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ASSESSING THE "ENGINES OF LIBERATION": HOME APPLIANCES AND FEMALE LABOR FORCE PARTICIPATION

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Abstract—The secular rise in female labor force participation, highlighted in the recent macroeconomics literature on growth and structural change, has been associated with the declining price and wider availability of home appliances. This paper uses a new and unique country data set on the price of home appliances to test its impact on female labor supply. We assess the role of the price of appliances in raising participation by comparing it to other structural determinants such as average male income. A decrease in the relative price of appliances— the ratio of the price of appliances to the consumer price index—leads to a substantial and statistically significant increase in female labor force participation. In the United Kingdom for instance, the decline in the relative price of home appliances accounts alone for about 10% to 15% of the increase in female labor force participation from 1975 to 1999. This result is robust to the inclusion of additional controls, such as country dummies, time trend, government spending, capital to output ratio, and the growth rate of real GDP. To assess causality, we test for exogeneity and use the manufactured price index and the terms of trade adjustment as instrumental variables confirming that lower appliance prices lead to increased female participation.

I. Introduction

OVER time, economies tend to experience an increase in women's participation in the labor force. Female labor force participation has risen from 34% to 41% in the last two decades alone in OECD countries.[1] This comes after substantial increases in female labor supply in the immediate postwar era, in countries where female labor force participation was already relatively high compared with the situation in developing countries.[2] Several factors have been pointed to as the root cause of increased female participation, and cultural and social changes are certainly very important.[3] The marked decrease in fertility rates, both *cause and result* of the increase in female labor supply, is an important factor.[4] Less obvious candidates have been put forward as well.[5] Economic factors also play a role. The increase in average real wages over time that accompanies economic growth has led to a rise in the opportunity cost of staying at home and encouraged labor force participation, as suggested by several studies.[6] However, as Blau (1998) argues, there is a substantial portion of the increase in female labor supply that is not explained by variables that are conventionally used in the empirical analysis. This paper investigates the role of technological progress in household appliances in the increase in female labor force participation. As stated in Greenwood and Seshadri (2005), "It seems unlikely that the small rise in the relative income of a female worker could explain the dramatic rise in labor force participation. It is more likely that the rise in overall real wages, in conjunction with the introduction of labor-saving household appliances, explains the rise in female labor-force participation." We use a new and unique country data set that allows us to assess the evolution of the relative price of appliances and relate it to women's participation in the market.

The rise in female labor force participation should respond to the availability and relative price of household appliances. A simple model of household production à la Becker (1965) suggests that a rational response to the

Received for publication June 14, 2004. Revision accepted for publication December 20, 2006.

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This paper has benefited from the financial support of Égide and Nova Forum at Universidade Nova as well as Fundação para a Ciencia e Tecnologia and POCTI through FEDER and Couselho Nacional de Desenvolvimento Cientifíco Technológico (CNPq-Brazil). We thank an anonymous referee for helpful comments. We are also indebted to Francesco Caselli, Chrissy Gianmitsaron, Jeremy Greenwood, Arye Hillman, José Ferreira Machado, Marco Per-coca, Michele Ruta, Guillaume Vandenbroucke, and Jamme Ventura for helpful suggestions and comments. We have also benefited from comments by audiences at the European University Institute in Florence. University of Cambridge. Universidade Nova de Lisboa. Universidade de Minho, Universidade Catolica Portuguesa, the Asset Annual Conference in Spain 2001, the European Public Choice Society Annual Meeting 2001, the European Eco-nomic Association Annual Meeting 2001, the Latin American Econometric Society Annual Meeting 2004, and the Annual Conference of the European Association of Labor Economists, 2006. We thank Daniel Santos and Paulo David for access to data used in the paper.

[1] World Bank (2001).

[2] Goldin (1995), in a historical overview of female labor market participation in the United States shows a rise from 3.1% to around 50% of the labor force between 1900 and 1980. As reported by Killingsworth and Heckman (1987), most of this increase in female labor force participation in the past century is attributable to increased participation of married women.

[3] Jaumotte (2003) surveys the determinants of female labor force participation in OECD countries and finds that cultural attitudes, in addition to general labor market conditions, female education, and the nature of tax and subsidy policies, all affect participation. Cavalcanti and Tavares (2007) consider cultural factors as a possible restriction of female labor force participation and provide a macroeconomic estimate of the output cost associated with discrimination. These authors uncover a substantial effect of discrimination on output per capita, both directly through lower participation as well as, indirectly, through increased fertility.

