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What accounts for the increase in female labor force participation in Spain

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Abstract

Over the last three decades, Spanish female labor force participation (LFP) has tremendously increased, particularly, that of married women. At the same time, the income tax structure, the fiscal treatment of families, policies to reconcile family and work, and the education distribution of married couples have substantially changed. By contrast, the gender wage gap has remained quite stable. In this paper the author investigates the relevance of these factors in accounting for the growth in Spanish married women labor force participation from 1994 to 2008. For that purpose, she uses Kaygusuz' model of household labor market participation, and data from Eurostat to calibrate the model and evaluate its performance. The model successfully accounts for the rise in aggregate female labor force participation, and matches hours worked by males and females. The model is also able to replicate the pattern of female labor force participation by age and education. From this analysis we can conclude that changes in tax rates and in the education distribution are the main factors behind the increase in female LFP during the late nineties, while changes in child care costs and earning profiles are mainly responsible for the subsequent growth in the 2000s.

JEL J11 J12 J13 J22 J31

Keywords Female labor force participation; gender wage gap; income tax; educational distribution; wage profiles; child care costs

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1 Introduction

Over the last three decades, Spanish female labor force participation (LFP) has tremendously increased, particularly, that of married women. Between 1994 and 2008 the participation rate of married women aged 18–54 years soared from 42.2 to 78.3 percent in 2008.[1] Not only did the participation rate of a given birth cohort of women rise as women got older, but it also increased across cohorts, with younger cohorts having larger participation rates. The labor force participation of married women aged 18–29 years almost doubled and that of married women aged 44–55 more than tripled. During the same period, weekly market hours remained quite stable.

Part of the reason for the growth in married women labor force participation may be attributable to compositional changes, related to changes in the education distribution of married couples, given the huge increase in female education. During this period the fraction of college graduate females significantly grew, while that of females with less than high school education declined. In 1994, 60% of married women aged 18–54 years had less than high school education and only 20% had college education, while in 2008 these numbers were 33% and 42%, respectively.

Nonetheless, non-compositional effects may have been at work too. Changes in the income tax structure, in the fiscal treatment of families, in wage profiles, in child care costs, and new policies aimed to reconcile family and work, may have altered married women economic incentives to work.

Regarding the income tax policy, recent reforms have lowered the top marginal tax rates, from 56 percent in 1994 to 42 percent in 2008, and progressively reduced the number of brackets from 17 to 4. Figure 1 in the Appendix shows marginal tax rates for households filling jointly in the period under study. Also the fiscal treatment of families has been modified. The Law 214/1999 changed how family structure affects tax calculations. Before 1999, there was a deduction from tax liability for dependent children. Since 1999 deductions for family size have been directly applied to taxable income, and the tax liability is calculated for household income net of deductions. Another reform took placed in 2003 (Law 46/2002). This reform increased the tax deduction applied based on the number of children and introduced a monthly cash benefit for working mothers of children less than three years old.

Concerning wage profiles, the gender wage gap has remained quite stable despite the huge decrease in the employment gender gap. According to Guner et al. (2014), the gender wage gap was about 20% in 2010, quite close to its value in 1994. De la Rica et al. (2008) find that the flatter evolution of the Spanish gender wage gap hides a compositional effect. They partly explain the evolution of the wage gap based on statistical discrimination exerted by employers in countries where less educated women have low participation rates.

With regard to child care costs, a major reform took place in 1990 (Law 1/1990), which made public education widely available for children aged three years and older. And, in the 2000s, the large inflow of immigrants played a significant role in making chid care services more affordable (see Farré (2011). As far as policy changes to help reconcile family and work, there was a reform

[1] The year 2008 has been chosen as the last data point in this analysis because the evolution of female labor force participation has substantially changed due to the recent crisis (see Guner et al., 2014).

in 1999 (Law 39/1999), which introduced unpaid leaves of up to three years, and right to part time for parents of less than seven years old children.

The aim of this paper is to quantify the extent to which these factors account for the growth in female labor force participation in the period 1994–2008. For that purpose, I first show the evolution of female labor force participation by age and education, age-earnings profiles for men and women, and the change in the distribution of married households by education. Next, following Kaygusuz (2010), I use a static heterogeneous agent model, populated by married households, in which households differ by age and educational attaintment levels of their members, to perform the computations.[2] A household makes labor supply decisions for its members taking into account that if the husband and the wife both participate in the labor market, the household incurs a fixed utility cost, which is meant to capture child care costs and difficulties in reconciling family and work.

Due to data considerations, I study two periods separately: 1994–2000 and 2004–2008. First, I choose parameter values so that the model is consistent with 1994 data in terms of the income tax structure, wage profiles, educational composition and female labor force participation. Then, I impose 2000 tax rates, 2000 wage earnings profiles, and 2000 marriage distribution, one at a time, to compute by how much female labor force participation would change due to these factors. In a subsequent exercise I calibrate the model to 2004 data and perform the same type of calculations, now considering 2008 tax rates, 2008 wage earnings profiles, and 2008 marriage distribution.

The first exercise shows that 40.4 percent of the growth in female labor force participation can be accounted for by income tax cuts. In fact, in this period, the top marginal tax rate was reduced from 56 to 48 percent and the number of brackets dropped from 17 to 6. Furthermore, changes in wage profiles exert a negative effect, while the change in the distribution of households contributes positively.

The simulation of the second exercise points to the role of changes in wage profiles and gender wage gaps as the key factors behind the rise in women labor force participation in the period 2004–08. For most education-age groups, the wages of married women either increased more or declined less than the wages of married men. This provided an incentive for nonworking women to reduce the time allocated to household activities and engage in market work. Hence, there is some support for the notion that family labor supply decisions are jointly made by the various family members, with female labor supply being particularly responsive to changes in the husband's wage.

Based on the differences in utility costs in the two calibrations, one can try to provide an explanation for the growth in married women labor force participation between 2000 and 2004, yet carefully because the data sets, from which we have information for these two years, are not perfectly comparable. The two candidate explanations are declining marginal tax rates, and the drop in the utility costs associated to having children and working in the market. The results let us conclude that the change in the income tax rate is not the main factor behind the increase in married women labor force participation between 2000 and 2004, but the change in utility costs, which is quite substantial.

