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The return to work and how it is taxed: a dynamic perspective

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Abstract: This paper provides an empirical account of the dynamic return to work, and how this is affected by taxes and benefits. In doing so we bring the insights from the literature on dynamic labour supply to the issue of estimating the financial return to work and how it is taxed, where the past literature has focused on the current period return. We do this with two new summary measures: the forward-looking replacement rate (FLRR), which measures the dynamic return to working at all, and the forward-looking participation tax rate (FLPTR), which measures the impact of personal taxes and transfers on the dynamic return to work, and implement these using simulated data from a sophisticated, structural dynamic model of education and labour supply. We find that the dynamic return to work is much higher than a static measure would imply: at the start of working life, the expected FLRR and static RR differ by at least 5 percentage points for more than two thirds of women, and by over 10 percentage points for over a third of women. These results are driven by returns to experience. In contrast, we find a dynamic perspective makes relatively little difference to the extent to which personal taxes and transfers reduce the return to work, with the expected FLPTR and static PTR differing little for most women in our data. This mainly reflects the fact that that the UK tax and benefit system tends to treat the future returns to working today similarly to how it treats the current-period return.

JEL codes: H21, H24, I38, J22, J24

Keywords: labour supply, work incentives, replacement rate, participation tax rate, forward-looking, lifecycle, taxes, human capital

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1. Introduction

The processes of human capital formation, employment and earnings are intimately linked over the course of life. For instance, early investments in education are later productive in the labour market, stimulating employment, the accumulation of working experience and further human capital investments during adult years. Conversely, returns realised in the future shape the incentives and decisions to work and invest in human capital, something that was recognised in the seminal contributions of Becker (1964), Ben-Porath (1967) and Heckman (1976) and has since been demonstrated empirically.[2] The tax and benefit system interferes with human capital investments and working decisions in a number of ways. For instance, a progressive income tax distorts the values of working and accumulating human capital by, on the one hand, taxing future returns more heavily than current earnings and, on the other hand, insuring against earnings risk. Work-contingent subsidies for families with children accentuate these effects by promoting work among low-paid families during child-rearing years while taxing strongly future returns to experience when earnings increase above some threshold and fall in the subsidy-withdrawal interval (Heckman, Lochner and Cossa, 2003).

The purpose of this paper is to investigate the importance of links across time in labour supply, human capital and earnings in driving the financial return to work for forward looking individuals and how that return is taxed. Past research analysing these issues (such as Immervoll, 2004; Adam and Browne, 2010; Mulligan, 2013; OECD, 2015) has been based on standard static measures of work incentives that exclude any sort of dynamic considerations in the form of future returns from working today.[3] This omission seems particularly surprising given that one of the reasons economists devote much effort to understanding labour supply behaviour is to understand better the distortionary effect that modern tax

[2] For example, see Shaw (1989), Eckstein and Wolpin (1989), Heckman, Lochner and Taber (1998), Keane and Wolpin (1997, 2010).
[3] Another dynamic perspective would be to consider how work incentives change for an individual as they age; we attempt this in a companion paper, Brewer and Shaw (2015).

systems and welfare states have on labour supply choices. In contrast, recent contributions in the optimal taxation research recognise the importance of accounting for the dynamic links between working, human capital and earnings (e.g. Bovenberg and Jacobs, 2005; Bohacek and Kapicka, 2008; Anderberg, 2009; Stantcheva, 2014) and considered the case for age-dependent taxes (Kremer, 2002; Weinzierl, 2012; Mirrlees et al., 2011). But, to the best of our knowledge, there is as yet no empirical account of the dynamic return to work that includes consideration of the role played by taxes and benefits.

To quantify the dynamic return to work and how it is taxed, we define two summary measures – the forward-looking replacement rate (FLRR), which measures the return to working at all, and the forward-looking participation tax rate (FLPTR), which measures the impact of personal taxes and transfers on the return to work.[4] Both measures are defined in a dynamic setting, in the sense that they account for the contemporaneous and future returns to employment, through earnings and employment opportunities, and how these are treated by the tax and benefit system. The value of these returns for the worker depends on many uncertain factors, such as his/her future family arrangements, family unearned income or other determinants of productivity, and how these interact with the tax and welfare system. Hence, measures of the return to work and how it is taxed that take into account the taxation of future returns to work and how it depends on the worker's changing circumstances are likely to diverge from a static measure.

We implement our new measures on simulated data from the empirical dynamic life-cycle model of female labour supply and earnings developed by Blundell et al. (2013); see also Blundell et al. (2016). The focus is on women, who are more responsive to work incentives than men, and for whom time off-work and short working hours are especially prevalent and

[4] Terminology here is not standard: Mulligan (2013) uses the term "marginal tax rate" to refer to what we call the participation tax rate, and when OECD (2015) analyses what it calls "marginal tax rates", it calculates what we call the METR for workers and the PTR for non-workers (see p548).

carry potential consequences for the value of working and the accumulation of human capital (Altonji and Blank, 1999; Goldin, 2006, 2014; Meghir and Phillips, 2010; Adda et al., 2015). In their model, employment affects future earnings capacity through the accumulation of experience capital. Women can choose labour supply at the extensive and intensive margins, each carrying different returns through experience. This feature of the model supports a rich characterisation of how the tax and benefit system affects the incentives for different hours of work. The model also formalises the dynamics of family formation, a key driver of women's work decisions that interacts strongly with the tax and welfare system. It accounts for other family income, notably spouse's earnings, and for uncertainty in the different sources of income.