[4] See Goldin and Katz (2002). Olivetti (2001) for instance argues, "In the past, married women of childbearing age tended to specialize in childrearing and home production activities at the expense of engaging in market work. Now, they do not curb the hours worked in the market."

[5] As an example, Fernández, Fogli, and Olivetti (2004) argue that the evolution of male preferences plays an important role in the dramatic increase in female education and work decisions.

[6] Goldin (1995) shows that female labor force participation of married women tends to decrease and then increase as national income rises. This decline is due to a strong initial income effect that is later dominated by a substitution effect. Goldin (1995) also suggests that when women have poor human capital and their wage in the market is connected only with manual work, social stigma adds further resistance to female participation: as women become educated this stigma disappears. Blau (1998) shows that the more educated the woman, the more she tends to participate in the labor market: those with more than sixteen years of education have an 83% participation rate compared with 47% for those with fewer than twelve years. Acemoglu, Autor, and Lyle (2004) find that after the increase in female labor force participation in the wake of World War II, women were closer substitutes for male high-school graduates than lower skilled males.

relative costs and benefits of the use of time would result in increased female labor force participation as household appliances become relatively cheaper.[7] Technological progress in home appliances implies the saving of time and the substitution of labor for durable goods. Greenwood, Seshadri, and Yorukogln (2005) first raised this hypothesis: the emergence of cheap durable goods that perform household tasks facilitates the integration of women into the labor force. These authors present data on home utilities such as electricity, flush toilet, and central heating that show their availability rising from under 20% to more than 80% of U.S. households in the period between 1920 to 1970. Different appliances that reduce the cost of household chores —such as refrigerators, vacuum cleaners, washers, dryers, dishwashers, and microwaves—became widely available from the late 1940s (the first three) and from the 1970s and 1980s (the last three). The investment of households in home appliances and their accumulated stock in percentage of GDP almost doubled between 1955 and 1990. In addition, Greenwood, Seshadri, and Yorukoglu (2005) document a significant decrease in the number of domestic workers as well as hours worked at home for the postwar period: people working at home decreased by a factor of three while average weekly hours worked at home fell from 60 to 20 hours.[8]

A substantial portion of the tasks related to home and family care are unequally distributed between men and women, with the latter performing the larger share. Blau (1998) points out that while married women not in the labor force worked between 33 and 37 hours a week at home, men—independently of their status, single, married, with or without employed wife—worked between 5 and 8 hours.[9] Our question is simply put: does a lower relative price of home appliances encourage female labor force participation? Our data set provides yearly information on the price index of home appliances for a wide sample of OECD countries between 1975 and 1999. This index considers only household appliances that are likely to save labor in household cleaning and maintenance.[10] The home appliance price index is divided by the consumer price index and the value in 1985 set to 1 for standardization purposes. Our data allow us to take advantage of the time and cross-country variations in the relative price index of home appliances to study their impact on female labor force participation.[11] In our sample this relative price index of appliances tends to decrease over time for all countries, and the total decrease for the period under study is substantial for all countries. In figure 1 (panel A) we plot the evolution over time of the average relative price index of home appliances, plotted against the female and male rates of labor force participation.[12] It is evident that female labor force participation rose dramatically by about 30%, while the relative price of home appliances decreased by around 20%.[13] In contrast, male labor force participation remains almost constant, even decreasing slightly.[14] Figure 1 (panel B) shows the 25-year change in female labor force participation by country against the 25-year change in the relative price of the home appliance index. It shows that on average, countries that experienced large increases in female labor force participation from 1975 to 1999 also had larger drops in the relative price of home appliances.

Our main objective is to determine whether the decrease in the relative price of home appliances is correlated with the rise in female labor force participation and how important this effect is, in quantitative terms. We assess the robustness of this relationship to other determinants of labor force participation by women, including "structural" determinants such as average male income and government spending as a share of GDP and "cyclical" determinants such as the rate of growth of real GDP.[15] In addition, we added country dummies to control for country-specific differences in female labor force participation, as well as year time dummies and country-specific time trends. We also run a robustness exercise using the manufactured price index and the terms of trade adjustment as instrumental variables to the relative price of home appliances to assess whether there is evidence of a causal relationship.

