Labour Supply Responses and the Extensive Margin: The US, UK and France

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January 2011
Preliminary draft

Abstract

This paper documents the key stylised facts underlying the evolution of labour supply at the extensive and intensive margins in the last forty years in three countries: United-States, United-Kingdom and France. We develop a statistical decomposition that provides bounds on changes at the extensive and intensive margins. This decomposition is also shown to be coherent with a theoretical analyis the analysis of labour supply elasticities at these margins. We use detailed representative micro-datasets to examine the relative importance of the extensive and intensive in explaining the overall changes in total hours worked. We also present some initial estimates of the broad distribution of implied elasticities at the extensive and intensive margin and their implication for the overall aggregate hours elasticity.

1 Introduction

Forty years ago the Europeans (here French and British) used to work more than the Americans. They now work less. The aim of this paper is to provide a coherent picture of these changes. To do so we split the overall level of work activity into the number of individuals in work and the intensity of work supplied by those in work. This reflects the distinction between whether to work and how much to work at the individual level and is referred to, respectively, as the extensive and intensive margin of labour supply. At

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the aggregate level the former is typically measured by the number of individuals in paid employment and the later by the average number of working hours.

The difference between the extensive and intensive margins has been highlighted in recent research attempting to resolve differences between micro and macro responses of labour supply to tax reform. For example, Rogerson & Wallenius (2007), following the work of Prescott (2004), argue that the responsiveness of the extensive margin of labour supply to taxation plays a major role in explaining aggregate differences in total hours worked across countries. They show that an economy with fixed technology costs for firms and an inverted U-shape life-cycle productivity for workers can produce large aggregate extensive labour supply responses driven by movements in employment at either end of the working life. This they argue can reconcile the small micro-based elasticities of hours worked with the large responses required if taxes and social security are to explain cross-country differences in total hours of work.

The distinction between the extensive and intensive margin has long been recognised in microeconometric studies of labour supply, see Heckman (1993). For example, building on the insights by Gronau (1974) and Heckman (1974, 1979), Cogan (1981) documented the importance of fixed costs of work in separating the link between responses at the employment and hours margin. His study found that earlier estimates of hours of work elasticities at the intensive margin for married women were biased upwards due to the omission of fixed costs. In subsequent empirical analyses the size of the wage elasticities at these two margins has been found to differ significantly by gender, family composition and age, see Blundell and MaCurdy (1999). Typically the elasticity at the extensive margin has been found to be somewhat larger than the elasticity at the intensive margin. Over time, as labour force participation of women increased, the labour supply elasticities of men and women have, to some extent, converged see Blau and Kahn (2007).

It is not only women with children where the role of the extensive labour supply margin has been found to play a major role in understanding individual and family labour supply behaviour. 'Early retirement' behaviour has been found to respond systematically to participation tax rates implicit in social security systems, see for example Gruber and Wise (1999) and papers therein.

The relative size of labour supply responses at the intensive and extensive margin has also been a key parameter in the public economics literature on earnings tax design, see Diamond (1980), Saez (2002) and Laroque (2005). A 'large' extensive elasticity at low earnings can 'turn around' the impact of declining social weights implying a higher transfer to low earning workers than those out of work, in turn providing a role for earned income tax credits. Participation tax rates (PTR) and effective marginal tax rates (EMTR) at low earnings remain very high in many current tax systems. This is carefully documented in the evidence to the Mirrlees Review, see Brewer et al. (2010) and references therein. In the UK effective marginal tax rates are well over 80% for some low income working families because of phasing-out of means-tested benefits and tax credits.

But what do we know about the importance of these margins for different types of workers? How well does the extensive margin explain changes in total hours over time and across countries? In this paper we provide a detailed decomposition of the evolution of total hours of work into changes at the extensive and intensive margin. We examine three key countries - the US, the UK and France. These three countries stand at the top, middle and bottom, respectively, of Prescott's 2004 table of labour supply flexibility. They are also countries where we can access nationally representative detailed microdata over a long period of time so as to examine the relationship between the extensive and intensive margin across different individual types. We study the forty year period up to 2008. The UK provides an interesting comparison with the polar cases of France and the US. Over this period the UK has adopted many of the same (or similar) tax policies as in the US(refs) while, at the same time, it has moved from a dominant position in the supply of total hours to one lying between the US and France.

Our analysis finds that neither margin dominates in explaining changes in total hours worked for these countries, rather the relative importance of the extensive and intensive margin is shown to differ systematically by age, gender and family composition. In Blundell et al. (2010), we investigate in more detail the variation for the young and the old. Here we look more broadly at the overall responses at the extensive and intensive margins and draw out their implications for aggregate behaviour.

2 A Picture of Labour Supply in US, UK and France

2.1 Trends in Employment and Hours since 1968

Figure 1 highlights the starting point of our analysis and the key piece of evidence used to motivate the debate on the changing trends in aggregate hours worked across countries. It charts the evolution of the average annual hours of work per individuals aged 16 to 74 from 1968 to 2008.[1] The pattern of total hours per individual shows evidence of a three way split after 1980 in the evolution of total hours across the three countries. However, this simple description of total hours disguises some of the major differences between these three countries.

Changes in total hours represent both the effect of changes at the extensive margin of labour (employment rate) and at the intensive margin (including both the number of weeks worked and the weekly hours). Underlying the trends in total hours are two key bifurcations which determine the pattern of employment and hours per worker between France, the UK and the US.

Overall employment rates in the UK and the US have moved somewhat in line with each other showing an increase over this period. Employment rates in France have progressed very differently. Figure 1B shows a strong decline in employment in France until the mid-1990s with recovery thereafter but leaving a large difference in current employment rates. Note that we are aggregating across all adult men and women aged 16 to 74 in these figures. Later we will document further key differences by gender and age.

Changes in hours per worker tell a different story. Figure 1C shows the UK and France following each other with strong declines over this period stabilizing somewhat in the 2000s. In contrast, the US has retained a stable pattern of hours per worker over the entire period apart from a dip in the late 1970s and early 1980s.

Before digging deeper into these movements in hours and employment we note that whereas the measure of the employment rates across time and countries is considered fairly robust, the measure of annual hours of work is on much less firmer ground, in particular in earlier years.[2] We have chosen here to make use of the data from the Labour Force surveys, which provide detailed information, every year, about employment patterns, hours of work as well as precise demographics, education attainment etc.[3]

Partly as a reflection of these concerns with the measurement of hours in earlier years and partly due to the major changes occurring after this period, we focus the major part

[1]Usually the working age population is defined as those aged 16 to 64. We extend this definition to age 74 in order to capture the sizeable increase in the employment rate of 65-74 year old in the US.

[2]Appendix A and B of Blundell et al. (2010) review the details of the measurement issue.

[3]We use the Enquête Emploi (EE) for France, the Labour Force Survey (LFS) and Family Expenditure Survey (FES) for the UK and the Census Population Survey (CPS) for the US. This represents overall 120 annual surveys. The LFS sample size varies: it was around 160,000 observations when the survey was annual (pre 1992) and between 500,000 and 600,000 subsequently (for a total of 12 million observations across all years). The EE sample size was around 130,000 observations when the survey was annual (pre 2002) and around 260,000 since then (for a total of 6 millions observations across all years). The CPS sample size is around 100,000 to 150,000 observations per month, so 5 million observation for the March series.

Figure 1: Measures of market work for individuals aged 16 to 74 (1968-2008)

Notes: Annual hours of work are measured using actual weekly hours of work from continuous surveys and averaging over the year. These surveys exist since 2002 for all three countries. For the UK for the years from 1968 to 1974, the start of the UK LFS, we use the trend in hours and employment from the Family Expenditure Survey adjusted to the LFS 1975 level. See appendix for details.

Sources: Enquête Emploi, Labour Force Survey, Family Expenditure Survey, Census Population Survey.

of our remaining analysis on the period since the late 1970s. For this period we are more certain as to the reliability of our data. 1977 is one of the earliest years available for all three labour force surveys and provides a key initial point for our study.

2.2 The Importance of Age and Gender

The trends in hours and employment in Figure 1 tell only part of the story. Much of what is interesting is hidden beneath these aggregate trends. A lot more is learned from the distinction between age and gender. To illustrate these differences we compare two years: 1977 and 2007. The first of these years is before the disjuncture in the series noted in Figure 1 and allows us to use relatively comparable sources across the three countries. The year 2007 is chosen as it is before the impact of the financial crisis was felt in the labour market and may reflect labour supply behaviour rather than shorter term business cycle concerns. Blundell, Bozio and Laroque (2010) consider some of the key business cycle movements over this period, here we are interested in longer term more secular changes in labour supply.