Based on the simulated life-cycle profiles of 22,000 women, we find that the return to work at the start of working life is much higher than a static measure would imply: for more than two thirds of women, the expected FLRR and RR differ by at least 5 percentage points, and for almost a third the difference exceeds 10 percentage points. These results are driven by returns to experience: working now will increase future earnings capacity. The differences drop with age, as experience profiles become flatter and the number of future working periods drops. They are also larger for highly educated women (because returns to experience are more important for this group), for women in families without children (because they have greater labour market attachment) and for younger women. However, although a forward-looking perspective makes a considerable difference to estimates of the return to work, we find it makes relatively little difference to our impression of the extent to which personal taxes and transfers reduce the return to work: we find that the expected FLPTR and static PTR differ relatively little for most women in our data. This mainly reflects that the UK tax and benefit system tends to treat the future returns to working today similarly to how it treats the current-period return. Put differently, for most women the returns to the experience accumulated by

one extra working year are not strong enough to move them across a tax/benefit threshold. However, we can identify some groups for whom a forward-looking perspective does change the extent to which the tax and transfer system weakens the return to work. Specifically, this happens to young women and lone mothers.

The economic mechanism that underpins our main findings is returns to experience (or the accumulation of human capital through on-the-job learning), which we identify by exploiting exogenous tax and transfer reforms. Our mechanism is similar to the one behind the results in Keane (2011). Within an intertemporal model of labour supply, Keane (2011), following Imai and Keane (2004), shows that the welfare losses from income taxation are larger if one allows for endogenous human capital formation through learning-by-doing because higher taxes contemporaneously reduce work, leading to lower levels of accumulated human capital and less output in the future. Keane also shows that, with human capital formation through learning-by-doing, permanent tax changes may induce larger labour supply responses than transitory changes, contrary to the conventional belief, because permanent changes affect the returns to human capital. The model we use also has human capital accumulation through on-the-job learning and generates similar responses, but it extends the models used by Keane by also having an extensive labour supply margin, an education decision, a realistic tax and welfare system, and stochastic family dynamics. Our contribution, therefore, is to examine the importance of taking a dynamic perspective to considering the impact of the tax system in a richer and more realistic model with not just endogenous human capital formation through learning-by-doing but also changing family composition, and a real-world, non-convex tax and benefit system that depends heaving on family circumstances. We also show how the dynamic considerations highlighted by Imai and Keane (2004) can be captured in a summary measure of the tax burden.

Section 2 outlines our two new forward-looking measures of the return to work and how it is taxed. Section 3 describes the model and data used to implement the measures. Section 4 sets out our results and Section 5 concludes.

2. Forward-looking measures of the return to work and how it is taxed

In this section, we define and analyse two summary measures: the forward-looking replacement rate (FLRR), which measures the return to working at all, and the forward-looking participation tax rate (FLPTR), which measures the impact of personal taxes and transfers on the return to work. These measures are consistent with a dynamic, forward-looking, model of individual labour supply and human capital accumulation. Each is intended as a dynamic variant to commonly-used measures of static work incentives: the replacement rate (RR) and the participation tax rate (PTR).

2.1. The forward looking replacement rate

The static replacement rate (RR) measures the return to working compared to not working. [5] From the point of view of a worker, it describes what fraction of net income would remain if he or she (we use "she" hereafter, as our empirical application is to women) moved out of work. In a discrete time world where a indexes the woman's age, the static RR at h working hours is defined as:

$$RR_a(h) = \frac{Y_a(0)}{Y_a(h)}$$

where $Y_a(h_a)$ is net (of taxes and transfers) income when the woman is aged a, a function of her contemporaneous working hours h_a. Net income Y is typically measured at the family level since this is the unit used to assess entitlement to most benefits. Higher values of RR correspond to a weaker incentive to work.

[5] It is also used as a measure of the adequacy of retirement incomes or unemployment insurance, but we do not pursue that interpretation here.