[7] Greenwood, Seshadri, and Vandenbroucke (2005) explain the baby boom as the result of a surge in technological progress in household appliances that lowered the cost of having children.

[8] Landsburg (2003) confirms these data: housework took an average of 58 hours a week in 1900 and was down to about 18 hours by 1975. Blan (1998) reports that, in the decade from 1978 to 1988, the number of women's work hours at home and in the market practically reversed from 27/20 to 21/26.

[9] Case and Paxson (2000) find that it is children's mothers that make most investments in children's health, namely as regards time consumed in doctor visits and the like.

[10] Furniture and audiovisual appliances are excluded.

[11] Greenwood, Seshadri, and Yorukoglu (2005) documented a decrease in the price of appliances for a sample of countries, but no individual country data are reported.

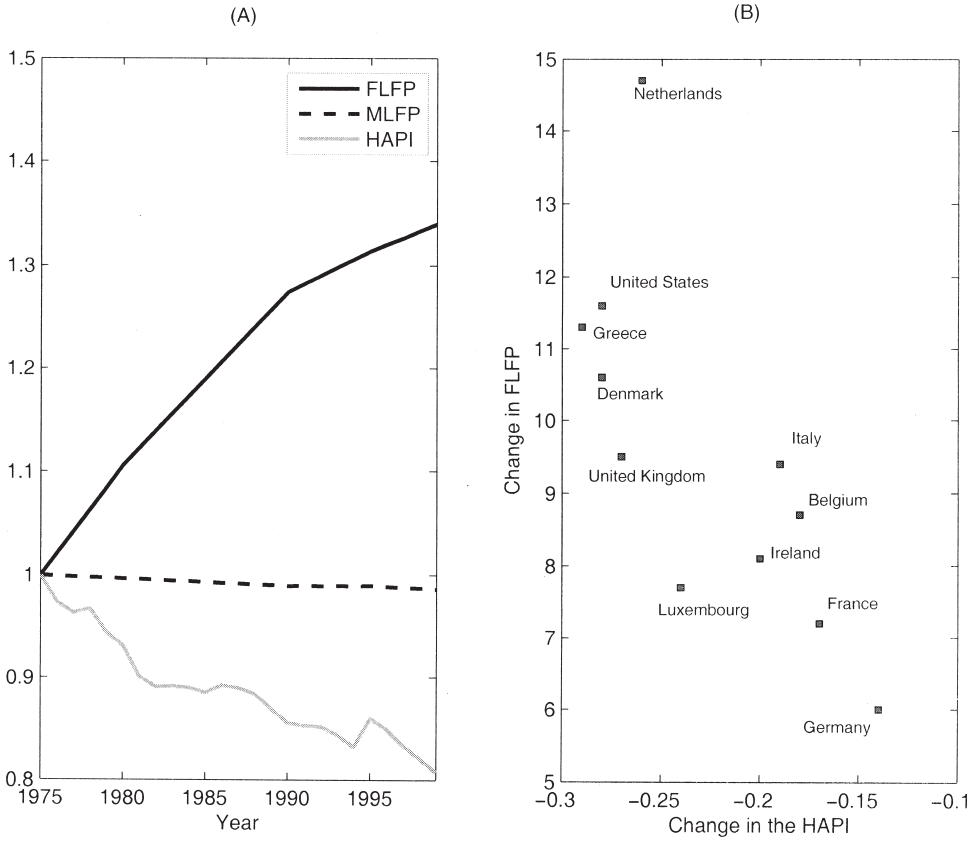
[12] All series are normalized to 1 in the year 1975.

[13] Greenwood, Seshadri, and Yorukoglu (2005) document a positive relationship between the stock of appliances and female labor force participation, as well as a worldwide negative relationship between changes in the relative price of appliances worldwide and female participation (this is, a cross section, not panel observation, as is our case). International comparisons show that countries where durable goods are cheapest are those where more women work for wages.

[14] Blan (1998) shows that the participation rates of men in the United States actually decreased about 6% between 1970 and 1995.

