS and 2SLS Estimates of the Effect of Household Appliance Ownership on Employment, Full-Time and Year-Round Employment of Married Women, and Total Hours Worked Last Year

	Employment Previous Week		*Worked Full-Time Last Week*		*Worked Year-Round Last Year*		*Hours Worked Last Year*	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)	OLS (7)	2SLS (8)
All Three Appliances Present in Household	0.006***	0.251***	-0.004*	0.329***	-0.001	0.208***	-0.721	574.91***
	(0.002)	(0.065)	(0.002)	(0.062)	(0.002)	(0.054)	(3.885)	(132.30)

Notes: Standard errors corrected for state-year clustering are reported in parentheses. The data are from the Census IPUMS for 1960 and 1970 (State Form 1), with the sample restricted to white, U.S.-born, married women of prime working age (18 to 55 years old), with state information, and working husbands. The sample size is 322,312. Dependent variables: 'Employment Previous Week' is a binary indicator for whether the individual was employed in the previous week; 'Worked Full-Time Last Week' is a dummy variable indicating whether the individual worked at least 35 hours the previous week; 'Worked Year-Round Last Year' is an indicator for whether the individual worked at least 48 weeks in the previous year. 'Hours Worked Last Year' denotes a regression in which the dependent variable is represented by hours worked by a married woman in the previous year (0 if she did not work). All regressions include four education dummies; a quartic in potential experience; household income (in 1970 dollars); number of children under age 5; number of children over age 5; mean log female wages in the state and year; and a full set of state and year dummies. 2SLS models use the state's contemporaneous mean appliance ownership rates among single women as instruments for the endogenous regressors listed on each row. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.