This conventional RR is therefore a static measure of the return to work that considers only the current period. We can define a forward-looking version of the RR that accounts for the dynamic returns to current working. We assume income realisations are annual and use:

$$FLRR_a(h) = \frac{Y_a(0)}{Y_a(h) + \sum_{s=1}^{A-a} R^{-s}[Y_{a+s}(h_{a+s}|h_a = h) - Y_{a+s}(h_{a+s}|h_a = 0)]}$$

where R is the (risk free) interest factor, $a + s$ is the age of the woman in future periods, ranging between $a + 1$ and some terminal age A, and the path of future income is conditional on present labour supply as it affects working experience. The numerator is therefore the reward to not working (net out-of-work income) at age a, and the denominator is the contemporaneous reward to working at age a plus the additional income that accrues because future wages are higher having worked at age a; this latter term itself depends also on future levels of labour supply and future personal tax and transfer systems. Clearly, the FLRR is identical to the RR in the final period, at age $a = A$. More generally, if working today bears no consequences for future work or earning capacity, then the FLRR reduces to the RR in every period.[6]

Both the static and the forward-looking measures can be evaluated at different values of labour supply at age a – and so we think of them as describing the functions $RR_a(h_a)$ and $FLRR_a(h_a)$. The FLRR also requires a choice of the future labour supply path $(h_{a+s}, s = 1, \ldots, A - a)$ to calculate future income. Different choices of these future values alter the interpretation of these measures. For example, evaluating $Y_{a+s}(h_{a+s}|h_a = h)$ and $Y_{a+s}(h_{a+s}|h_a = 0)$ at h_{a+s} at the maximum value of labour supply for all $s = 1, \ldots A - a$ would correspond to a full-income concept in future years (as in, for example, Blomquist, 1981). At the other extreme, evaluating $Y_{a+s}(h_{a+s}|h_a = h)$ and $Y_{a+s}(h_{a+s}|h_a = 0)$ at

[6] It is important to recognise that an increase in the FLRR need not imply that work this period has become less likely (and vice versa). To see this, consider the case where future taxes go up. This will raise the FLRR all else equal, but may induce the individual to work today due to an intertemporal substitution effect.

$h_{a+s} = 0$ for all $s = 1, \ldots A - a$ would reduce the FLRRs to its usual static measure. Another alternative is to evaluate $Y_{a+s}(h_{a+s}|h_a)$ at the optimal working hours h_{a+s} conditional on working hours at time a being h_a (either 0 or h). This accounts for the role of future labour supply responses in shaping present returns to working. Two mechanisms drive the responses in future labour supply to changes in present working hours. On the one hand, working accumulates experience that is productive in the future, thus making future work more attractive. However, working is also associated with higher income and higher savings, leading to a wealth effect that reduces future labour supply. These two conflicting effects complicate the interpretation of the dynamic return to work.

In our empirical application, we evaluate $Y_{a+s}(h_{a+s}|h_a = h)$ and $Y_{a+s}(h_{a+s}|h_a = 0)$ at the individual's preferred choice of hours worked at age $a + s$ assuming she did not work at age a. This is a concept we can calculate because we use a structural, forward-looking model of labour supply to generate simulated working histories. With this choice, the difference between the FLRR and the static RR describes how human capital accumulated through working experience, and productive only in the future, increases the reward to working today. Provided the return to experience is non-negative, then we have $FLRR_a \leq RR_a$.

As defined above, the FLRR is an ex post measure, taken once uncertainty has been realised. We calculate its ex ante counterpart, which is defined at age a as the expected value at a of the FLRR over the domain of future income, $E_a[FLRR_a(h_a)]$. At our preferred choice of future labour supply paths, the calculation of $E_a[FLRR_a(h_a)]$ requires the optimal labour supply profile to be computed at each point in the distribution of the unpredictable drivers of labour supply and earnings. We also compute the standard deviation of the distribution of ex post realisations to assess the degree of uncertainty in the FLRR.

2.2. The forward looking participation tax rate

The participation tax rate (PTR) is a common measure summarising the extent to which the personal tax and transfer system weakens the return to work. It describes what fraction of the increase in gross earnings caused by a worker moving into work is lost through increased personal tax liability and reduced transfer payments (and is therefore a tax rate). At age a, for a woman working h hours, it is defined as:

$$PTR_a(h) = 1 - \frac{Y_a(h) - Y_a(0)}{E_a(h) - E_a(0)}$$

where $E_a(h_a)$ is gross (before taxes and transfers) income at the family level when the woman is aged a, a function of her contemporaneous working hours h_a, and Y and h are defined as above. Higher values mean that the personal tax and transfer system reduces the return to work by more. We note that the RR is a direct measure of the return to work, driven by individual earnings, other family income and the tax and benefit system, whereas the PTR is a measure of the impact of the personal tax and transfer system on the return to work.

Analogous to the FLRR, we define a forward-looking participation tax rate (FLPTR) that takes into account the dynamic consequences of working today. For an individual at age a, it is defined as:

$$FLPTR_a(h) = 1 - \frac{\sum_{s=0}^{A-a} R^{-s}[Y_{a+s}(h_{a+s}|h_a = h) - Y_{a+s}(h_{a+s}|h_a = 0)]}{\sum_{s=0}^{A-a} R^{-s}[E_{a+s}(h_{a+s}|h_a = h) - E_{a+s}(h_{a+s}|h_a = 0)]}$$

The numerator (denominator) now measures the change in net (gross) income today and in all future periods that results from working today, and the FLPTR is the fraction of current and future earnings that is offset by current and future increases in personal tax liabilities net of entitlements to transfer payments.