[15] In the spirit of Jones, Manuelli, and McGrattan (2003), we could have also added the gender wage gap as an explanatory variable, but there are too few observations available for this variable. Though this gap might be the result of differences in working characteristics among women and men, it may also be a consequence of labor market discrimination, which would discourage women from working. In a broad survey of studies of the gender wage gap. Weichselbaumer and Winter-Ebmer (2003) find that wage differentials between men and women tend to decrease, and that this is mostly due to an increase in the market productivity of females. The theoretical model and simulation exercises of Jones, Manuelli, and McGrattan (2003) suggest that the reduction in the gender wage gap is the main determinant of the increase in female labor market participation. Bassi (2003) finds evidence that, instead, the gender wage gap is not strongly related to female labor force participation.

FIGURE 1.—FEMALE LABOR FORCE PARTICIPATION AND THE RELATIVE PRICE OF HOME APPLIANCES



Panel A: Relative price of home appliances, female and male labor force participation rates (1975=1). Average of OECD countries from 1975 to 1999. Panel B: Changes in female labor force participation (FLFP) versus changes in the home appliance price index (HAP1). In panel (B) we used only countries with data available for the 1970s.

We find that a decrease in the price of home appliances leads to a sizable, statistically significant and robust increase in female labor force participation. On average a 20% decrease in the relative price of appliances leads to an increase in participation of between 2% and 3%. In the United Kingdom, for instance, the decline in the relative price of home appliances accounts alone for about 10% to 15% of the increase in female labor force participation from 1975 to 1999. Besides the year dummies, the change in the relative price of home appliances has the strongest impact on female labor force participation. Moreover, this effect is robust for different specifications. We see our work as complementary to the microeconomic literature on the determinants of female labor force participation, suggesting new avenues for further research.

II. Empirical Results

We now present the empirical results on the impact of home appliances on female labor force participation. The data are available for seventeen OECD countries—including all the largest European economies and the United States, between the years 1975 and 1999, totaling 311 observations.[16] All data are from World Bank (2001), with the exception of the price index of home appliances, our main variable of interest, obtained from the New Chronos Database at the Statistical Office of the European Union. The data appendix presents, for each variable, its description, unit, and source, and table 1 presents some descriptive statistics for all variables. Our basic specification is

$$FLFP_{it} = \alpha + \beta_0, PAPPLIANCES_{it} + \beta_1 \cdot Z_{it} + \varepsilon_{it}, \quad (1)$$

where $FLFP_{it}$ is female labor force participation in country i at year t, and $PAPPLIANCES_{it}$ is the relative price of home appliances measured as the yearly ratio of the home appliance price index to the consumer price index. Z_{it} is a vector of additional determinants of female labor force participation: *average male income, GDP per capita, growth of real GDP, government spending as a share of*

[16] The data points correspond to the availability of our key variable, the yearly price index for home appliances, which is used to construct our relative price of home appliances. The countries in the sample are Austria, Belgium. Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, Great Britain, and the United States.

TABLE 1.—SUMMARY STATISTICS

	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Female labor force part.	311	34.57	8.38	20.60	51.60
Relative price of home appl.	311	1	0.07	0.77	1.18
Average male income	310	43,937.21	17,008.95	15,153.32	107,919.8
Growth rate	311	2.69	2.33	−6.57	10.74
Government spending/GDP	311	20.02	3.56	12.55	28.69
Urban population	311	75.83	14.07	30.96	97.24

GDP, and the *share of the urban population.* Table 1 shows summary statistics for these variables.

The level of average male income may affect female labor supply as the opportunity cost of not working in the market increases with market wages (substitution effect), which are closely associated with average male income.[17] On the other hand, higher male income might allow married women to stay at home instead of going to the market to increase household income (income effect). The response of female labor force participation to the increase in market wage depends on the strength of these two effects. As to the growth rate of real GDP, this business cycle indicator captures the response of female labor supply to cyclical fluctuations. Women may respond to recessions either by moving into the labor force—and supplement dwindling family incomes—or by being discouraged from participation. Higher government spending as a share of GDP might decrease the cost of performing household chores—including, but not limited to, child rearing and child care—thereby increasing female labor supply, as suggested by Cavalcanti and Tavares (2006).[18] As Blau (1998) suggests, female labor force participation is associated with changes in social norms, such as smaller number of children and the widespread use of birth control methods, which are in general associated with the urban population. Therefore, we should observe a positive effect of the share of the urban population on female labor market participation. Besides these control variables, we also add country dummies, year dummies, and country-specific time trends. The country dummies are important to control for country-specific differences in female labor force participation. Without the year dummies, any variable that is negatively correlated with time (such as the relative prices of home appliances) is bound to be negatively correlated with female labor force participation, which trends upward in almost all OECD countries. Country-specific time trends are a demanding test of the data and might capture the fact that female labor force participation might behave differently over time in different countries. We add the controls in succession to the simplest specification, where only the relative price of home appliances is introduced as a right-side variable.[19] This allows us to test the robustness of the effect of the price of home appliances on female labor supply.