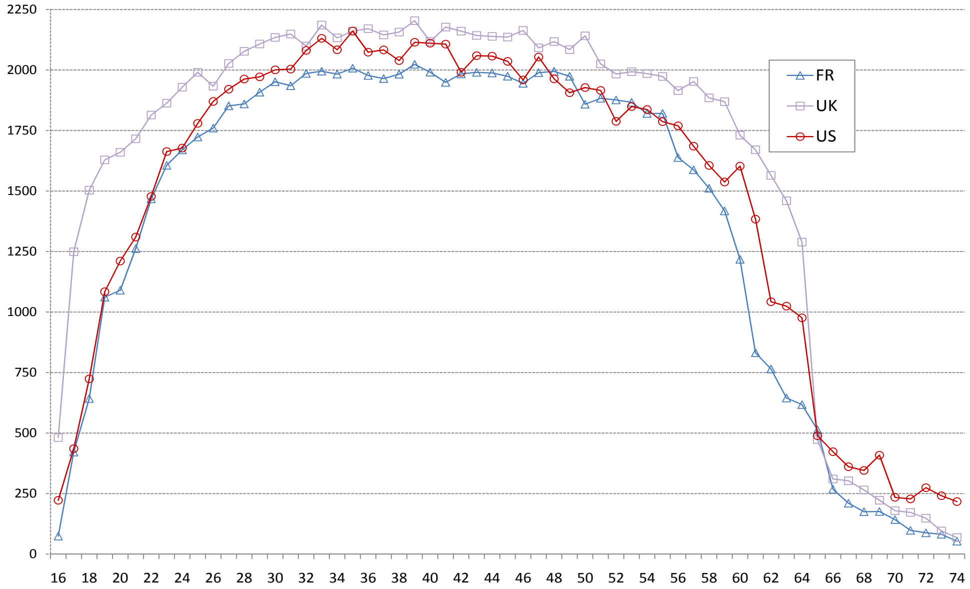
In Figures 2 and 3 we show total hours and the employment rate, respectively, by age for men. The comparison between 1977 and 2007 highlights the interest in decomposing the changes in labour supply across age groups. In 1977 the employment rates were higher in the two European countries than in the US at most ages (with the exception of France at older ages), in 2007 the American rate describes the outer envelope. In 1977 the British males distinguish themselves with very higher employment at young ages (between 16 and 22) and at older age (between 60 and 65). All three countries exhibit strong decline in participation at the age of early eligibility for pensions (60 in France, 65 in the UK and the US).

In 2007, the key differences in average male employment rates between the three countries come exclusively from the young and the old. For males aged 30 to 54, employment rates are almost indistinguishable. Moreover, British and American males have very similar employment rates at all ages up to 65 when the British rate drops markedly. The French drop in employment rate at older age is much earlier with a marked decline as soon as age 55 a further drop before age 60. At age 61 there is a 41-43 points difference in employment rates between French and British or American males. Past age 65, almost no French is working while 20% of American males remain in work at age 73!

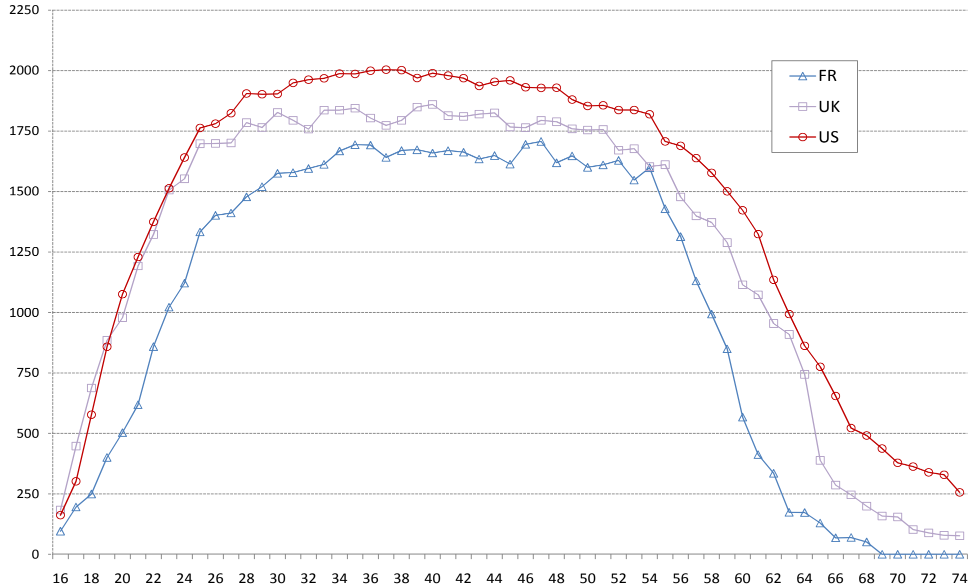
Figures 4 and 5 show the corresponding changes for women. In 1977 women in France and the US hardly differed in their avearage hours, certainly up to their late 50s. Hours

Figure 2: Male total hours by age (1977-2007)

A. Male 1977



B. Male 2007

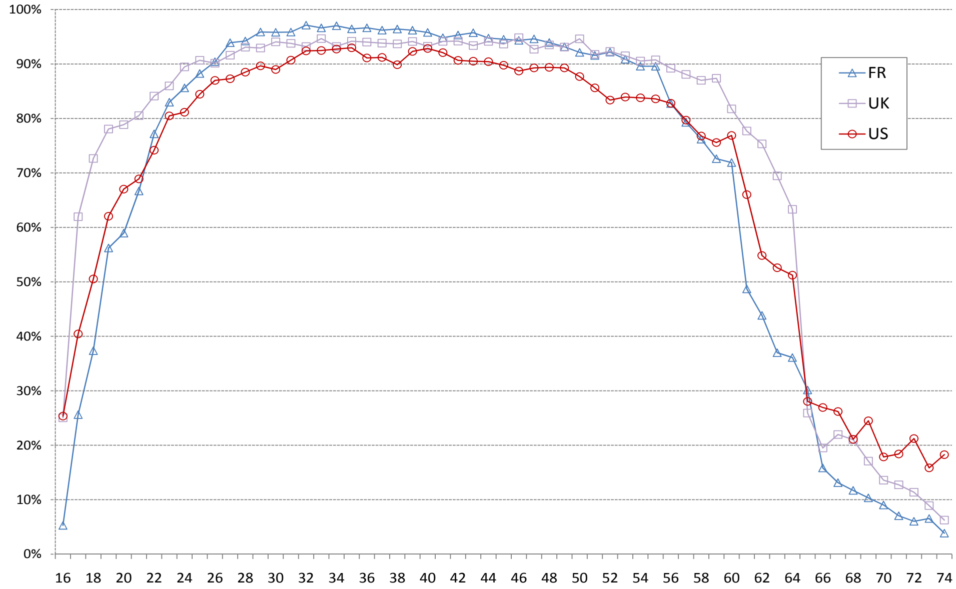


Sources: Enquête Emploi, Labour Force Survey, Census Population Survey.

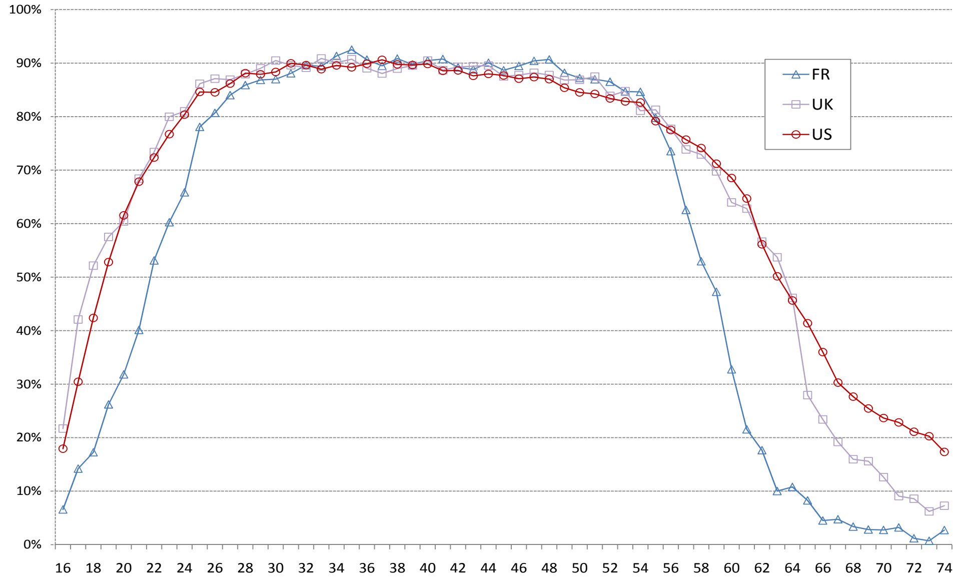
for women in the UK instead showed a distinct 'M' shape, with very high average hours in their late teens and then a strong decline in their early 20s reflecting, as we will see, child birth. By 2007 hours look very different. Women in the US dominate at every age. Women in Britain maintain relatively high hours at younger working ages but the M shape