Straightforward algebra reveals that we can write the FLPTR as a weighted average of today's PTR and future tax rates (which are marginal effective tax rates) for those future periods in which earnings are higher thanks to the individual working today:

$$FLPTR_a(h) = \alpha_a PTR_a(h) + \sum_{s \in S, s \neq 0} \alpha_{a+s} METR_{a+s}(h) \quad (1)$$

where:

$$\begin{aligned} \alpha_{a+s} &= \frac{R^{-s}[E_{a+s}(h_{a+s}|h_a = h) - E_{a+s}(h_{a+s}|h_a = 0)]}{\sum_{t \in S} R^{-t}[E_{a+t}(h_{a+t}|h_a = h) - E_{a+t}(h_{a+t}|h_a = 0)]} \\ METR_{a+s}(h) &= 1 - \frac{Y_{a+s}(h_{a+s}|h_a = h) - Y_{a+s}(h_{a+s}|h_a = 0)}{E_{a+s}(h_{a+s}|h_a = h) - E_{a+s}(h_{a+s}|h_a = 0)} \\ S &= \{s = 0, \dots, A - a : E_{a+s}(h_{a+s}|h_a = h) - E_{a+s}(h_{a+s}|h_a = 0) \neq 0\} \end{aligned}$$

and where terms are omitted if $E_{a+s}(h_{a+s}|h_a = h) - E_{a+s}(h_{a+s}|h_a = 0) = 0$, i.e. if earnings at age $a + s$ are not affected by the decision to work today (which would occur if the individual did not work at age $a + s$, for example).

These future tax rates, $METR_{a+s}(h)$, are calculated on the change in future earnings that arises due to working at age a, and the weights at age $a + s$ depend on the size of the change in future earnings at age $a + s$. In our preferred implementation, the change in earnings at age $a + s$ reflects only the increase in hourly wages at age $a + s$ that arises from working at age a, and so the age profile of change in future earnings reflects the interaction of the age profile of experience effects and the age profile of future labour supply.

Equation (1) means that whether the FLPTR exceeds the static PTR will depend upon the time profile of future METRs, their relationship to the static PTR, and on the size of the change in future earnings through working today relative to the current-period reward. For example, a FLPTR is more likely to exceed a static PTR for those whose future (static) METR exceeds the current (static) PTR, or whose (static) METR rises with age, and for those for whom experience effects are large.

As with the FLRR, we measure the ex ante counterpart at age a as the expected value at a of the FLPTR over the domain of future income, $E_a[FLPTR_a(h_a)]$, and we compute the standard deviation of the distribution of ex post realisations to assess the degree of uncertainty.

3. Model, data and implementation[7]

To characterise the incentive to work that frame the labour supply decisions of forward-looking individuals one needs to observe the returns to work as they are realised, over future periods. *Ex ante* measures further require knowledge of the uncertainty surrounding these future returns. In this section we briefly describe the construction of the lifetime working and earnings histories that underlie our estimates of the return to work and how it is taxed.

3.1 Brief description of the model

We construct our new forward-looking measures with complete lifecycle data simulated using the life-cycle model of labour supply and human capital formation developed and estimated by Blundell et al. (2013, see also Blundell et al., 2016). To our knowledge, this is the first tool capable of supporting the study of the dynamic features of tax and transfer design.

This is a structural, dynamic model of female labour supply, human capital accumulation, earnings and savings. The model was developed and estimated to describe women's inter-temporal decisions on education, labour supply and savings, and assess their consequences for earnings and family income; so our focus is also on women. In general, women have been found to be more responsive to work incentives than men are (Meghir and Phillips, 2010 or Keane, 2011), and also more vulnerable to poverty partly as a consequence of long periods

[7] Some of this text draws on Brewer and Shaw (2015), which analyses data produced by the same model.