We first estimate our model by OLS, using standard errors robust to the presence of heteroskedasticity. We then run an additional exercise: we use IV to assess causality. The OLS method uncovers the association between the variables and female labor supply, whereas the IV procedure attempts to address whether the relationship between the price of home appliances and female labor supply is causal.

A. *Basic Results*

In table 2 we present results for the specifications using the OLS estimation procedure. The first noticeable result is the negative sign of the coefficient of the home appliance price index, which strongly suggests that as household appliances become less expensive, women are more willing to participate in the labor market, as we expected. If in *all* regressions the coefficient of the home appliance index is negative, it is also statistically different from 0 *except* for the regression in column 9. The coefficient on home appliance price index is robust to the introduction of country fixed effects and country time dummies, although it decreases in absolute value in the latter case.[20] The negative coefficient on the price of home appliances is robust to the introduction of the different additional control variables: average male income, the growth rate of GDP, government spending over GDP, and the share of population that is urban.[21] Observe also that the *R*-squared indicates that the most complete specification captures a very substantial share of the total variability in female labor force participation. Even when introduced in isolation, in column 1, the relative price of appliances explains a good share of total variability in female participation.

In the last three columns of table 2 we introduce country-specific time trends to take into account the possibility that the trend might affect female labor participation differently

[17] We could have used income per capita. However, when females enter the labor force, they raise national income without raising the number of people. Therefore, there would be reverse causality between income per capita, and female labor force participation would be mechanical.

[18] Evidence that specific tax and subsidy policies in OECD countries affect female labor force participation can be found in Jaumotte (2003), for instance.

[19] We could have added the fertility rate. However, fertility and female labor force participation are jointly determined: women who plan to work are more likely to use contraceptive methods and therefore less likely to become pregnant. We also added the capital to output ratio, which we took from Klenow and Rodrígnez-Clare (2005), but results were unchanged.

[20] This is consistent with figure 1. panel B, where we verified that countries with larger decreases in the home appliance price index also experienced larger changes in female labor force participation.

[21] The coefficient decreases slightly from −5.60 (column 3) to −3.42 (column 7).

TABLE 2.—DETERMINANTS OF FEMALE LABOR FORCE PARTICIPATION—ORDINARY LEAST SQUARES ESTIMATION

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Home appliance price index	−39.83** (−4.45)	−36.94** (−16.58)	−5.60** (−3.74)	−4.21** (−2.96)	−3.87** (−2.66)	−3.15** (−2.03)	−3.42** (−2.17)	−7.11** (2.63)	−3.42** (−3.07)	−0.30 (−0.23)
Average male income				−0.00007** (−8.11)	−0.00008** (−8.65)	−0.00008** (−7.84)	−0.00009** (−7.81)	0.0003** (5.33)	−0.00002 (−0.70)	0.00004 (1.18)
GDP growth rate					0.09** (2.48)	0.07** (2.04)	0.06* (1.72)	0.001 (0.02)	0.02 (1.45)	0.03 (1.22)
Gover. spend./GDP						−0.10 (−1.50)	−0.13 (−1.59)	0.07 (0.58)	−0.05 (−0.99)	−0.12** (−2.20)
Urban population							0.02 (1.39)	−0.02 (−0.63)	0.79** (3.44)	0.72** (3.16)
Country dummies	NO	YES	YES	YES	YES	YES	YES	NO	YES	YES
Year dummies	NO	NO	YES	YES	YES	YES	YES	NO	NO	YES
Country time trends	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
N. of observ.	311	311	311	311	311	311	311	311	311	311
R^2	0.07	0.93	0.98	0.98	0.98	0.98	0.99	0.94	0.99	0.99

All specifications include a constant, not reported. *t*-statistics are presented in parentheses, using heteroskedasticity-consistent standard errors. *indicates significant at the 90% confidence level and **at the 95% confidence level. The source, unit, and definition for each variable are presented in the data appendix.