Surely, there are other factors that may have played a role. Changes in average fertility, which dropped from 3.3 to 2.0 children, might be one of them. But, it is also possible that the rise in the market wage, particularly pronounced in the second period analyzed, also made childbearing a

[2] While the model consists of households with different ages, it abstracts from life-cycle dynamics.

very expensive household activity, so that the causation runs in the opposite direction: women have fewer children because they participate more. Another factor might be the remarkable time-saving technological advances in household production, which have reduced the gap in marginal products between the two spouses, lessening the need for specialization, and further contributing to female labor force participation (see Greenwood et al., 2005). Last, other factors, such us changes in institutions (i.e divorce laws) and in cultural attitudes towards women in the labor market, may also explained, in part, the boost in married women labor force participation. Nonetheless, the results indicate that changes in demographics and in the economic environment explain a significant amount.

It goes without saying that this is not the only paper that has studied Spanish female labor force participation. Guner et al. (2014) document recent trends in gender gaps in employment and wages. Azmat and González (2010) evaluate the impact of the 2003 reform in the Spanish income tax on the employment of mothers with small children, finding positive effects, especially among less educated women. Farré et al. (2011) claim that immigration, by means of providing child care or elderly care, accounts for one third of the recent increase in the employment rate of college-educated women.

The outline of the paper is as follows. In Section 2, the empirical analysis is shown. In Section 3, the model is presented. In Section 4, I discuss the calibration of the model. In Section 5, the results are reported. Finally, Section 6 concludes.

2 Empirical analysis

In this section I show the evolution of female labor force participation by age and education, age-earnings profiles for men and women, and the change in the distribution of married households by education between 1994 and 2008. Data from Eurostat is used to perform the computations. In particular, I use the European Community Household Panel (ECHP) for years 1994–2000 and the European Union Statistics on Income and Living Conditions (EU-SILC) for years 2004–2008.[3] I confine the analysis to a sample of married individuals because the main focus of this analysis is the labor supply of married females. In order to analyze individuals who are potentially in the labor force and to avoid retirement issues, I restrict the sample to those between ages 18 and 55. The population is divided into three education groups: people who have less than a high school degree ($< hs$), a high school degree (hs) and a college degree (col). Based on these three categories, one can define nine household types by the educational attaintment of the husbands and the wives.

Table 1 shows the labor force participation rates of married females in each of these nine household types in 1994 and 2008. In 1994, the participation rate of females in households in which both the husband and the wife have less than a high school degree is 27%, while it soared to 67% in 2008. Given their husband's education, female's labor force participation is increasing in their own education. However, the same is not true for female's labor force participation as their husband's education rises, except for those females with a college degree. That is, for females with less than a college degree we observe some non monotone behavior regarding female labor force

[3] The ECHP has been carried out for the years 1994 to 2001, while the EU-SILC, a similar survey in terms of variables and definitions, was first carried out in 2004 and it is still carried out on a yearly basis.

participation as their husband's education rises. This my reflect some kind of specialization at home. Overall, the participation rates have improved for all groups between 1994 and 2008.

Table 2 displays the labor force participation of married women by age groups for some years between 1994 and 2008. For this purpose, I divide married households between ages 18 and 55 into three broad age groups, 18–29, 30–44 and 45–55 years. Over the period 1994–2008 participation rates have raised for all age groups, amounting to 42 percentage points increase for the youngest, and to 54 percentage points for the oldest.

Regarding the number of hours worked per week, they remained quite stable both, for men and women. Average hours per married working men were 42.8 in 1994, and 42.3 in 2008 while, for women, they were 36.0 in 1994, and 35.0 in 2008.

Concerning wages, age-earning profiles for husbands and wives are computed for the years 1994, 2000, 2004 and 2008. Average hourly wage is calculated as monthly salary and wage income divided by monthly hours worked.[4] Age earning profiles are normalized by the mean wage rates of the samples in each period, so that wages are comparable between these years. Tables 3 and 4 displays wage profiles for 1994 and 2000, while Tables 5 and 6 shows the gender wage gaps for these two years and the percentage change in average hourly wages from 1994 to 2000.[5] The wages of married men either increased more or declined less than the wages of married women in most cases. There are two exceptions. Females with less than high school education aged 18–29 and 45–55 years earn higher wages in 2000, while men experience the opposite change. As a consequence, the gender wage gap for these two groups diminished.

Table 1: Female LFP by education

1994				2008			
	Female				Female		
Male	$< hs$	hs	col	Male	$< hs$	hs	col
$< hs$	27	60	69	$< hs$	67	82	83
hs	34	53	70	hs	53	81	90
col	26	52	75	col	60	79	89

Table 2: Female LFP by age

Age	1994	2000	2004	2008
18–29	44.2	61.4	81.2	86.0
30–44	47.5	49.3	72.0	78.4
45–55	23	32.7	68.8	76.7

[4] For the sample selection, I only consider full-time workers and exclude people who are self-employed or unpaid workers.

[5] The gender wage gap is calculated as the ratio of females's hourly wage and males's hourly wage.

Furthermore, the college premium for both genders decreased, except for females in the 45–55 age group. However, for this group, the gender wage gap increased, which may suggest the existence of glass ceilings for college women. In general, there was a tendency to broaden the gender wage gap over this period (Guner et al., 2014 corroborates this finding), the exception being the low skilled aged 45–55 years.

On the other hand, Tables 7 and 8 show wage profiles for 2004 and 2008, while Tables 9 and 10 display the gender wage gaps for these two years and the percentage change in average hourly wages from 2004 to 2008. In the period 2004–2008, the evolution of the earnings profiles is quite different. For most education-age cells, the wages of married women either increased more or declined less than the wages of married men. Two exceptions are high school and college women aged 18–29 years, for which the wage gap increased. Particularly relevant is the drop in earnings of young college women. On the contrary, the earnings of young college men did rise. Besides that, the college premium only rose for the 30–44 age group. For the oldest women the college premium declined. In general, there was a tendency to close the gender wage gap over this period.