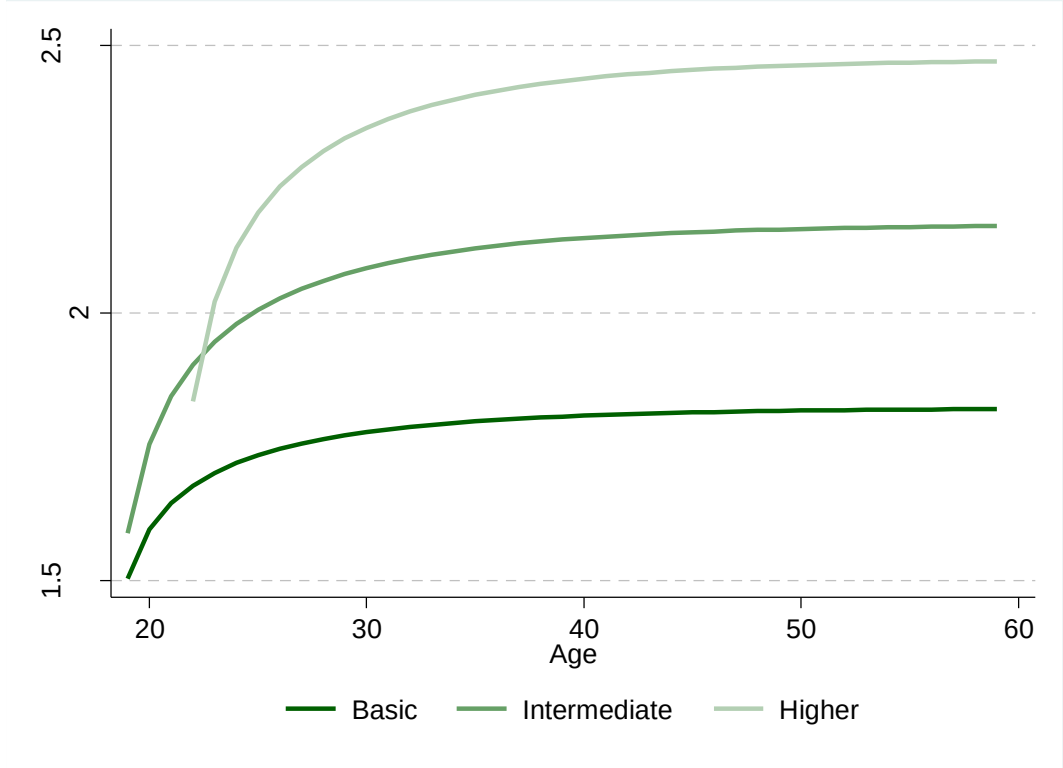
out of work due to family responsibilities. Hence, the dynamic financial incentives may be a stronger determinant of labour supply for women than for men.

The model formalises women's lifecycle labour supply and education choice problem, in the style of Eckstein and Wolpin (1989), Shaw (1989) and Keane and Wolpin (1997), but with additional features that make it suitable to assess forward-looking returns to work. The most important of these are: evolving family composition; a rich characterisation of the personal tax and transfer system that relies on an accurate UK personal tax and transfer calculator; and experience capital accumulation.

A woman's life is split into education, working life and retirement. At age 17, women choose between three levels of education: basic (corresponding to GCSEs or less in the UK), high school (A-levels or post-compulsory vocational education) and university (three-year degree or more). The level of education determines the type of human capital a woman has to offer in the labour market, and the age at which she enters the labour market. After education, women enter the labour market and in each period they choose how much to save and work; the latter choice is limited to three points: not working, part-time work and full-time work. Women working different hours will accumulate different amounts of experience capital, as will women with different levels of education. For the estimates presented in Blundell et al. (2016), the return to experience is twice as high for women with higher education than for women with basic education; this will turn out to be important for our later results. The value of this extra experience depends on women's family circumstances and how these interact with the tax and benefit system. Family composition changes according to stochastic but exogenous processes of partnering and childbearing. At age 60, individuals compulsorily retire, and choose how much to consume each period until the end of life at age 69.

Individuals are risk averse, and face uncertainty over future productivity and family composition but not over future tax and benefit systems. Insurance markets are incomplete, and partial self-insurance is possible through saving and the accumulation of human capital (education and experience). Individuals are unable to borrow except to fund education. This set-up means that the tax and benefit system may be of value to individuals both by providing insurance and by alleviating credit constraints.

Figure 1. Log wage profiles implied by model assuming full-time employment



Notes: authors' calculations based on model parameters. Working life is assumed to begin at age 19 for individuals with basic and intermediate education and at age 22 for individuals with higher education.

As mentioned above, the economic mechanism that underpins our results is returns to experience. It is therefore important that we are able to separate experience effects from unobserved heterogeneity. In order to identify experience effects, we rely on exogenous tax and transfer reforms, which changes women's incentives to work different numbers of hours, combined with longitudinal data, which allow us to observe women both before and after reforms. This is similar to the way a difference-in-differences estimator works. To identify

the distribution of unobserved heterogeneity, we use women at the start of working life before childbirth. Most women are employed at this point, meaning there is little selection into the labour market. We choose the unobserved heterogeneity parameters in order to fit the distribution of the unobserved component of the wage equation among these women. Identification of the model parameters is discussed in more detail in Blundell et al. (2016). Here, Figure 1 shows the average log wage profiles implied by the model for women with different education levels, assuming full-time employment every period. This demonstrates that experience profiles are steepest for better-educated women and at start of working life, which will be important for interpreting our main results.

3.2. Data

Using the model, we simulate full lifecycles for 22,000 women and their families. These are constructed by randomly drawing initial conditions (age 17) from the BHPS data, and then, for each woman, randomly drawing lifecycle profiles for the exogenous components of the model (productivity and family composition) and solving the decision problem at each age. The result is a lifecycle profile for each simulated individual for each of the exogenous and endogenous variables in the model (e.g. labour supply, consumption, assets, experience and education, plus the work incentive measures). The population we simulate is, effectively, all families containing an adult female (single men are the only excluded family type).