Fn22 across countries.[22] We observe that in the absence of year dummies, the coefficient on the home appliance price index is negative and statistically different from 0, as observed in columns 8 and 9. Only when year dummies are added to country dummies and country-specific time trends does the coefficient on the price of home appliances lose statistical significance, though it maintains its negative sign, as in column 10. It is important to notice, though, that the *R*-squared in column 7—without country-specific time trends—is already at 0.99 and increases only marginally. The simultaneous introduction of time and country dummies and country-specific time trends is a very demanding test of the data: all coefficients lose statistical significance with the introduction of country time trends and country-specific time trends. We will concentrate on regressions 1–7 in our quantitative analysis.

The quantitative impact of the price of home appliances on female labor market participation is sizable: the estimated elasticity for the average value of female labor force participation and the relative price of home appliance ranges Fn23 from −0.10 to −0.15.[23] On average a 20% decrease in the relative price of appliances leads to an increase in participation of between 2% and 3%. Recall that, for our sample covering the 1975 to 1999 period, a country-specific decrease in the relative price of appliances of 15% to 20% is quite common. In the United Kingdom, for instance, the home appliance price index decreased by roughly 28%. According to our estimates, such a decline in the home appliance index would imply an increase in labor force participation of about 3% to 4.5%.

In columns 1 to 7, all other additional controls display stability as to the sign, size, and significance of the associated regression coefficient. We observe that female labor force participation increases with the growth rate of real GDP, and decreases with average male income. This suggests that the income effect is stronger than the substitution effect, but the sign of average male income changes when we introduce country-specific time trends. The coefficient of the variable government spending is not statistically different from 0 in most specifications. As expected, the share of urban population seems to have a positive effect on female labor force participation.

B. *Causality*

A strong and robust association between the price of appliances and female labor force participation does not imply that one causes the other. Indeed, some have argued that technological innovations that increase the quality and lower the price of appliances might be driven by demand (directed technical change),[24] that is, by an increase in Fn24 female labor force participation. In this section we conduct additional tests to investigate the causal link between female labor force participation and the relative price of home appliances.

To assess causality we would like to find instrumental variables that are strongly related to the relative price of appliances and that are unlikely to directly affect female participation rates. We use two instruments: the relative manufacturing price index and the terms of trade adjustment. Our reasoning is that changes in the manufacturing price index and in the terms of trade adjustment are likely to have a strong impact on the *relative* price of home appliances. In addition, there is no reason to believe that the manufacturing price index or the terms of trade should

[22] The sign, magnitude, and statistical significance of the home appliance price index in table 2 (columns 3–7) are all robust to the substitution of year dummies for country-specific time trends.

[23] The estimated elasticity is based on the coefficient of the home appliance index in regressions 3 and 8 in table 2.

[24] See Acemoglu (1998) and Sehmookler (1966). Although directed technical change is an important explanation for rapid growth in innovation, we would be surprised if technological innovation in appliances were driven by higher female labor force participation. We believe that much of the decline in appliance prices is explained by general innovation in engineering and manufacturing, as well as changes in raw material and energy prices.

TABLE 3.—DETERMINANTS OF FEMALE LABOR FORCE PARTICIPATION—INSTRUMENTAL VARIABLES ESTIMATION

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Home appliance price index	−85.70** (−1.61)	−62.20** (−12.11)	−27.29** (−2.96)	−26.18** (−3.65)	−25.40** (−3.51)	−31.55** (−3.32)	−32.86** (−3.79)	−28.01** (−4.05)	−16.93* (−1.84)	−24.08 (−1.62)
Average male income				−0.00004** (−2.60)	−0.00004** (−2.73)	−0.00003 (−1.55)	−0.00005** (−2.70)	0.0001** (3.24)	0.00006** (2.40)	0.00005 (1.10)
GDP growth rate					0.05 (1.12)	0.06 (1.14)	0.03 (0.49)	0.08 (1.19)	0.02 (0.67)	0.02 (0.65)
Gover. spend./GDP						0.09 (0.83)	−0.02 (−0.24)	0.36 (2.70)	−0.11 (−1.25)	−0.13 (−1.37)
Urban population							0.10** (2.62)	−0.03 (−0.94)	1.52** (7.26)	0.74** (2.47)
Country dummies	NO	YES	YES	YES	YES	YES	YES	NO	YES	YES
Year dummies	NO	NO	YES	YES	YES	YES	YES	NO	NO	YES
Country time trends	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
N. of observ.	306	306	306	306	306	306	306	306	306	306
R^2	0.07	0.91	0.97	0.98	0.98	0.98	0.98	0.92	0.99	0.99