Table 3: Age-earning profiles, 1994

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.68	0.79	0.91	0.47	0.61	1.11
30–44	0.79	1.03	1.36	0.68	0.94	1.21
45–55	0.90	1.15	1.64	0.73	1.16	1.41

Table 4: Age-earning profiles, 2000

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.65	0.77	0.77	0.48	0.58	0.86
30–44	0.71	0.98	1.27	0.55	0.83	1.11
45–55	0.88	1.44	1.89	0.80	0.82	1.52

Table 5: Wage gap, 1994–2000

	Wage gap 1994			Wage gap 2000		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.69	0.77	1.22	0.74	0.75	1.13
30–44	0.86	0.91	0.89	0.78	0.85	0.87
45–55	0.81	1.01	0.86	0.91	0.57	0.80
average	0.81	0.85	0.87	0.77	0.73	0.80

Table 6: % change in earning levels, 1994–2000

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	-4.8	-1.7	-15.3	2.5	-4.4	-22.0
30–44	-9.6	-4.9	-6.6	-18.1	-11.0	-8.0
45–55	-1.6	26.0	15.3	10.5	-29.1	8.1

Table 7: Age-earning profiles, 2004

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.72	0.70	0.99	0.48	0.58	0.80
30–44	0.80	0.99	1.37	0.62	0.69	1.00
45–55	0.93	1.29	1.70	0.55	0.86	1.46

Table 8: Age-earning profiles, 2008

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.78	0.80	1.02	0.57	0.64	0.70
30–44	0.82	0.93	1.26	0.66	0.81	1.08
45–55	0.81	1.15	1.48	0.70	0.97	1.40

Table 9: Wage gap, 2004–2008

	Wage gap 2004			Wage gap 2008		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	0.66	0.82	0.81	0.73	0.80	0.68
30–44	0.77	0.69	0.73	0.80	0.87	0.86
45–55	0.59	0.66	0.86	0.86	0.84	0.94
average	0.73	0.68	0.71	0.80	0.84	0.84

Table 10: % change in earning levels, 2004–2008

	Male			Female		
Age	$< hs$	hs	col	$< hs$	hs	col
18–29	7.8	13.3	3.2	19.2	10.8	-13.1
30–44	2.9	-6.8	-7.7	6.1	17.1	7.9
45–55	-12.5	-11.2	-13.0	27.6	12.9	-4.2

Table 11: Distribution of married households by education

1994					2008				
Male	Female				Male	Female			
	$< hs$	hs	col	Total		$< hs$	hs	col	Total
$< hs$	42.0	6.4	2.2	50.6	$< hs$	21.7	8.5	6.2	36.5
hs	9.6	6.3	4.2	20.1	hs	6.5	10.8	8.5	25.8
col	8.3	7.4	13.7	29.4	col	5.0	5.4	27.3	37.7
$Total$	59.9	20.0	20.1	100	$Total$	33.3	24.6	42.1	100

With regard to the educational composition of households, Table 11 shows the changes in the distributions of married households according to the education level from 1994 to 2008. The fraction of married households with both members having less than a high school degree decreased by 20.3 percentage points, and the fraction of the married households having both at least a high school degree rose from 31.5 percent to 52 percent. This increase is mostly due to the growth in the percentage of college graduates. The share of male and female high school graduates slightly went up: it was 20.0 percent in 1994 and 24.6 percent in 2008 for women, and 20.1 percent in 1994 and 25.8 percent in 2008 for males. In contrast, the proportion of women with a college degree soared from 20.1 percent to 42.1 percent, and the fraction of married households with both members having a college degree grew by 13.6 percentage points.[6]

Using these data on educational distributions and wages, one can compute gender wage gaps according to the level of education. In 1994, the gender wage gaps for females with less than high school education, high school, and college education, were 0.79, 0.84 and 0.87, respectively. Using 1994 distribution and 2008 wages, I find these gender wage gaps to be 0.81, 0.85 and 0.92, respectively.[7] This exercise let us conclude that gender wage gaps improved more for more educated women. Moreover, if we take into account the previous results, where the two periods 1994–2000 and 2004–2008 were separately analyzed, we can affirm that the gender wage gap narrowing took place in the second period of analysis.

To sum up, from 1994 to 2008, (i) married women female labor force participation raised by 36 percentage points, from 42.4% to 78.3%, (ii) the gender wage gap did not decline steadily, but it rose from 1994 to 2000 and dropped from 2004 to 2008, especially for experienced and college educated women, and (iii) the proportion of married households with both members having at least a high school degree considerably increased.

[6] The analysis here takes a human capital approach to productivity and associates different productivity levels with completed schooling categories.

[7] By using the distribution of 1994 I control for the changes in marital sorting between 1994 and 2008. Hence, the gender wage gaps reported above are only due to the changes in relative wages of males and females.

3 The model

The model that I present here follows Kaygusuz (2010). Consider an economy populated with a continuum of married households of mass one. Married households differ by age and labor market productivity (education) of their members. Each member of the household is characterized by a given productivity level. Let $x(k,j)$ and $z(i,j)$ denote the age j labor productivity of a female of skill level k and of a male of skill level i, respectively. It is assumed that $z(i,j)$ and $x(k,j)$ take a finite number of positive values in the sets Z and X. Suppose there are J different age groups and N different education groups in the economy, so that there are JN elements in the sets X and Z. It is assumed that a husband and a wife have the same age. As a result, at any point in time, there are JN^2 different types of couples (by age and productivity of the members) in the economy.

Agents value consumption, c, and dislike labor, h. Utility function of a household is the sum of its members's utility functions, and is given by

$$u(c)+v(h^m)+u(c)+v(h^f)-\mu(h^m,h^f)q$$

where h^m and h^f denote labor supply of the husband and the wife, respectively. Households incur a fixed utility cost, $q>0$, if both members work in the market, i.e. $\mu(h^m,h^f)=1$. These utility costs, which capture difficulties in reconciling work and family and child care costs, are known before making any labor supply decision. It is assumed that q is randomly distributed according to a distribution function F.