When performing these simulations, we assume individuals face a single tax and benefit system throughout life: that in operation in the UK as of April 2012. This combines a relatively simple, individual-based, income tax system with a relatively complicated, family-based set of transfer payments and refundable tax credits for which maximum entitlements are strongly influenced by family circumstances and there is a heavy reliance on means-testing (for more detail, see Pope and Roantree (2014) and Hood and Oakley (2014)). The way that the personal taxes affect work incentives is fairly intuitive, but the cash benefits and

refundable tax credits affect work incentives in much more complicated ways, meaning that the impact they have on a given individual's work incentives will depend upon the earnings of any partner, and on other family or household characteristics, such as the presence and age of children, and housing tenure. The April 2012 system is implemented using an accurate UK tax and benefit calculator called FORTAX (see Shephard, 2009 and Shaw, 2011).

Simulated data has a number of advantages relative to using panel survey data. The first is practical: it enables us to analyse complete lifecycles. Using UK panel data, we would be limited to half a full working life at most: the UK's longest-running panel dataset (the British Household Panel Survey and its successor) has existed only since 1991, and only a small fraction of the sample has been interviewed in every wave. Second, patterns observed in panel data will be confounded by changes in institutions over time, as well as cohort effects, whereas we can model cleanly how women would behave as if they faced a constant personal tax and transfer system throughout life, and can do so having stripped out cohort effects. Third, we can use the model to calculate our new forward-looking measures of the return to work, taking into account the uncertainty that individuals face.

3.3. Practical implementation of the forward-looking measures of the return to work

We calculate the FLPTR and FLRR for workers setting h_a to their observed current-period number of hours worked; for non-workers we set h_a equal to the number of hours individuals would have worked had they been employed – something we know because the model gives us a complete ranking for the different choices of hours. Income is the combined income of a family (woman plus partner if she has one), after deducting personal taxes and adding transfer payments. We treat childcare costs like a tax liability, effectively assuming that spending on childcare is a cost of working that would not otherwise be incurred, and does not

in itself affect the family's utility. When calculating the FLRR and FLPTR, we use total family earnings and income (not equivalised).[8]

4. Results

4.1. The forward-looking replacement rate

Figure 2 compares the conventional, current-period-only, measure of return to work with our new forward-looking measure of the return to working now, plotting the distribution of RRs and expected FLRRs across all women. The left panel shows the distribution for all working-age women, and the right panel is for women at the start of working life. There is a remarkably even distribution of expected FLRRs between about 0.1 and 0.9 for all working-age women. For women at the start of working life, there is a higher concentration of expected FLRRs between 0.1 and 0.3.

Figure 2. Cumulative distribution of RRs and expected FLRRs

Notes: authors' calculations based on simulated data.

[8] Equivalisation makes no difference to the RR and PTR because it cancels from the numerator and denominator. But this isn't true for the FLPTR because family composition varies across life so different terms in the discounted sum will be scaled differently. In practice, this seems to make little difference.

There are substantial differences between the distribution of expected FLRRs and RRs, particularly from the perspective of the start of working life, where the distribution of expected FLRRs is up to 10 percentage points to the left of that for the RR. As Section 3 discussed, this is to be expected, as it is at the start of working life where experience profiles are steepest, and there are more future periods in which women can benefit from the experience effects caused by working now.[9]

Expected FLRRs and RRs also differ substantially at the individual level. Column (1) of Table 1 shows the mean difference between the expected FLRR and the RR, and how this varies by women's characteristics. (Note that negative values indicate that the expected FLRR is below the RR; all differences are negative because $RR_a \geq FLRR_a$ given that returns to experience are non-negative). Overall, the average difference between the expected FLRR and the RR is -2.9 percentage points across all of working life, and -8.0 percentage points when assessed at start of working life. This indicates that the forward-looking return to work is substantially stronger than the static return, particularly from the perspective of the start of working life.

Table 1. Mean difference between the expected FLRR and RR

	Mean	> 5 ppts	> 10 ppts
	(1)	(2)	(3)
Overall	-0.029	0.167	0.019
Start of working life	-0.080	0.729	0.353
By education			
Basic	-0.017	0.044	0.002
Intermediate	-0.035	0.222	0.030
Higher	-0.039	0.270	0.026

[9] Imai and Keane (2004) similarly find that allowing for endogenous human capital formation makes more of a difference to younger workers than older workers in terms of the size of tax-induced distortions (see their Figure 7).