Figure 3: Male employment rate by age (1977-2007)

A. Male 1977



B. Male 2007



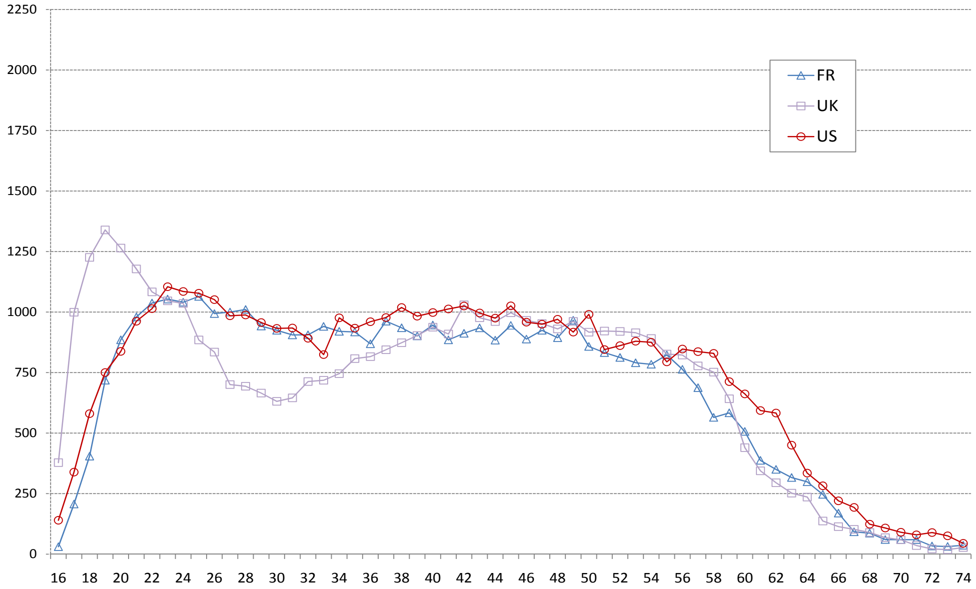
Sources: Enquête Emploi, Labour Force Survey, Census Population Survey.

is considerably more smoothed and throughout their 30s, 40s and 50s UK women follow closely the hours of French women.

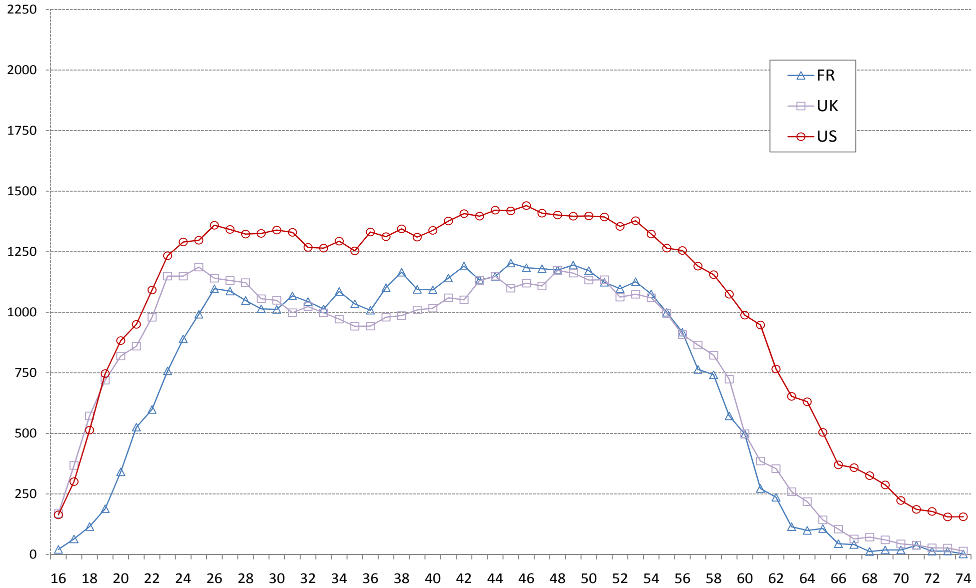
The employment pattern of females by age has also changed markedly during this period. In 1977, Figure 5 A. shows US and French women had similar patterns with UK

Figure 4: Female total hours per by age groups (1977-2007)

A. Female 1977



B. Female 2007

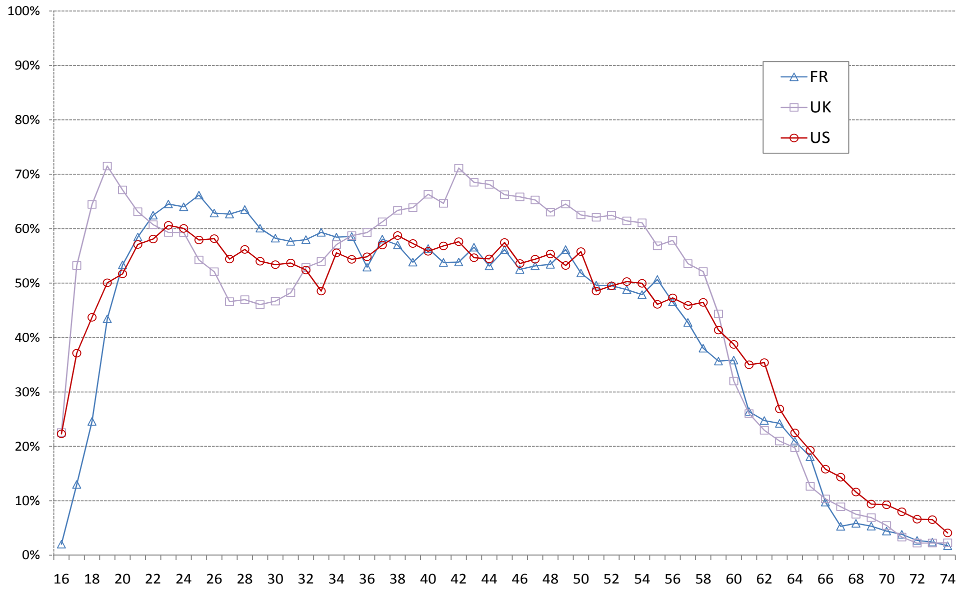


Sources: Enquête Emploi, Labour Force Survey, Census Population Survey.

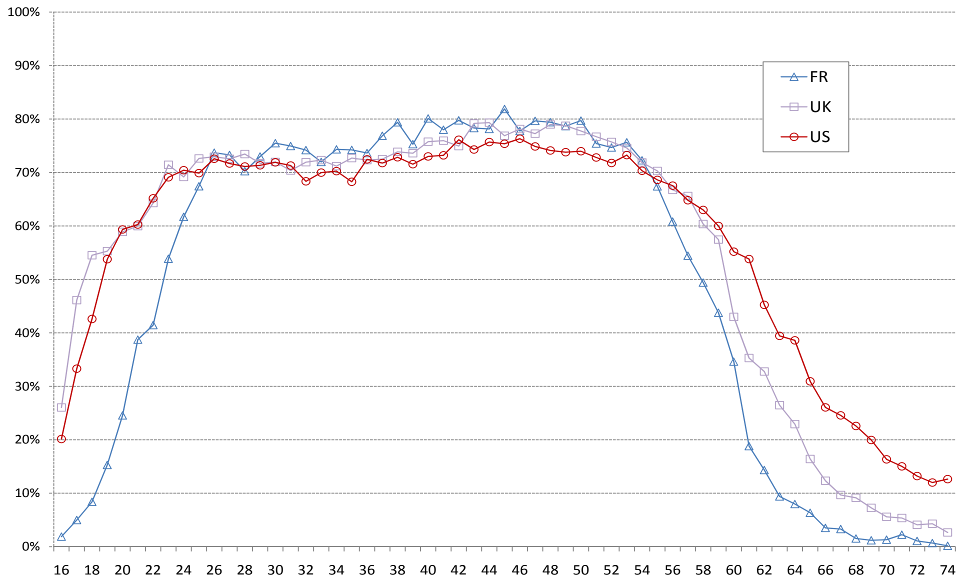
women again having the strongest M-shape. Employment was high for the very young adult women, then a drop until the early thirties, when women become mothers of young children, then an increase in participation as children age and then the decline in employment at older age, but much earlier than the British males. This M-shape pattern does not appear

Figure 5: Female employment rate by age (1977-2007)

A. Female 1977



B. Female 2007



Sources: Enquête Emploi, Labour Force Survey, Census Population Survey.

to be as strong a feature in France or in the US.