All specifications include a constant, not reported. *t*-statistics are presented in parentheses, using heteroskedasticity-consistent standard errors. *indicates significant at the 90% confidence level and ** at the 95% confidence level. The source, unit, and definition for each variable are presented in the data appendix.

directly affect the participation choices of potential female workers.[25]

We first regress the relative price of home appliances on the manufacturing price index, terms of trade adjustment, and on all right-side variables in the specification for female labor force participation. Panel A of table B1 in Appendix B shows the results of the first-stage regressions. Observe that in all regressions the coefficient on either the manufacturing price index or the terms of trade (or both) are statistically different from 0. As expected, there is a positive and in general statistically significant effect of the relative price of the manufacturing price index on the relative price of appliances. Panel B of table B1 reports the *p*-value from the appropriate χ^2 overidentification test. This test assumes that one of the instruments (for example, the food price index) is exogenous and tests the validity of the second instrument (such as the lag of the relative price of home appliances). Notice that in regressions 2–7 we could not reject the null hypothesis of orthogonality of the instruments at the 95% confidence level.[26]

Table 3 presents our second-stage regression results. The first thing to note is the remarkable consistency of the results in table 3 when compared with those of table 2. Again the relative price of appliances is robustly significant and negatively associated with female labor force participation.[27] As we instrument for the price of appliances we find that quantitatively, the causal relationship with female participation is actually stronger than suggested by the OLS estimates. The elasticity of female labor force participation now ranges from −0.73 to −0.46.[28] A decrease in the relative price of appliances of 20% can lead to an increase in participation from 13% to 20% depending on the specification considered. For the United Kingdom, for instance, the relative price of home appliances explains about 33% to 55% of the total change in female labor force participation from 1975 to 1999.

The results on the controls are similar to those found previously in table 2. Average male income and government spending seem to negatively correlate with female labor force participation, but the coefficients on these variables are not robust to the introduction of other controls. Growth of real GDP correlates positively with female labor force participation, confirming our previous results, in spite of not being statistically significant. As expected, the coefficient of the share of urban population seems to correlate positively with female labor force participation. The overall fit statistic on the different specifications suggests that these are capturing a substantial amount of the variability in female labor force participation.

In sum, our empirical results suggest a strong negative causal relationship between the relative price of home appliances and female labor force participation. The evidence is in favor of a positive impact of availability in home appliance technology on participation, and this is robust to the introduction of different controls, including country dummies, year dummies, and country-specific time trends.

III. Conclusion

This paper conducts an empirical investigation of the role of the availability of home appliance technology on the labor market participation of women. Our conjecture, in line with Greenwood, Seshadri, and Yorukoglu (2005), is that

[25] One might argue that inflation could affect female labor force participation directly, Bassi (2003), however, shows that in Argentina—a country with historical experience in abrupt changes in the price level—inflation did not seem to have any direct effect on female labor force participation. According to Bassi, changes in social norms, contraceptive methods, and labor-saving devices in the home were the main determinants of changes in female labor force participation from 1983 to 2002.

[26] Only in regressions 1 and 8, we reject the validity of our instruments at the 95% confidence level. However, notice that in these regressions we do not control for country effects or time dummies.

[27] Even in the last regression, when we control for country dummies, time dummies, and country-specific time trends, the coefficient on the relative price of home appliances is statistically significant at the 80% confidence level.

[28] Here we used regressions with year dummies or country-specific time trends (columns 3–10).

wider availability and lower cost of home appliances facilitates the participation in the labor market by decreasing the amount of time necessary to perform household chores. Since an unequal share of these chores tends to fall on women's shoulders, female labor force participation should increase in response. We have assembled a unique new data set on yearly price changes of a composite of home appliances that are related to household chores and computed the relative price of appliances as the ratio of the home appliance index to the general price index. In the last two and a half decades, there has been a marked decrease in the relative price of appliances—between 7% and 28%—accompanied by increases in female labor force participation. Male labor force participation has remained virtually unchanged.