By family type			
Childless single	-0.037	0.244	0.046
Childless couple	-0.029	0.146	0.015
Lone mother	-0.020	0.108	0.006
Couple parent	-0.027	0.143	0.007
By education x family type			
Basic, childless single	-0.025	0.118	0.009
Basic, childless couple	-0.017	0.031	0.001
Basic, lone mother	-0.010	0.010	0.000
Basic, couple parent	-0.016	0.021	0.000
Intermediate, childless single	-0.044	0.322	0.069
Intermediate, childless couple	-0.031	0.158	0.017
Intermediate, lone mother	-0.028	0.173	0.009
Intermediate, couple parent	-0.032	0.202	0.012
Higher, childless single	-0.037	0.236	0.041
Higher, childless couple	-0.040	0.306	0.033
Higher, lone mother	-0.040	0.326	0.020
Higher, couple parent	-0.038	0.260	0.008
By age band			
20s	-0.039	0.325	0.040
30s	-0.028	0.150	0.006
40s	-0.030	0.132	0.007
50s	-0.016	0.025	0.002

Notes: authors' calculations based on simulated data. The column headed "Mean" is the average value of the expected FLRR less the RR, so negative values indicate that the expected FLRR is lower than the RR. Since the return to experience is non-negative, the expected FLRR cannot exceed the RR when behaviour is held fixed. The columns headed "> 5 ppts" and "> 10 ppts" give the proportion of observations where the expected FLRR is more than five and 10 percentage points below the RR respectively.

Differences between the expected FLRR and the RR are driven by returns to experience. As returns to experience are estimated to be larger for high-education individuals, there is a

greater divergence between the expected FLRR and the RR for these individuals: -3.9 percentage points for women with higher education, compared to -1.7 percentage points for women with basic education. The mean difference between the expected FLRR and the RR also tends to be larger for women in families without children (because they have greater labour market attachment, on average, than those with children) and for younger women (whose experience profiles are steeper, on average, and who have more periods of working life ahead of them, than older women). Indeed, columns (2) and (3) of Table 1 show that, at the start of working life, more than 70 per cent of women have a difference between their expected FLRR and their RR of at least 5 percentage points; over a third have a difference of more than 10 percentage points. The return to work at the start of working life is, therefore, much stronger than standard static measures would imply, and large differences are also more common for women with higher education, individuals in their 20s and childless singles (partly because they tend to be younger).

So far we have focused on the expected value of the FLRR. We now briefly discuss uncertainty, which we measure using the standard deviation of the FLRR. This is low, at around 0.8 percentage points on average. There is also little variation in the standard deviation of the FLRR by women's observable characteristics (not shown), except that it is somewhat higher at the start of working life (at around 1.8 percentage points). This relatively low variance may seem surprising given we observed substantial variability in the expected FLRR across groups; the explanation lies in the fact that, although the future matters for the FLRR, it is still dominated by the current period, over which there is no uncertainty.

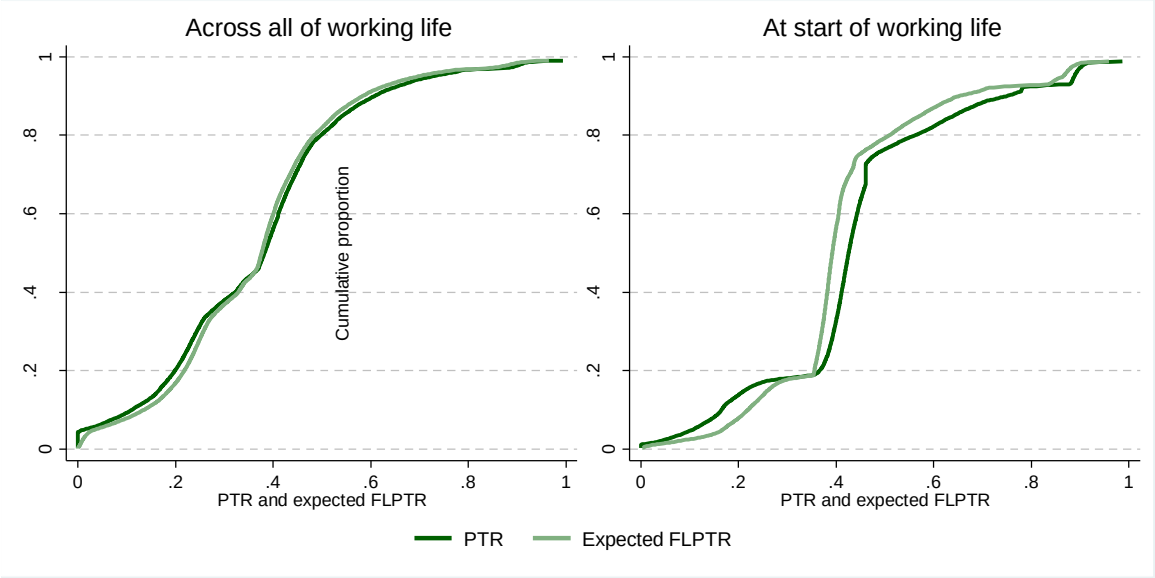
4.2. The forward looking participation tax rate

Figure 3 compares the conventional, current-period-only, measure of the extent to which the tax system reduces the gain to work with our new measure which incorporates the future returns to working now by showing the distribution of PTRs and expected FLPTRs across

women. The left panel shows the distribution for all working-age women, and the right panel is for women at the start of working life. Across all working women, most expected FLPTRs lie between 0.2 and 0.6, and are fairly evenly distributed in this range. At the start of working life, there is a far greater concentration around 0.4.