By 2007, female employment rates increased in all three countries. Unlike in the case of total hours, Figure 5 B. shows the British 'M' shape has all but disappeared and the age patterns have tended to become closer to the one of males. Employment rates in the three economies are almost indentical for women from their late 20s to their mid-50s. At older ages British women show a lower employment rate than those in the US. Note that the state pension age in the UK is 60 for females and 65 for males. In France the lower employment rate of females seems to be almost entirely due to the low participation at young and older ages.

The figures in this section point to important differences at the hours and employment margin by age and gender for each of these countries. But can we be more systemtaic about these comparisons? In the next section we develop a simple theoretical framework for decomposing responses at the intensive and extensive margin and examining the impact on the aggregate hours elasticity. We then develop a statistical decomposition that mirrors the theoretical analysis.

3 Elasticities at the Intensive and Extensive Margin

Our aim here is to provide an illustrative theoretical framework to analyze the decomposition of hours responses at the intensive and extensive margins. To do this we consider an economy made of heterogeneous workers choosing between whether to work and how many hours to supply in work. In the application we use more flexible specifications and allow explicitly for observable heterogeneity.

To capture the main ingredients, different workers face different fixed costs of work and have different tastes for work. The labor supply decision in each period is based on the after-tax wage and the marginal utility of income λ. We assume that the period is short compared with the whole lifetime, so that λ can be considered as given, independent of current labor supply.[4] Preferences are represented as

$$U = \begin{cases} \lambda R(h) - \dfrac{h^{1+1/\alpha}}{1+1/\alpha} - \beta & \text{if } h > 0 \\ \lambda s & \text{if } h = 0, \end{cases}$$

where h labor supply measured in hours, $R(h)$ is the disposable income of someone who works h hours, h positive, s is subsistence income when unemployed and (α, β, λ) are positive parameters. The parameter α describes the marginal (dis)utility of hours worked while β stands for fixed costs of work. The agents in the economy also differ according to

[4]This hypothesis is satisfied in a continuous time model, where instantaneous utility is separable in consumption and leisure.

hourly wages w. It is convenient to describe the distribution of agents' characteristics in the economy through the conditional distribution of β given (α, λ, w), $F(\beta|\alpha, \lambda, w)$, and the marginal pdf of (α, λ, w), $g(\alpha, \lambda, w)$.

In this discussion we shall limit ourselves to a fairly simple linear tax and benefit system, $R(h) = r + w(1-\tau)h$. We assume a constant marginal tax rate τ and allow for a possible discontinuity at the origin, subsistence income s possibly being different (larger) than the income r of a worker who supplies little market hours. If an individual works, her preferred number of hours maximizes

$$\lambda w(1-\tau)h - \frac{h^{1+1/\alpha}}{1+1/\alpha},$$

which gives

$$h(\lambda w(1-\tau), \alpha) = (\lambda w(1-\tau))^{\alpha}. \tag{1}$$

She works when the benefit exceeds the fixed cost β, that is when

$$\lambda r + (\lambda w(1-\tau))^{1+\alpha}\left[1 - \frac{\alpha}{1+\alpha}\right] - \beta \geq \lambda s,$$

or

$$\beta \leq \lambda(r-s) + \frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha}.$$

From this condition, the employment rate of agents of type (α, λ, w) is

$$p(\lambda w(1-\tau); \alpha) = F\left(\lambda(r-s) + \frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha} \,\Big|\, \alpha\right), \tag{2}$$

so that the number of hours worked by type (α, λ, w) agents is

$$H(\lambda w(1-\tau), \alpha) = p(\lambda w(1-\tau); \alpha)h(\lambda w(1-\tau), \alpha).$$

Hours and employment elasticities follow from standard definitions. From the functional form, the elasticities with respect to wages w or to $(1-\tau)$ are equal, and we shall denote them with the letter ε. We shall use η for the elasticities with respect to subsistence income s. At the intensive margin of labour supply for individuals of type (α, λ, w) the elasticities are :

$$\varepsilon_I(\alpha, \lambda, w) = \frac{\partial \ln(h(\lambda w(1-\tau), \alpha))}{\partial \ln w} = \alpha,$$

and

$$\eta_I(\alpha, \lambda, w) = \frac{\partial \ln(h(\lambda w(1-\tau), \alpha))}{\partial \ln s} = 0,$$

whereas at the extensive margin we have:

$$\varepsilon_E(\alpha,\lambda,w) = \frac{\partial \ln(p(\lambda w(1-\tau);\alpha))}{\partial \ln w} =$$
$$(\lambda w(1-\tau))^{1+\alpha} f\left(\frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha} \,\Big|\, \alpha,\lambda,w\right) / F\left(\frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha} \,\Big|\, \alpha,\lambda,w\right),$$

and

$$\eta_E(\alpha,\lambda,w) = \frac{\partial \ln(p(\lambda w(1-\tau);\alpha))}{\partial \ln s} =$$
$$-\lambda s f\left(\frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha} \,\Big|\, \alpha,\lambda,w\right) / F\left(\frac{(\lambda w(1-\tau))^{1+\alpha}}{1+\alpha} \,\Big|\, \alpha,\lambda,w\right).$$

To see how changes in the total hours in the economy relates to these elasticities, first note that the total number $\tilde{H}$ of hours worked is

$$\tilde{H} = \int_w \int_\alpha \int_\lambda H(\lambda w(1-\tau),\alpha) g(\alpha,\lambda,w) \mathrm{d}\alpha \mathrm{d}\lambda \mathrm{d}w =$$
$$\int_w \int_\alpha \int_\lambda p(\lambda w(1-\tau);\alpha) h(\lambda w(1-\tau),\alpha) g(\alpha,\lambda,w) \mathrm{d}\alpha \mathrm{d}\lambda \mathrm{d}w.$$

The elasticity of $\tilde{H}$ with respect to $(1-\tau)$ is

$$\varepsilon = \frac{\partial \ln \tilde{H}}{\partial \ln(1-\tau)} = \frac{1-\tau}{\tilde{H}} \frac{d\tilde{H}}{d(1-\tau)} =$$
$$\frac{1}{\tilde{H}} \int_w \int_\alpha \int_\lambda \Bigg[p(\lambda w(1-\tau);\alpha) h(\lambda w(1-\tau),\alpha) \frac{1-\tau}{h(\lambda w(1-\tau),\alpha)} \frac{\partial h(\lambda w(1-\tau),\alpha)}{\partial(1-\tau)}$$
$$+ p(\lambda w(1-\tau);\alpha) h(\lambda w(1-\tau),\alpha) \frac{1-\tau}{p(\lambda w(1-\tau);\alpha)} \frac{\partial p(\lambda w(1-\tau);\alpha)}{\partial(1-\tau)} \Bigg] g(\alpha,\lambda,w) \mathrm{d}\alpha \mathrm{d}\lambda \mathrm{d}w. \quad (3)$$

or

$$\varepsilon = \frac{1}{\tilde{H}} \int_w \int_\alpha \int_\lambda H(\lambda w(1-\tau),\alpha) [\varepsilon_I(\alpha,\lambda,w) + \varepsilon_E(\alpha,\lambda,w)] g(\alpha,\lambda,w) \mathrm{d}\alpha \mathrm{d}\lambda \mathrm{d}w. \quad (4)$$

The first term is the contribution of the intensive margin, the second that of the extensive margin, whose elasticities are weighted by the share of type (α,λ,w) labor supply in the aggregate.