Consider a j year old household with a type i male and a type k female. In this world, every individual is endowed with one unit of labor. When the male and the female works h^m and h^f hours, respectively, total earnings of the couple will be $I=z(i,j)h^m+x(k,j)h^f$. The household pays income tax and payroll tax. The tax function, $\tau(.)$ determines the income tax payment. The payroll tax payment is given by function $\tau_p(.)$. Unlike the income tax, the payroll tax depends on the individual earnings of the members. Tax revenue is simply wasted.

Each period households solve a static problem and decide on male's labor supply, female's labor supply, and on consumption. To simplify the analysis, it is assumed that the husband is the primary earner. The problem of a married household is then summarized as

$$\max\left\{\max_{(c,h^m,h^f)}\{2u(c)+v(h^m)+v(h^f)-\mu(h^m,h^f)q\},\max_{(c,h^m)}\{2u(c)+v(h^m)+v(0)\}\right\}$$

subject to

$$c=I-\tau(I)-\tau_p(z(i,j)h^m)-\tau_p(x(k,j)h^f),$$

where

$$I=z(i,j)h^m+x(k,j)h^f,\quad 0\leq h^m\leq 1,\ 0\leq h^f\leq 1,\text{ and } c\geq 0,$$

and

$$\mu(h^m, h^f) = \begin{cases} 1 & \text{if } h^m, h^f > 0 \\ 0 & \text{otherwise} \end{cases}$$

Finally, $\psi(i,k,,j)$ denotes the mass of age j, type (i,k). The assumption of married households having mass one implies

$$\sum_{j=1}^{J} \sum_{i=1}^{N} \sum_{k=1}^{N} \psi(i,k,j) = 1$$

Computating aggregate statistics for this economy is straightforward since wages, taxes and distributions of agents are taken as given. This helps us focusing on the key endogenous variables: labor force participation decisions and hours worked.

4 Calibration

As I already mentioned in the introduction, I calibrate the model using two sources of data from Eurostat, the European Community Household Panel (ECHP) and the European Union Statistics on Income and Living Conditions (EU-SILC). Since the two sources of data are not perfectly comparable, I first calibrate the model using 1994 ECHP data, and evaluate its performance based on the predictions for the year 2000. Then, I calibrate the model using year 2004 EU-SILC data, and evaluate its performance based on the predictions for the year 2008.

4.1 Calibration to year 1994 data

There are three types of parameters. Those related to productivity of the household members and their distribution according to age and education (which serves as a proxy for productivity) are calibrated using their empirical counterparts. Those related to the tax functions are estimated using the Income Panel Data provided by the Spanish Institute for Fiscal Studies (see the Appendix). Finally, those that do not have a clear counterpart in the economy are pinned down using the method of moments.

Regarding the first type of parameters, the 1994 wage profiles from Table 3 in Section 2 are used to calibrate the productivity sets Z and X. As in the empirical analysis, I assume the economy consists of households that belong to one of the following age groups: 18–29, 30–44 or 45–55 years; and to one of the following education categories: less than high school, high school and college. The 1994 values in Table 12 are used to calibrate the distribution of households by age and education, $\psi(i,k,j)$.

Table 12: Distribution of households by education, by age, 1994–2000

1994									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	0.0760	0.0172	0.0079	0.2564	0.0463	0.0152	0.0945	0.0040	0.0033
hs	0.0086	0.0119	0.0053	0.0641	0.0436	0.0350	0.0007	0.0212	0.0040
col	0.0106	0.0053	0.0165	0.0535	0.0535	0.1005	0.0205	0.0112	0.0172
2000									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	0.077	0.027	0.018	0.215	0.041	0.034	0.065	0.008	0.003
hs	0.011	0.014	0.013	0.051	0.040	0.043	0.020	0.004	0.003
col	0.009	0.009	0.025	0.043	0.051	0.124	0.022	0.007	0.024

In the benchmark economy, I use the following income tax and payroll tax functions for the year 1994 (see the Appendix for the details),

$$\tau(I) = (0.1053\, log(I) + 0.1589)I$$

$$\tau_p(I_{labor}) = (I_{labor})0.0613$$

where I is household income, I_{labor} is the individual labor income and $\bar{I}_{labor}$ is average individual labor income in the economy.

The last set of parameters are related to the utility functions and utility costs. The per period utility functions for males and females are specified as follows

$$u(c) + v(h_m) = log(c) - B^m \frac{(h^m)^{1+\sigma}}{1+\sigma}$$

$$u(c) + v(h^f) = log(c) - B^f \frac{(h^f)^{1+\sigma}}{1+\sigma}$$

where c is consumption, h^m and h^f denote the labor supply of a male and a female, respectively. I choose B_m and B_f to match the average working hours of married men and women. In particular, when B_m is 23.5 and B_f is 23, married men in the model work on average 43.4 hours per week, while the same number for married women is 35.8. In the data married men work 42.8 hours per week, and married women work 36.0 hours per week on average. The parameter governing the Frisch elasticity of labor supply, $1/\sigma$, is set to $\sigma = 2$, so that the elasticity, 0.5, is within the range of typical micro estimates.

Table 13: Calibration to 1994 data

Statistics	1994 Data	1994 Simulation
Agregate LFP	42.4	42.2
Men $hrs/week$	42.8	43.4
Women $hrs/week$	36.0	35.8
LFP age 1	44.2	44.1
LFP age 2	47.5	46.7
LFP age 3	23.0	22.8
LFP educ. $< hs$	28.1	29.5
LFP educ. hs	51.4	53.3
LFP educ. col	67.6	68.2

Table 14: Param. of utility cost distributions, 1994–2000

	Age:1		Age:2		Age:3	
	α	β	α	β	α	β
$< hs$	56	0.0111	2.4	0.4408	4.5	0.9
hs	4.2	0.18	1.2	0.6748	2.4	0.577
col	1.8	0.1973	0.65	1.3065	0.82	0.5

Finally, it is assumed that the utility cost parameter, q, is distributed according to a gamma distribution with parameters $\alpha_{i,j}$ and $\beta_{i,j}$. Thus, conditional on the husband's productivity, i, and the household's age, j

$$q \sim F(q \mid i,j) = \int_0^q u^{\alpha_{i,j}-1} \frac{exp(-u/\beta_{i,j})}{\Gamma(\alpha_{i,j})\beta_{i,j}^{\alpha_{i,j}}} du$$

where $\Gamma(.)$ is the Gamma function. The utility costs parameters, $\alpha_{i,j}$ and $\beta_{i,j}$, are parameterized so that the model matches both, the aggregate female labor force participation, and the disaggregate participation rates by age and education. The model should also be consistent with the labor force participation rates of females married to j year old males with productivity type i. Table 13 shows the participation rates in the data and in the benchmark economy, while Table 14 reports the parameter values of $\alpha_{i,j}$ and $\beta_{i,j}$.