We estimate the relationship between the price of appliances and participation after controlling for a host of macroeconomic factors, structural and cyclical. We uncover a robust negative relationship between the relative price of appliances and female participation, with a sizable quantitative effect. For the United Kingdom, for instance, our estimates suggest that the decline in the relative price of home appliances accounts alone for about 10% to 15% of the increase in female labor force participation from 1975 to 1999, a sizable effect to be acknowledged in future research.

We see this paper as complementary to the microeconomic literature on the determinants of female participation in the labor market. The new macroeconomic data set exploited here delivers new results and suggests new avenues for future research.

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APPENDIX A

Data Appendix

Female labor force participation - Description: Female labor force activity rate, percentage of female population ages 15 to 64. Unit: Percentage points. Source: World Bank (2001).

Household appliance price index - Description: Ratio of price index of household appliances to consumer price index. Unit: Ratio with first available year taking value 1. Source: Eurostat (2003).

Male labor force participation - Description: Male labor force activity rate, percentage of female population ages 15 to 64. Unit: Percentage points. Source: World Bank (2001).

Average male income - Description: Gross domestic product divided by the male population. Unit: Constant 1995 US dollars. Source: World Bank (2001).

Real GDP growth - Description: Growth in real per capita gross domestic product. Unit: Yearly growth rate in percentage points. Source: World Bank (2001).

Government size - Description: General government final consumption expenditure, in percentage of GDP. Unit: Percentage points. Source: World Bank (2001).

Urban population - Description: Urban population as percentage of total. Unit: Percentage points. Source: World Bank (2001).

Tax rate - Description: Average tax rate computed as current tax revenues as percentage of GDP. Unit: Percentage points. Source: World Bank (2001).

Manufacturing price index - Description: Ratio of price index of manufacturing products to consumer price index. Unit: Ratio with first available year taking value 1. Unit: 1995 = 1. Source: World Bank (2001).

Terms of trade adjustments - Description: The terms of trade effect equals capacity to import (the value of exports divided by an import price index) less exports of goods and services in constant prices. A positive value corresponds to greater capacity to import or a positive terms of trade shock. Data are in constant 1987 US dollars. Source: World Bank (2001).

APPENDIX B

First-Stage Regressions

TABLE B1.—DEPENDENT VARIABLE: RELATIVE PRICE OF HOME APPLIANCES—FIRST-STAGE REGRESSIONS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: First Stage for Relative Price of Home Appliances										
Manufacturing price index	0.14** (6.52)	0.25** (10.80)	−0.02 (−0.77)	−0.06** (−2.16)	−0.06** (−2.56)	−0.03 (−1.12)	0.005 (0.17)	0.20** (6.68)	0.03 (1.07)	0.02 (0.77)
Terms of trade	−9.58e–14 (−0.59)	1.34e–13 (0.38)	7.41e–13** (2.78)	9.51e–13** (3.60)	9.26e–13** (3.50)	8.31e–13** (3.15)	9.32e–13** (3.56)	2.74e–13 (0.85)	7.69e–13** (3.02)	4.74e–13* (1.75)
Average male income				2.18e–06** (1.06)	2.43e–06** (4.26)	2.33e–06** (4.14)	1.37e–06** (2.15)	−5.52e–06** (−5.94)	−1.47e–06 (1.60)	9.84e–07 (0.79)
GDP growth rate					−0.001 (−1.28)	−0.0006 (−0.46)	−0.001 (−0.93)	0.002* (1.70)	−0.0001 (−0.16)	0.00002 (0.02)
Gover. spend./GDP						0.005** (2.72)	0.002 (1.05)	0.006** (3.02)	−0.005** (−2.36)	−0.0001 (−0.07)
Urban population							0.003** (3.09)	0.001 (3.78)	−0.02** (−3.64)	0.006 (0.85)
Country dummies	NO	YES	YES	YES	YES	YES	YES	NO	YES	YES
Year dummies	NO	NO	YES	YES	YES	YES	YES	NO	NO	YES
Country time trends	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
N. of observ.	306	306	306	306	306	306	306	306	306	306
R^2	0.12	0.42	0.76	0.77	0.77	0.78	0.79	0.53	0.84	0.87
Panel B: Results from Overidentification Test										
p-value (*chi*-squared test)	0.00	0.12	0.10	0.05	0.06	0.13	0.91	0.91	0.06	0.09

All specifications include a constant, not reported. *t*-statistics are presented in parentheses, using heteroskedasticity-consistent standard errors. * indicates significant at the 90% confidence level and ** at the 95% confidence level.