A similar computation yields the elasticity of aggregate hours with respect to subsistence income:

$$\eta = \frac{\partial \ln \tilde{H}}{\partial \ln s} = \frac{1}{\tilde{H}} \int_w \int_\alpha \int_\lambda H(\lambda w(1-\tau), \alpha)[\eta_I(\alpha, \lambda, w) + \eta_E(\alpha, \lambda, w)] g(\alpha, \lambda, w) \mathrm{d}\alpha \mathrm{d}\lambda \mathrm{d}w. \quad (5)$$

This formulation is written in terms of Frsich elasticities where we have conditioned on the marginal utility of wealth λ. A similar decomposition in terms of the extensive and intensive elasticites will follow for alternative definitions of the labour supply elasticities for example those that condition on a consumption based measure of other income as in the two-stage budgeting formulations of the life-cycle model as discussed in Blundell and MaCurdy (1999, section 4).

4 Bounding Changes at the Extensive and Intensive Margins

We are interested in studying how the overall average hours worked H per person varies over time and across countries. Of course, this quantity differs across a person characteristics, age and gender for instance. Suppose there are $j = 1, ..., J$ broad categories. The overall statistic H_t is computed in any year t as an average of the category hours H_{jt} with weights equal to the population shares q_{jt}

$$H_t = \sum_{j=1}^{J} q_{jt} H_{jt}.$$

Evidence from the long history of empirical labour supply studies suggests that measured responses of hours worked at the intensive and extensive margins differ across different categories of workers. Following the analysis of the elasticity decomposition formula (5) we decompose total hours of work H_{jt} as the product of hours per worker h_{jt} and participation to the labour market p_{j_t}

$$H_{jt} = p_{jt} h_{jt}.$$

When we observe a change in yearly hours worked per person, $H_t - H_{t-1}$, we would like to be able to know how much of the change is due to the intensive or extensive margins. We propose a statistical decomposition: First we define a structural effect S_t due to the change in the composition of the population:

$$S_t = \sum_{j=1}^{J} H_{jt}[q_{jt} - q_{j,t-1}].$$

Then we measure the change due to the behavior of category j, holding the population structure constant as in date $t-1$, as in a Laspeyres index

$$\Delta_{jt} = q_{j,t-1}[H_{jt} - H_{j,t-1}] \tag{6}$$

and the total change across all J categories of workers is simply

$$\Delta_t = \sum_{j=1}^{J} \Delta_{jt} \tag{7}$$

and we have by construction

$$H_t - H_{t-1} = S_t + \Delta_t. \tag{8}$$

There is no obvious way to decompose the change in total hours experienced by category j into the sum of an extensive E_j and an intensive I_j components. It is however natural to suppose that any plausible measure I_j of the intensive margin would have the same sign as the difference of the hours worked per worker[5] at date $t-1$ and t: $\Delta h_j = h_{jt} - h_{j,t-1}$. Assuming linearity, we get the following expression

$$I_j = p_{Ij}\Delta h_j,$$

where p_{Ij} denotes the fraction of those workers. Supposing p_{Ij} is in the interval $[p_{j,t-1}, p_{jt}]$, we get the intensive bounds

$$I_j \text{ belongs to the interval } [p_{j,t-1}(h_{jt} - h_{j,t-1}), p_{j,t}(h_{jt} - h_{j,t-1})].$$

From the identity $\Delta_{jt} = I_j + E_j$, the extensive bounds are given by

$$E_j \text{ belongs to the interval } [h_{j,t-1}(p_{jt} - p_{j,t-1}), h_{j,t}(p_{jt} - p_{j,t-1})].$$

[5]Strictly speaking one might want to treat separately the hours of the workers present at both dates, from those of the workers only working at one of the dates, $t-1$ or t. The computation implicitly assumes that the difference, if any, can be neglected.

At the limits, the change in total hours for any category of workers reflecting changes at the intensive margin - hours per worker, and at the extensive margin - employment satisfies two polar exact statistical decompositions:

$$\Delta_{jt} = q_{j,t-1}\left\{[h_{jt} - h_{jt-1}]p_{jt} + [p_{jt} - p_{jt-1}]h_{j_{t-1}}\right\} \tag{9}$$

or

$$\Delta_{jt} = q_{j,t-1}\left\{[h_{jt} - h_{jt-1}]p_{jt-1} + [p_{jt} - p_{jt-1}]h_{jt}\right\} \tag{10}$$

The first term on the right hand side is the intensive margin, weighted in the top formula (9) with the final participation rate (as in a Paasche index) and in the bottom formula (10) with the initial participation rate (as in a Laspeyres index). The second term is the extensive margin (Laspeyres in (9), Paasche in (10)).

In the next section we examine the evolution of h_{jt} and p_{jt} for different age and gender groups. We then use (9) and (10) to provide bounds on the importance of intensive and extensive margins in the evolution of hours worked across these various groups.

Before turning to this we note that the formula in levels relate naturally to the decomposition of the total hours elasticity into its intensive and extensive components as described by (3). Suppose we think of the decomposition (9) for small changes and write

$$\Delta H \simeq \sum_{j=1}^{J} [\Delta h_j p_j + \Delta p_j h_j]$$

This expression can be rewritten in terms of the proportionate changes

$$\frac{\Delta H}{H} \simeq \frac{1}{H}\sum_{j=1}^{J}\left[p_j h_j \frac{\Delta h_j}{h_j} + p_j h_j \frac{\Delta p_j}{p_j}\right]$$

$$= \frac{1}{H}\sum_{j=1}^{J} p_j h_j \left[\frac{\Delta h_j}{h_j} + \frac{\Delta p_j}{p_j}\right]$$

$$= \sum_{j=1}^{J} \frac{H_j}{H}\left[\frac{\Delta h_j}{h_j} + \frac{\Delta p_j}{p_j}\right]$$

corresponding to the terms in the elasticity decomposition formula in (3) and (5) above.

5 The Decomposition of Total Hours Worked

In our discussion of Figures 2-5 we have seen how an analysis of changes in total hours worked in an economy covers up some key variation by age and gender. In this section we apply the approach to the decomposition of total hours for different subgroups of the population developed in the last two sections. We put the decomposition to work to pull together an overall picture of the facts about labour supply changes in the UK, the US and France.

Table 1: Decomposition of the evolution of hours of work between 1977 and 2007 by sex and age groups

	Year	Youth (16-29)		Prime aged (30-54)		Old (55-74)		Residual	All
		Men	Women	Men	Women	Men	Women		(16-74)
FR	1977	1402	871	2010	951	827	367		1148
	2007	858	627	1639	1116	508	344		953
	Δ	-82	-38	-82	36	-36	-3	10	-195
UK	1977	1707	938	2117	873	1107	323		1212
	2007	1219	876	1786	1055	790	385		1094
	Δ	-71	-9	-70	39	-42	10	25	-118
US	1977	1344	835	2018	947	1025	447		1156
	2007	1236	956	1922	1373	1084	754		1321
	Δ	-19	22	-19	90	6	38	46	165

NOTE: Δ are computed following equation (6).

SOURCES: Enquête Emploi, Labour Force Survey, Census Population Survey.

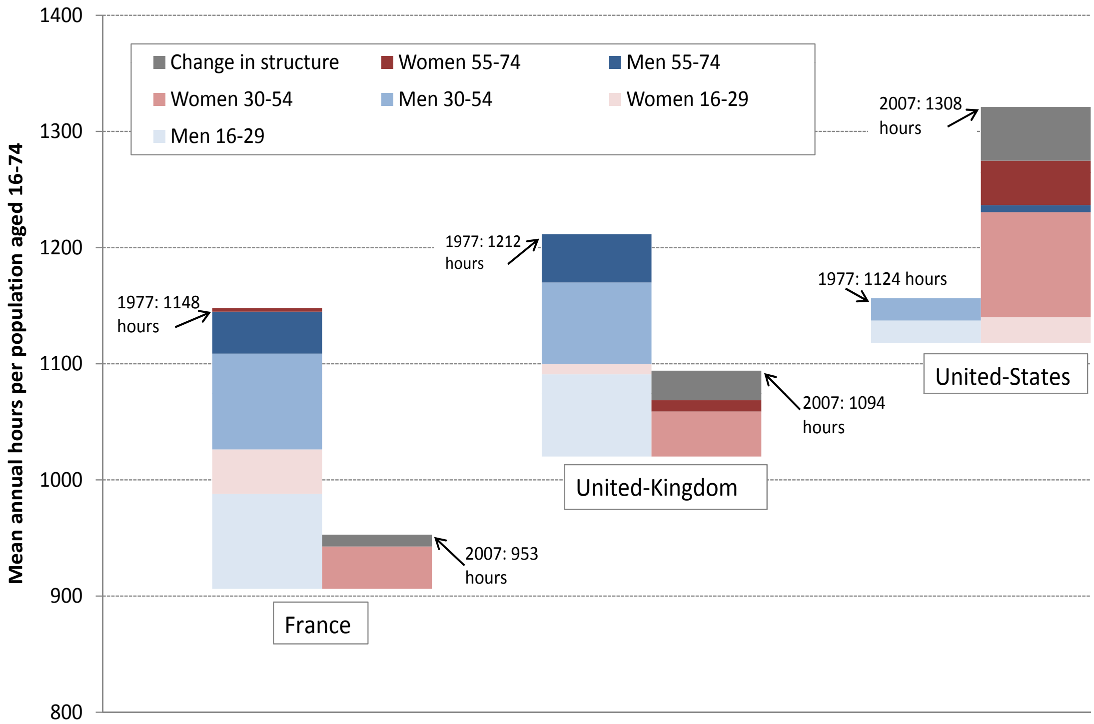
Table 1 decomposes the overall change between 1977 and 2007 by sex and broad age groups. As already mentioned, the three countries have very close number of hours worked per person at the starting year (France: 1148, UK: 1212, US: 1156), but their evolution differs: +165 hours for the US, -118 hours and -195 hours for the UK and France. The lines Δ of Table 1 show the contributions of the categories and the effect of demographic structure, according to equations (6), (7) and (8).