4.2 Calibration to year 2004 data

To calibrate the model to year 2004 I follow the same procedure, but with the EU-SILC data base. I use the 2004 wage profiles from Table 7 in Section 2 to calibrate the sets Z and X and the values in Table 15 to calibrate the 2004 distribution. As for the tax function, I use the estimated values for 2004 (see the Appendix)

$$\tau(I) = (0.0541\ log(I) + 0.2737)I$$

Parameters B_m and B_f are set to the same values than in the 1994 calibration since hours in the data do not change much. Utility costs, $\alpha_{i,j}$ and $\beta_{i,j}$, are parameterized, so that the model mimics both, the aggregate female labor force participation, and the disaggregate participation rates by age and education. These values substantially change from the previous calibration because utility costs associated to having children and working in the market significantly decreased in the second period of analysis. This is another reason why the calibration of the model to the year 1994 is not valid to evaluate the period 2004–2008. Utility costs markedly declined for two reasons. First, female immigration in the 2000s led to higher employment and lower wages in the household service sector (see Farré et. al (2011). And second, the Law 46/2002 introduced cash benefits for working mothers with children aged less than three years which amount to 30% of the average cost of private day care centers in Spain.

Table 15: Distribution of households by education, by age, 2004–08

2004									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	0.0275	0.0105	0.0075	0.1898	0.0609	0.05	0.0115	0.014	0.0425
hs	0.0060	0.0085	0.005	0.0529	0.0654	0.0569	0.0130	0.0105	0.0115
col	0.004	0.004	0.016	0.0365	0.048	0.1798	0.0504	0.008	0.0095
2008									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	0.0158	0.006	0.0077	0.1344	0.0557	0.041	0.0585	0.0191	0.0126
hs	0.0071	0.0044	0.0038	0.0377	0.0612	0.0667	0.0262	0.0273	0.0257
col	0.0027	0.0022	0.0093	0.0268	0.0497	0.1809	0.0186	0.0246	0.0743

Table 16: Calibration to 2004 data

Statistics	2004 Data	2004 Simulation
Agregate LFP	72.7	72.5
Men $hrs/week$	42.3	42.2
Women $hrs/week$	35.1	35.3
LFP age 1	81.2	81.4
LFP age 2	72.0	72.3
LFP age 3	68.8	68.8
LFP educ. $< hs$	58.3	60.0
LFP educ. hs	73.8	72.1
LFP educ. col	85.6	84.7

Table 17: Param. of utility cost distributions, 2004–08

	Age:1		Age:2		Age:3	
	α	β	α	β	α	β
$< hs$	48.2	0.0111	1.4	0.4408	5.3	0.1797
hs	2.85	0.1412	0.7051	0.6748	0.9	0.1638
col	1.5	0.05	0.3	1.3065	0.68	0.42

Table 16 shows the participation rates in the data and in the benchmark economy, while Table 17 reports the parameter values for $\alpha_{i,j}$ and $\beta_{i,j}$. The simulated model matches again Spanish data fairly closely (see Table 16). Therefore, the model can be considered a good starting point to investigate the question at hand.

5 Results

In this section I show to what extent factors, such us changes in the tax structure, changes in the composition of the married population in terms of educational attaintment, and changes in the earnings profiles may account for the growth in married women labor force participation in two separate periods: 1994–2000 and 2004–2008.

5.1 Results from 1994 to 2000

Participation rates for married females increased from 42.4% in 1994 to 47.1% in 2000. Table 18 reports the results of simulating the model using the taxes, the earnings profiles, and the distribution of households from year 2000. The model successfully accounts for the rise in aggregate female labor force participation and is also able to match hours per worker for males and females.

Table 18: Simulation results, 2000 economy

Statistics	2000 Data	2000 Simulation
Agregate LFP	47.1	47.9
Men $hrs/week$	42.6	43.6
Women $hrs/week$	36.3	36.4
LFP age 1	61.4	65.7
LFP age 2	49.3	47.8
LFP age 3	32.7	24.8
LFP educ. $< hs$	31.8	32.2
LFP educ. hs	51.4	53.8
LFP educ. col	80.5	69.3

In addition, the model is able to replicate the pattern of female labor force participation by age and education. As in the 1994 data, the participation rate in the 1994 simulated model increases between ages 1 and 2, and declines between ages 2 and 3; whereas in the 2000s, the participation rate is decreasing in age both, in the model and in the data. The model is also consistent with the fact that the participation rate rises with education.

In order to disentangle the possible factors that may account for the growth in female labor force participation, I consider three alternative economies. In the first economy, the taxes are changed to 2000 values, whereas the wage profiles and the household distribution are kept at their 1994 values. In the second alternative economy, the educational distribution is changed to 2000 values, whereas taxes and wage profiles are kept at their 1994 values. And in the third economy, wage profiles are set to their 2000 values, while taxes and the distribution are kept to their 1994 values.

The results are reported in Tables 19–21. Table 19 reports the effects on levels, Table 20 shows the decomposition of the changes in female labor force participation and Table 21 displays the effects on the distribution by age and education.

The simulation of the first alternative economy shows that if people of 1994 had been taxed at 2000 tax levels, the female labor force participation would have been 44.5 percent. Given the 5.7 percentage points increase that the model implies from 1994 to 2000, this change accounts for 40.4 percent of the total change. There are positive responses to the change in taxes at a disaggregate level too. Table 20 shows that the tax change accounts for 23.8 percent of the growth in labor force participation of young females, 39.5 percent of the increase in participation of females aged older than 44 years, and overestimate the rise in the participation growth rate of females aged 30-44 years. Moreover, female labor force participation improves for all education groups as a result of the tax change. The tax change accounts for 92.0 percent of the growth in labor force participation of females with less than high school education, and overestimate the rise in the participation

growth rate of females in the other education categories. Since the drop in marginal taxes rates is increasing in income (see Figure 1 in the Appendix), this result is not surprising.[8]

Table 19: Alternative economies

	1994 Economy	2000 Taxes	2000 Distrib.	2000 Wages	2000 Economy
Agregate LFP	42.2	44.5	46.2	40.6	47.9
Men $hrs/week$	43.4	43.9	42.8	43.7	43.6
Women $hrs/week$	35.8	36.4	36.3	35.2	36.4
LFP age 1	44.1	49.3	52.8	53.2	65.7
LFP age 2	46.7	48.7	48.9	43.3	47.8
LFP age 3	22.8	23.6	26.6	18.6	24.8
LFP educ. $< hs$	29.5	32.0	29.5	28.4	32.2
LFP educ. hs	53.3	55.5	54.3	49.8	53.8
LFP educ. col	68.2	69.8	69.1	66.7	69.3

Table 20: Decomp. of changes, 1994–2000

	2000 Taxes	2000 Distrib.	2000 Wages
Agregate LFP	40.4	71.2	-27.1
Men $hrs/week$	234.0	-264.7	154.6
Women $hrs/week$	111.2	89.5	-116.0
LFP age 1	23.8	40.0	42.1
LFP age 2	181.1	201.1	-309.8
LFP age 3	39.5	189.4	-205.1
LFP educ. $< hs$	92.0	0.2	-40.4
LFP educ. hs	448.5	206.9	-689.8
LFP educ. col	136.4	80.5	-120.1

[8] High income earners realized the largest benefits from the reforms that took place in this period. The top marginal marginal tax rate declined from 56 to 48 percent.

Table 21: Female LFP by education, by age, 1994–2000

1994 Taxes, Distribution and Wages									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	13.0	87.2	100	34.4	53.5	68.0	0.2	1.5	2.8
hs	19.9	39.1	85.8	43.0	57.6	68.6	12.1	29.5	39.6
col	61.6	77.6	97.1	42.5	52.7	60.8	54.4	73.1	80.1
1994 Taxes and Distribution, 2000 Wages									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	31.1	88.0	100	29.2	52.7	69.0	0.4	0.4	3.7
hs	22.4	36.7	71.0	36.6	54.6	67.2	8.8	9.1	31.4
col	73.6	83.7	95.9	38.6	51.2	60.4	52.5	53.1	77.8

The second alternative economy displays the effects of the change in the distribution. At an aggregate level, that change results in a 4 percentage points increase in the participation rate from the benchmark situation. Table 19 helps us understand this result. The labor force participation rates with different education levels are almost the same in the benchmark and in this alternative economy. Therefore, the change in the educational composition explains the effect on the aggregate participation rate. As it was shown in Section 2, from 1994 to 2000, the fraction of college graduate females markedly grew and the fraction of females with less than high school education declined. This, together with the fact that college graduate females participate more, explains the growth in the aggregate participation rate.

In the third economy, married women labor force participation rate amounts to 40.6 per cent. This exercise suggests that changes in wage profiles do not account for the growth in the participation rate of married women, but quite the opposite. Only young females participate more, mainly due to the wage profile improvement of young females with less than high school education (see Table 6 in Section 2), since the other education categories experience a decrease in earnings. As a result, young females with less than high school education participate more no matter with whom they are married, young females with college education participate less, and the results are mixed for young females with high school education depending with whom they are married (see Table 21).

For the other age groups, the contribution of changes in earnings is mostly negative, especially for women aged 30-44 years. Table 6 shows that, in fact, wages decrease for these women and, as a result, they participate less, except for college women married to men with less than high school education (see Table 21). This may be due to the fact that the wages of men with less than high school education are low relative to those of college women, what induces women to work in the market despite the decrease in wages.

As for the effects by education groups, the contribution of changes in earnings is also negative, especially for women with high school education. Table 6 shows that, in fact, wages decrease for these women and, as a result, they participate less, except for young females, depending with whom they are married, since they experience a lower wage decrease. Finally, college women also participate less because of the decrease in earnings of the youngest and the middle aged women.

A singular case is that of college females older than 44 years. They earn higher wages, but their wage gap deteriorates because males earnings rise even more. This might reflect the existence of glass ceilings effects for this group, so that the positive effect of wages on participation is counteracted by the negative evolution of the gender wage gap. In fact, only those married to men with less than high school education participate more. The fact that those married to men with high school or college education participate less, despite earning higher wages, may reveal the existence of specialization at home.

To sum up, in this period, the change in the income tax and in the distribution more than explains the rise in aggregate female labor force participation, while the change in wage profiles does not, but quite the opposite. Only young women with less than high school education participate more, due to higher wages. Moreover, the change in wage profiles negatively affects female working hours, while the opposite happens to male working hours. This is consistent with the evolution of the gender wage gap for this period (see Table 5). The results also suggests the existence of specialization at home and glass ceilings effects for some college women.

5.2 Results from 2004 to 2008

Participation rates for married females increased from 72.7% in 2004 to 78.3% in 2008. In order to perform a similar analysis to the one in the previous section, I have calibrated the model to year 2004 and I have simulated it for the year 2008. Then, I have computed the contribution of the same factors previously analyzed.

To this end, I first simulate the model using the taxes, the earnings profiles, and the distribution of households from 2008. The results are reported in Table 22. In the simulated economy 76.9 percent of the females participate in the market, a 4.3 percentage point rise from the 2004 economy. Hence the model is successful in generating the rise in female labor force participation observed in the data. Table 22 also reports participation rates of females with different characteristics according to the 2008 data and the 2008 simulation. The predictions for different types of females are mostly successful. The model is able to capture the pattern of participation rates by age and education. Both in the model and in the data, the participation rates are decreasing in age and increasing in education.

I, again, consider three alternative economies to disentangle the factors that may account for the growth in the female labor force participation in this period. In the first economy, the taxes are changed to 2008 values whereas the wage profiles and the household distribution are kept at their 2004 values. In the second alternative economy, the educational distribution is changed to 2008 values, whereas taxes and wage profiles are kept at their 2004 values. And in the third economy, wage profiles are set to their 2008 values, while taxes and the distribution are kept to their 2004 values.