A first remark on these statistics is that the overall country movements, US and France at the extremes with the UK in between, holds for nearly all the categories that we have retained. The contribution to the aggregate of the hours worked by the young and prime age men is negative in all countries, with a larger decline in France than in the UK than in the US. Table 1 shows a large decline in the number of yearly hours worked by these men in France and the UK: -544 and -488 hours for the French and British young men, -371 and -331 hours for the French and British prime aged men.

A second observation is that the increased participation of women in the labor market works against the general trend. This is particularly obvious for middle aged women who all work more in 2007 than in 1977, but appears also for the old and young women.

The graphical decomposition in Figure 6 serves to illustrate the striking differences across the three economies. The key rise in female hours being so much stronger for all ages in the US, it is sufficient to reverse the correspondingly small declines for men. The change in the structure of the population then serves to exagerate the difference. Leaving the US at the top of the figure after a relatively weak start in 1977.

Figure 6: Decomposition of the change in total hours per population (1977-2007)



NOTES: Decomposition assumes the population structure unchanged. The residual is attributed to changes in the population structure.

SOURCES: Enquête Emploi, Labour Force Survey, Family Expenditure Survey, Census Population Survey.

Using the statistical bounds framework developed in the previous section we can go further and examine some key features of these changes at the extensive and intensive margin.

This is what we report in Table 2. The indices examine what part of any overall change in hours is attributable to changes at the extensive or intensive margin for any particular subgroup of the population. The row [I-L, I-P] shows the bounds on the intensive margin, L standing for Laspeyres (the change in hours being weighted by the initial participation rate), P for Paasche (final participation rate). Similarly the Laspeyres index for the extensive margin (E-L) (resp. (E-P)), given by the second term in equation (9) (resp. (10)), is equal to the change in participation multiplied by average hours worked at the initial (resp. final) date. The teoretical discussion in section 3 suggests that the relative importance of these two margins, for any particular subgroup of workers, will depend on the distribution of fixed costs for that group and the proportion of that group in work.

Table 2: Decomposition of the evolution of hours of work between 1977 and 2007 by sex and age groups

	Year	Youth (16-29)		Prime aged (30-54)		Old (55-74)		All
		Men	Women	Men	Women	Men	Women	(16-74)
FR	Δ	-82	-38	-82	36	-36	-3	-195
	[I-L, I-P]	[-37,-28]	[-23,-19]	[-59,-56]	[-35,-49]	[-11,-8]	[-9,-10]	[-185,-183]
	[E-L, E-P]	[-54,-45]	[-19,-16]	[-27,-23]	[85,71]	[-28,-25]	[7,6]	[-12,-10]
UK	Δ	-71	-9	-70	39	-42	10	-118
	[I-L, I-P]	[-42,-36]	[-23,-26]	[-48,-45]	[-2,-3]	[-22,-19]	[-6,-8]	[-161,-167]
	[E-L, E-P]	[-35,-29]	[17,14]	[-25,-22]	[41,41]	[-23,-20]	[17,15]	[50,43]
US	Δ	-19	22	-19	90	6	38	165
	[I-L, I-P]	[-6,-6]	[1,1]	[-5,-5]	[14,19]	[3,3]	[3,5]	[15,17]
	[E-L, E-P]	[-13,-13]	[21,21]	[-14,-14]	[72,77]	[3,3]	[33,35]	[148,150]

NOTE: I-P designs the Paasche measure of the intensive margin, I-L the Laspeyre measure, and similarly E-P and E-L designs the Paasche and Laspeyre measure of the extensive margin, as described by equations (9) and (10).

SOURCES: Enquête Emploi, Labour Force Survey, Census Population Survey.

As a concrete example, examine the first entry in the top left of Table 2, French men aged 16-29. The impact on total hours for this group is -82. The I-L index of -37 tells us that the intensive margin does a good bit but not the majority of the work in explaining total hours changes for this group. The E-L estimate of -54 confirms the relative importance of the extensive margin for this group. Again as suggested from our model, and as we might also expect in reality, both margins to respond.

The actual changes for this subgroup, or any other subgroup we examine, will not only have come from changes in taxes, welfare and social security, but from many other changes in the labour market. Nonetheless, the indices in Table 2 give us an indication of where, and for which groups, each of these margins is likely to be important. The theoretical framework also enables us to speculate on what mix of changes to (after-tax) wages, income, fixed costs and benefits in each of these countries could explain these observed changes.

Turning first to prime-age workers, the steep decline at the *intensive* margin for prime aged men in France and the UK relative to the US is striking. For this group the bounds are quite narrow and leave little room for ambiguity. These changes represent an enormous shift in the relative position of these countries. Increases in effective tax rates and/or the regulation of working hours could explain these patterns. However, Britain has seen much less legal hours regulation than France and yet has experienced the same changes.

Income effects could be part of the explanation. There are two potential sources for these. First, as the economy grows individuals may prefer to take some of the gains in real wages in terms of increased leisure, cutting back their hours of work. However, given overall growth has been somewhat similar across all three countries, it would have to be that Europeans take more leisure in response to rises in income. A second source of income effect for prime age men is the increased participation by women. This is often termed the added-worker effect. Prime-aged women have certainly seen a strong increase in participation. Indeed, the bounds on the extensive margin changes in Table 2 for women aged 30-54 are the largest positive change to be found in any country-age cell and at any margin. But the largest overall increase, especially when the intensive margin is taken into account, is for US women. Yet the change in hours is the least for US men. Again responses would have to be different in Europe.

Table 2 tells us that the *extensive* margin for prime-age men in Britain and in France also falls more than in the US, although there are declines in the US too. Increases in relative employment costs or out of work benefits in France and Britain could explain such changes. Also, even at the extensive margin, income effects may play a role as individuals cut back on their overall life-cycle labour supply. However, this seems more likely at either end of the life-cycle rather than during prime-age.

As we have noted, for prime age women it is the increase at the extensive margin that is so extraordinary, especially in the US and in France where the bounds in Table 2 suggest a very similar change and one that is nearly twice he size of that experienced in the

UK. Intensive margin changes provide somewhat of a puzzle here, falling back strongly in France while growing in the US. Again differences in hours regulation or effective marginal tax rates may explain these changes. However, once again note that the level of hours per worker in France is pretty much identical to that in the UK by 2007. In Blundell et al. (2010) we show that what appears to be a strong similarity in the intensive margin for women in France and the UK hides a very different distribution of hours, UK women having a much larger spread in working hours than French women.

For older men and women there is a large decrease in hours per worker in France, similar in UK, contrasting with an increase in the US. There are falls at the extensive and intensive margin for UK men but increases at the extensive margin for UK women. This surely is linked to the strong increase in participation among younger cohorts of women. This phenomena is replicated to some extent across all coutries and offsets the stronger incentives to retire earlier in the UK and in France. The contrast with the US is stark. At all margins and for both genders the bounds point to positive changes for older workers. Clearly changes in social security, early retirement incentives and pension rules have a large role to play in explaining these differences and in Blundell et al. (2010) we return to a more detailed analysis of this group.