The results are reported in Tables 23–25. Table 23 reports the effects on levels, Table 24 shows the decomposition of the changes in female labor force participation, and Table 25 displays the effects on the distribution by age and education.

Table 22: Simulation results, 2008 economy

Statistics	2008 Data	2008 Simulation
Agregate LFP	78.3	76.9
Men $hrs/week$	42.3	41.0
Women $hrs/week$	34.9	36.6
LFP age 1	86.0	88.9
LFP age 2	78.4	76.3
LFP age 3	76.7	75.0
LFP educ. $< hs$	63.4	63.2
LFP educ. hs	80.9	78.8
LFP educ. col	88.6	87.1

Table 23: Alternative economies

	2004 Economy	2008 Taxes	2008 Distrib.	2008 Wages	2008 Economy
Agregate LFP	72.5	72.1	71.5	77.7	76.9
Men $hrs/week$	42.2	42.1	42.4	41.1	41.0
Women $hrs/week$	35.3	35.2	35.4	36.6	36.6
LFP age 1	81.4	80.2	79.7	90.6	88.9
LFP age 2	72.3	72.0	73.0	75.8	76.3
LFP age 3	68.8	68.4	65.0	79.3	75.0
LFP educ. $< hs$	60.0	59.5	56.0	66.7	63.2
LFP educ. hs	72.1	71.7	72.0	78.9	78.8
LFP educ. col	84.7	84.4	84.9	87.0	87.1

Table 24: Decomp. of changes, 2004–2008

	2008 Taxes	2008 Distrib.	2008 Wages
Agregate LFP	-10.6	-23.3	119.9
Men $hrs/week$	11.3	-10.6	90.1
Women $hrs/week$	-12.2	5.1	99.2
LFP age 1	-15.7	-21.8	121.7
LFP age 2	-9.1	17.6	87.4
LFP age 3	-7.9	-62.7	171.1
LFP educ. $< hs$	-17.1	-125.2	207.5
LFP educ. hs	-6.2	-1.7	101.6
LFP educ. col	-11.6	11.2	95.8

The simulations of the first alternative economy suggest that if people of 2004 had been taxed at 2008 tax levels, the female labor force participation would have been 72.1 percent. That is, the change in taxes from 2004 to 2008 has a negative impact on aggregate labor force participation. This is true for every category, being the youngest females and those with less than high school education the most affected groups. This is not surprising since marginal tax rates significantly increased in this period (see Figure 1 in the Appendix).

The second scenario shows that the change in the distribution only has a positive impact on participation for females with college education, and for those who are in the range 30–44 years. For the other categories, the change in the distribution exert a negative effect, especially for those women with less than high school education.

The last exercise shows the effect of changing the wage profiles, which is positive for every category, mostly for the oldest and the less educated females. This group is, precisely, the one that experiences the highest wage increase (see Table 6). College women participate more, in general, despite the fact that the young and the old college women register a drop in wages. The exception is young college women married to men with high school education, who participate less (see Table 25). In fact, the wage gap increases for these females, whereas it declines for the oldest college women, because male wages decrease even more. As for the other educational categories, women with high school education and with less than high school education participate more, which is consistent with the evolution of their wage profiles and gender wage gaps from 2004 to 2008.

In sum, the change in wage profiles from 2004 to 2008 largely explains the growth in labor force participation of most females, while the change in taxes does not, but quite the opposite. Changes in the distribution affect the groups differently, inducing a rise in participation only for college women and those aged 30–44 years.

Table 25: Female LFP by education, by age, 2004-2008

2004 Taxes, Distribution and Wages									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	50.7	95.1	100	62.9	68.3	84.2	9.0	38.6	83.4
hs	77.3	88.2	97.4	66.7	70.6	82.6	86.4	96.8	100
col	99.8	100	100	69.6	72.0	80.0	56.4	73.8	90.0
2004 Taxes and Distribution, 2008 Wages									
Age	1			2			3		
Male	Female			Female			Female		
	$< hs$	hs	col	$< hs$	hs	col	$< hs$	hs	col
$< hs$	80.7	97.0	99.5	64.5	74.4	85.7	32.2	62.4	88.1
hs	80.6	87.2	90.7	71.4	78.2	86.3	95.6	98.9	99.9
col	100	100	100	72.7	77.2	83.0	71.4	82.7	91.9

5.3 Results from 2000 to 2004

Given the previous results, one can try to offer an explanation for the change in married women labor force participation from 2000 to 2004, yet carefully because the data sets, from which we have information for these two years, are not perfectly comparable. In this period, two factors may have played a significant role: lower marginal tax rates and child care costs. The drop in child care costs was mainly due to immigration, which made household services more affordable, and to the introduction of cash benefits for working mothers with children aged less than three years (Law 46/2002).

To decompose the relevance of each of these two factors I perform the following exercise. First, I consider the model with 2000 wages and 2000 distribution, and change the taxes to 2004 values to compute the contribution of the change in taxes. Second, I consider the model with 2000 taxes, 2000 wages profiles and 2000 distribution, and change the calibration of the utility cost parameters to their 2004 values to compute the contribution of these other factors that reduced utility costs.

The results from the first exercise let us conclude that the change in taxes is not the main factor behind the growth in married women labor force participation between 2000 and 2004 since, on aggregate, this factor accounts for only a 0.5 percentage points. The main factor is the change in utility costs. Given 2000 taxes, wage profiles and distribution, the change in the parametrization of utility costs more than explains the increase in female labor force participation implied by the model with 2004 taxes, distribution and wage profiles, except for women older than 45 years.