The changes among the young are sizable and predominantly negative. In France and the UK there are large falls for young men at both the extensive and intensive margin. In France this is associated with a much higher recorded unemployment rate for youth than in other countries. When we delve deeper into the employment patterns of the young in Blundell et al. (2010) , this appears to be related to differences in the relationship between education and work across the countries. There is in fact around the same proportion of the young population out of work and looking for a job in all three coutries, especially in the UK and France. Moreover, there is a very similar proportion in education in the US and in France, a much larger proportion than in the UK. However, in France those in education typically do not work at the same time whereas in the US education and work in the 16-29 population is common.

In Blundell et al. (2010) we investigate the patterns of employment and hours for the young, for women with children and for the old in more detail. Here we complete our discussion by drawing out the relationship between the aggregate hours elasticity and the empirical distribution of structural elasticities at the micro-data level.

6 Estimating the distribution of elasticities

As an illustration of the way in which the evolution of the micro-data documented in the last section can be used to recover the distribution of labour supply elasticities, we provide an application to the British Family Expenditure Survey. The FES allows us to construct consistent series on marginal taxes, incomes, hours of work, wages and consumption for a representative sample of households from 1978 onwards mirroring the hours data in Table 2. We allow for general fixed costs of work and heterogeneity in preferences for work. As in the discussion of the structural model this permits separate responses at the extensive and intensive margins. We highlight differences between the extensive and intensive margins and draw implications for the aggregate hours elasticity.

The approach to estimation and identification of the labour supply elasticities follows closely that in Blundell et al. (1998). We use the large changes in relative growth in after tax wages and other incomes across different education, age and gender groups over the years 1978, 1987 1997 and 2007 to identify the distribution of wage and income elasticities. These years are boyant years in the economy for which we expect the labour supply model to provide a reasonable approximation to observed behaviour.

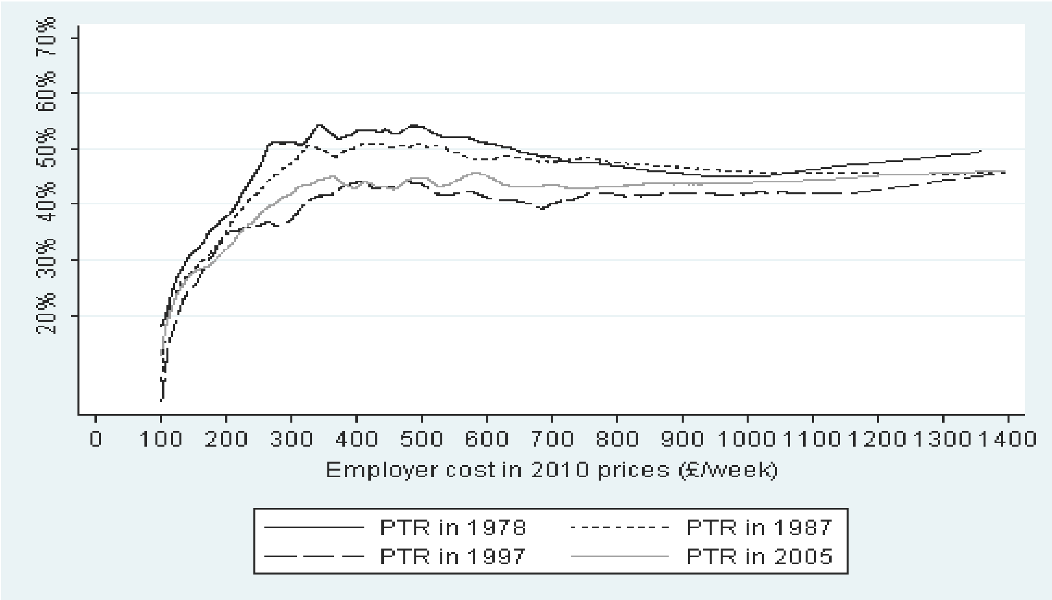
6.1 Tax Incentives at the Intensive and Extensive Margins

To get some idea of the way tax incentives to work have changed over this time period in the UK we examine summary measures of incetives at the extensive and intensive margin. We measure the incentive to be in paid work at all by the participation tax rate (PTR), the proportion of total earnings taken in tax and withdrawn benefits. Similarly, we measure the incentive to increase earnings slightly by the effective marginal tax rate (EMTR), the proportion of a small increase in earnings taken in tax and withdrawn benefits. To calculate PTRs and EMTRs for individuals in couples, we look at how the couple's net income changes when the individual in question stops work or changes their earnings slightly, holding the other partner's employment and earnings fixed.

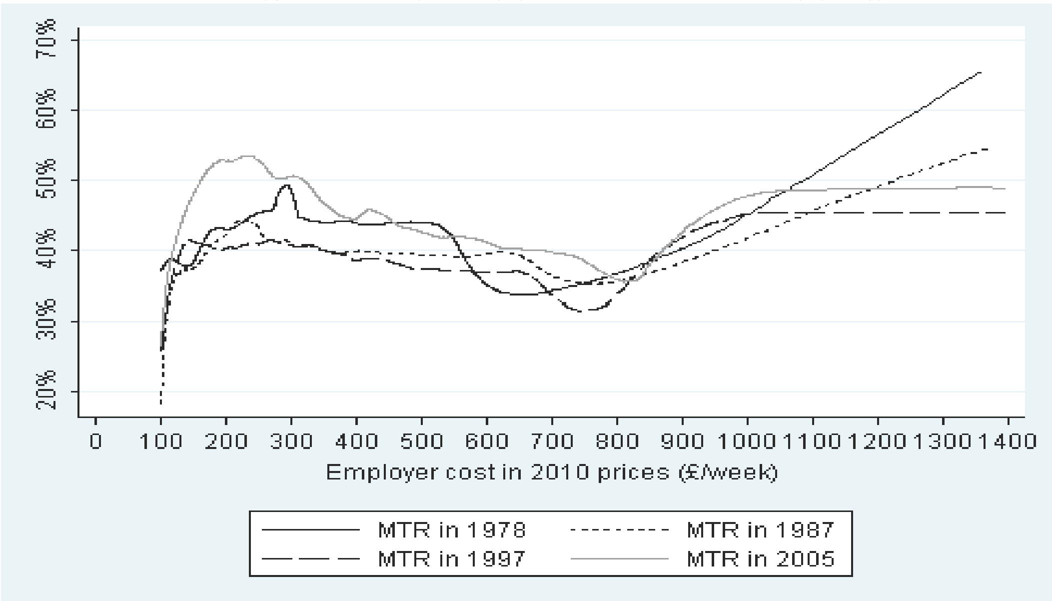
Figures 7A and 7B show the key changes in participation and effective marginal tax rates in the UK over the period respectively. Participation tax rates have fallen at the bottom of the earning distribution while marginal tax rates have risen at the bottom of the distribution and fallen at the very top, see also Adam and Browne (Mirrlees Review, 2010).

Figure 7: Effective Tax Rates for Men and Women (1978-2008)

A. Participation tax rate for male and female workers



B. Marginal tax rate for male and female workers



Notes: Non-parametric regression (lowess) estimates. Employer cost = gross earnings + employer NICs. Source: Author calculations using the IFS tax and benefit microsimulation model, TAXBEN.

6.2 Emprical Specification

Following Blundell, Duncan and Meghir (1998) we specify labour supply preferences at the intensive margin to generate semi-log optimal hours

$$h = \alpha + \theta lnw + \gamma y \tag{11}$$

where lnw is the log of the hourly after tax marginal wage rate, y is other income defined directly using consumption and the budget contraint. This definition of other income is a life-cycle consistent measure and identifies the Marshallian elastcitities for within period utilities, see Blundell and MaCurdy (1999, section 4). Frisch elasticities can also be estimated using the consumption data to measure marginal utility. As in Blundell, Duncan and Meghir (1998) we allow α to be a function of individual demographic, education characteristics and unobserved heterogeneity.

To correct for selection into employment and for the endogeneity of lnw and y we follow a control function approach. We use the interactions between education, gender and year as excluded instruments as in Blundell et al. (1998). Consequently it is the differential changes across gender and education over these periods that are used to correct for selection at the intensive margin and to identify the wage and income effects.

The probability at the extensive margin is defined through a structural normal binary response model which allows for general unobserved fixed costs of work. This probability is specified to depend directly on income in work, income out of work and a set of demographic and education chracteristics. These are measured for each individual using the tax and benefit simulation model together with demographic and income information.