Indeed, the change in utility costs is substantial. On average, the reduction in utility costs amounts to 36.4%. Using the change in married women labor force participation from 2000 to 2004 due to the sole change in parameters (Column 1 and 3 in Table 26), and the change in utility costs by age and education, one can compute the corresponding elasticities. It seems that women with less than high school education are more responsive to the change in utility costs, since their

Table 26: Alternative economies

	2000 Economy	2004 Taxes	2004 Parameters	2004 Economy	% reduc. util.costs	Elasticity LFP w.r.t. ut.costs
Agregate LFP	47.9	48.4	74.9	72.5	–	–
Men $hrs/week$	43.6	43.7	41.4	42.2	–	–
Women $hrs/week$	36.4	36.5	36.0	35.3	–	–
LFP age 1	65.7	67.2	89.9	81.4	-61.6	-0.5
LFP age 2	47.8	48.2	73.4	72.3	-42.6	-1.0
LFP age 3	24.8	25.0	61.3	68.8	-42.7	-2.0
LFP educ. $< hs$	32.2	32.9	65.4	60.0	-23.0	-3.0
LFP educ. hs	53.8	54.2	79.8	72.1	-27.9	-1.4
LFP educ. col	69.3	69.7	88.7	84.7	-20.6	-1.2

elasticity more than doubles those of women with high school education and college education, 3.0 versus 1.4 and 1.2, respectively. In fact, Azmat and González (2010) find that the effects of the 2003 reform (Law 46/2002) were more pronounced among less educated women.

6 Conclusion

In this paper I investigate to what extent factors, such us changes in the tax structure, changes in the composition of the married population in terms of educational attaintment, and changes in the earnings profiles may account for the growth in Spanish married women labor force participation from 1994 to 2008. For that purpose I have used Kaygusuz (2010) model of household labor market participation and data from Eurostat to calibrate the model and evaluate its performance. Due to data availability, the analysis is done separately for two periods: 1994–2000 and 2004–2008.

The model successfully accounts for the rise in aggregate female labor force participation as well as hours worked by males and females. The model is also able to replicate the pattern of female labor force participation by age and by education.

In the period 1994–2000, the change in taxes and in the distribution more than explains the growth in aggregate female labor force participation, while the change in wage profiles does not, but quite the opposite. Only young women with less high school education participate more, mainly because they earn higher wages. The other age and education categories experience a decrease in earnings. The change in wage profiles negatively affects female working hours, while the opposite happens to male working hours, which is consistent with the evolution of the gender wage gap for this period. The results also suggests the existence of specialization at home and glass ceilings effects for some college women.

In the period 2004–2008, the change in wage profiles from 2004 to 2008 largely explains the growth in labor force participation of most females, while the change in taxes does not, but

quite the opposite. Changes in the distribution affect the groups differently, inducing a rise in participation only for college women and those who are 30–44 years old. The results for this period are also consistent with the evolution of gender wage gaps.

Given these results, one can try to offer an explanation for the growth in married women labor force participation from 2000 to 2004, yet carefully because the data sets, from which we have information for these two years, are not perfectly comparable. The two candidate explanations are declining marginal tax rates, and the drop in the utility costs associated to having children and working in the market. The results let us conclude that the change in the income tax rate is not the main factor behind the increase in married women labor force participation between 2000 and 2004, but the change in utility costs, which is quite substantial.

In this paper I have pointed out to some of the reasons that may have altered these utility costs, such us immigration and cash benefits to working mothers with children aged less than three years. One way to improve this analysis in future work would be to explicitly incorporate those elements into the model. Additionally, there are two other aspects that are missing in this paper and that may be relevant to explain the growth in married women labor force participation, particularly in the second period of analysis: the rise in the divorce rate, possibly due to recent changes in the divorce law (Law 15/2005), and the house price boost in the 2000s. In both cases, a dynamic model is essential because savings will play a central role. This type of analysis is out of the scope of the present paper, but it is an interesting avenue for future research.

A Appendix: Tax functions

As mentioned in the introduction, there have been some reforms over the period of study regarding the income tax policy which changed marginal tax rates and, as a result, may have affected the incentives to work: Law 214/1999, Law 46/2002 and Law 35/2006. Using the Income Panel Data provided by the Spanish Institute for Fiscal Studies, I obtain tax functions for married couples for the years 1994, 2000, 2004 and 2008. To perform this calculation I divide the sample into ten income brackets. For each income bracket I calculate the average income levels and the average taxes paid. To be able to compare tax functions across years, income must be comparable across years as well. Therefore, I divide the income levels by mean married household income for each year. Next, I fit the following equation to the data points

$$\frac{\tau(I_i)}{I_i} = \eta_1 + \eta_2 \, log(I_i) + \varepsilon_i \tag{1}$$

where I_i is the normalized average income in the income bracket i, and $\frac{\tau(I_i)}{I_i}$ is the average tax rate paid in the income bracket i. Table 27 shows the estimates that I use in the calibration and simulation of the model and Figure 1 shows marginal tax rates.

Table 27: Tax functions

Year	η_1	η_2
1994	0.1589	0.1053
2000	0.3070	0.0576
2004	0.2737	0.0541
2008	0.3160	0.0575

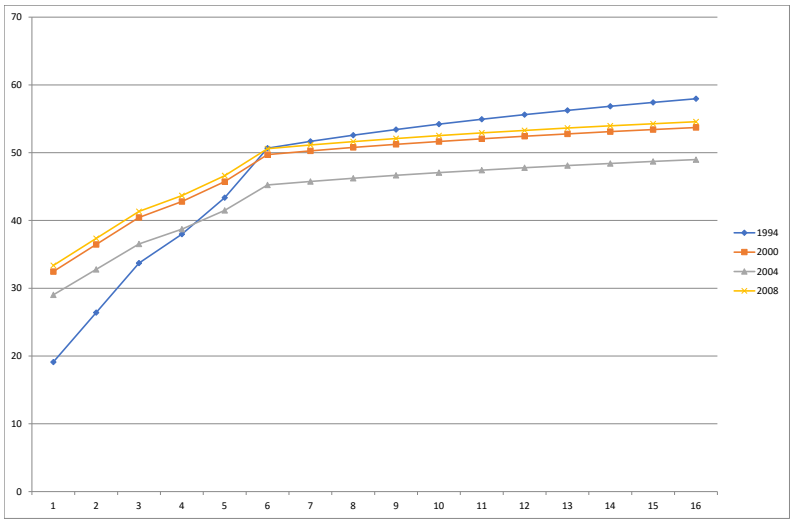

Figure 1: Marginal Tax Rates

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