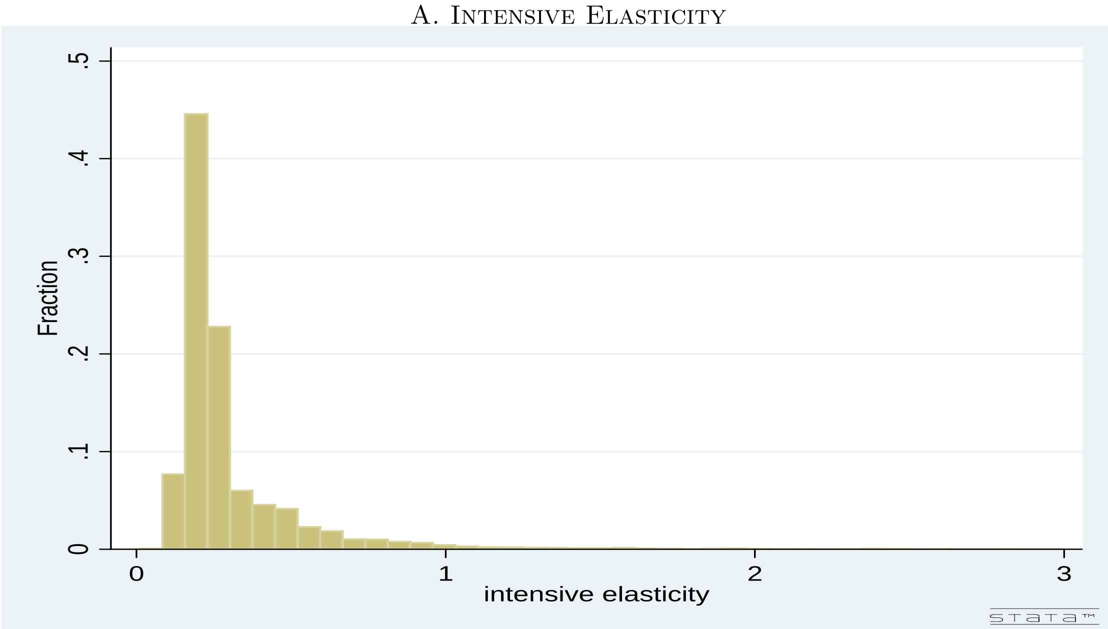
6.3 Elasticity Results

We estimate labour supply models for the central age group 30-54 of Table 2. The parameter and elasticity results at the intensive margin for women line up closely with the original results reported in Blundell et al. (1998). Labour supply for women depends importantly on demographic composition and education. There are also significant income effects for women with children. Adjusting for the endogeneity in marginal wages, other income and selection in to work using the differential changes in wages, taxes and other incomes across gender, education and age are all important and result in larger estimated elasticities.

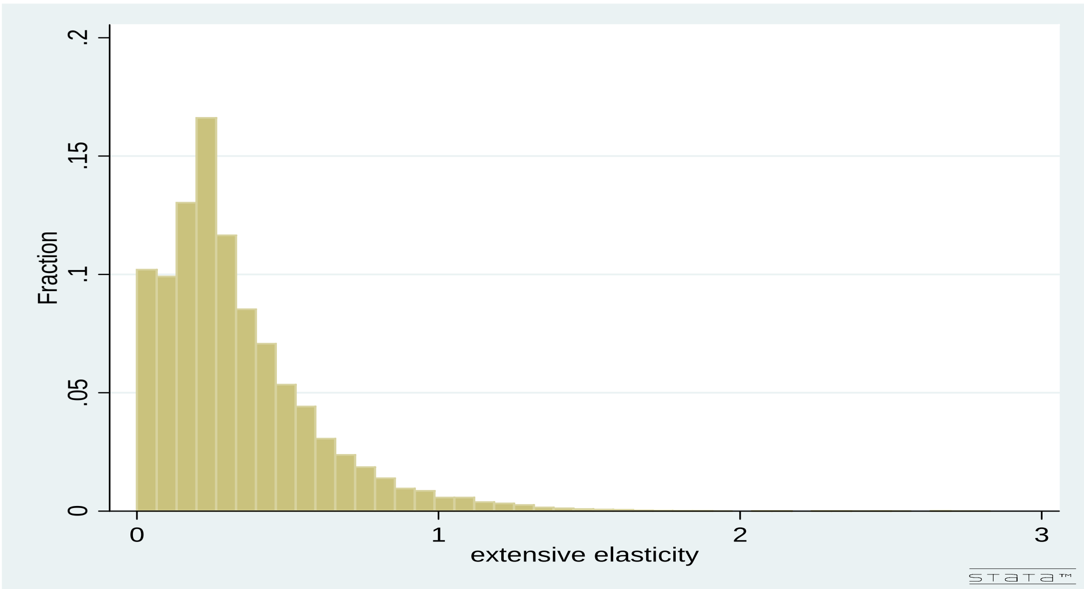
As expected women with children have higher elasticities at the intensive margin that either for women without children or for men. Even though the data covers a much longer period, the results for women with children line up very closely with those reported in Blundell et al. (1998). After allowing for differences in household composition, there are few differences between male and female labour supply. There is also little evidence of strong instability of preferences over time once we account for selection, and condition on the demographic, wage and other income effects.

Figure 8: Elasticity Distribution: Prime-age men and women (30-54) in the UK

A. Intensive Elasticity



B. Extensive Elasticity



Notes: Authors calculations from estimated models. Detailed model estimates and standard errors avaliable from the authors

On average the intensive and extensive elasticities are relatively small for this age group. Elasticities at the extensive margin are somewhat larger than those at the intensive margin and elasticities for women at both margins are larger than those for men. The key determinant of these differences across gender is the age composition of children in the family. The distributions are plotted in Figures 8A and 8B respectively.

Depending on the specification, the median value intensive elasticity ranges between .09 and .23 but with a wide distribution depending on age and demographic charateristics. The overall distribution of elasticities at the intensive margin is presented in Figure 8A. As noted above these are life-cycle consistent Marshallian within period intensive elasticities. Frisch elasticities are somwhat larger.

At the extensive margin we find a strong impact of potential in-work income as well as out of work income. These are both simulated using the tax and benefit model and the wage, demographic and other information. Extensive elasticities are larger for women than men, the median elasticity for women being around .34 and that for men of around .25. An overall extensive elasticity with a median of .3 and an interquatile range between .13 and .37. The complete distribution of extensive elasticities is presented in Figure 8B.

Using the empirical distribution of the wages, charateristics and unoberserved heterogeneity we can use the empirical analog of equation (5) to compute the aggregate elasticity for total hours. This overall hours elasticity for the age 30-54 group lies in the range .3 to .44.

7 Conclusions

In this paper we have proposed a systematic way of examining the importance of the extensive and the intensive margins of labour supply in explaning the overall movements in total hours of work over time. We have shown how informative bounds can be developed on each of these margins. We have applied this analysis to the evoluation of hours of work in the US, the UK and France over the past 40 years. We have shown that the extensive and intensive margins both matter in explaining changes in total hours.

The analysis has highlighted some key differences in behaviour at the intensive and extensive margin. For example, the overall trend in employment rates for women is strikingly similar and has almost doubled in all three countries. The intensive margin, on the other hand, offers a completely different picture. American married women have not only increased their participation, but also their mean annual hours of work, while French women have seen their average hours decline markedly. The UK also stands apart with married women hours of work below those of their French counterpart but also markedly below the hours worked on average by American married mothers.

The contribution to the aggregate of the hours worked by the young and prime age men is negative in all countries, with a larger decline in France than in the UK than in the US. The steep decline at the intensive margin for prime aged men in France and the UK relative to the US is striking. For this group the bounds are quite narrow and leave little room for ambiguity. These changes represent an enormous shift in the relative position of these countries. The extensive margin for prime-age men in Britain and in France also falls more than in the US, although there are declines in the US too.

The changes among the young are sizable and predominantly negative. In France and the UK there are large falls for young men at both the extensive and intensive margin. In France this is associated with a much higher recorded unemployment rate for youth than in other countries. When we delve deeper into the employment patterns of the young below, this appears to be related to differences in the relationship between education and work across the countries. Blundell et al. (2010) show that there is in fact around the same proportion of the young population out of work and looking for a job in all three coutries, especially in the UK and France. Moreover, there is a very similar proportion in education in the US and in France, a much larger proportion than in the UK. However, in France those in education typically do not work at the same time whereas in the US education and work in the 16-29 population is common.

For older men and women there is a large decrease in hours per worker in France, similar in UK, contrasting with an increase in the US. There are falls at the extensive and intensive margin for UK men but increases at the extensive margin for UK women. The contrast with the US is stark. At all margins and for both genders the bounds point to positive changes for older workers.

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