Figure 3 also shows that there are fairly small differences between the expected FLPTR and the PTR, particularly when assessed across the whole of working life (left panel). Expected FLPTRs and PTRs are also similar at the individual level. Overall, the mean difference across

Figure 3. Cumulative distribution of PTRs and expected FLPTRs



Notes: authors' calculations based on simulated data.

the whole of working life is negligible (around -0.1 percentage points), and the mean absolute difference is about 1.6 percentage points (Table 3).

There are two main reasons why the expected FLPTR and PTR differ relatively little at the individual and aggregate level. First, the majority of the return to working today is received in the current period. Table 2 presents a decomposition of the overall expected FLPTR according to equation (1). On average, the weight α_a on the current-period PTR is 88 per cent, meaning that the expected FLPTR is inevitably dominated by the value of the current-period PTR.

Second, current and future returns tend to be treated fairly similarly, on average, by the UK personal tax and transfer system. The second row of Table 2 shows that the average value of the current-period PTR is 0.369. Subsequent rows break down the mean tax rates on future earnings according to the woman's future family circumstances, something which makes a considerable difference to how earnings are taxed in the UK personal tax and transfer system. They show that only for future periods in which women will be single mothers is there much

Table 2. Decomposition of expected FLPTR across all of working life

	Weight (α_{a+s})	Tax rate
Expected FLPTR	1.000	0.368
Current PTR	0.878	0.369
Future METR		
Childless single	0.038	0.355
Childless couple	0.038	0.322
Lone mother	0.010	0.576
Couple parent	0.036	0.343

Notes: authors' calculations based on simulated data. The decomposition in this table corresponds to that set out in equation (1) but where future METR terms have been grouped according to family type. The expected FLPTR is equal to the product of entries in the "Weight" and "Tax rate" columns, summed together. Average future METRs are weighted averages.

difference between future and current tax rates on earnings, but these periods receive a weight of only 1 per cent when assessed across all working-age women.

Although the mean absolute difference between the expected FLPTR and the PTR assessed across all of working life is relatively small, there is some variation across different subgroups. Column (2) of Table 3 shows the mean absolute difference between the expected FLPTR and the PTR according to woman's characteristics. At the start of working life, the difference is a fairly substantial 3.9 percentage points. The absolute difference is smaller for women with basic education because returns to experience for this group are low: the mean

absolute difference is 1.2 percentage points, compared to 1.8 percentage points for women with intermediate education and 1.7 percentage points for higher-educated women. The mean absolute difference is also smaller for older women than younger women; as with the expected FLRR, this is partly because there are fewer periods of working life left, but also because the experience profile flattens out at higher levels of experience.

Table 3. Mean absolute difference between the expected FLPTR and PTR

	Mean (1)	Mean absolute (2)	> 5 ppts (3)	> 10 ppts (4)
Overall	-0.001	0.016	0.038	0.004
Start of working life	-0.021	0.039	0.258	0.049
By education				
Basic	0.000	0.012	0.020	0.001
Intermediate	-0.002	0.018	0.052	0.006
Higher	-0.001	0.017	0.034	0.004
By family type				
Childless single	-0.015	0.017	0.052	0.006
Childless couple	0.010	0.016	0.041	0.004
Lone mother	0.009	0.018	0.049	0.006
Couple parent	-0.001	0.014	0.019	0.001
By education x family type				
Basic, childless single	-0.009	0.014	0.039	0.000
Basic, childless couple	0.006	0.012	0.015	0.000
Basic, lone mother	0.011	0.014	0.029	0.003
Basic, couple parent	-0.003	0.010	0.008	0.000
Intermediate, childless single	-0.018	0.020	0.065	0.010
Intermediate, childless couple	0.010	0.018	0.055	0.005
Intermediate, lone mother	0.012	0.023	0.078	0.012
Intermediate, couple parent	-0.002	0.016	0.030	0.002
Higher, childless single	-0.015	0.015	0.038	0.006
Higher, childless couple	0.013	0.019	0.046	0.006
Higher, lone mother	-0.008	0.021	0.043	0.001
Higher, couple parent	0.002	0.015	0.016	0.000
By age band				
20s	-0.005	0.021	0.067	0.006
30s	-0.001	0.016	0.026	0.001
40s	0.002	0.017	0.032	0.004
50s	0.002	0.009	0.010	0.001

Notes: authors' calculations based on simulated data. The column headed "Mean" is the average value of the expected FLPTR less the PTR, so negative values indicate that the expected FLPTR is lower than the PTR. The "Mean absolute" column is the average absolute value of the expected FLPTR less the PTR. The columns headed "> 5 ppts" and "> 10 ppts" give the proportion of observations where the expected FLPTR and the PTR differ by more than five and 10 percentage points respectively.

There are also some groups of women for whom substantial differences exist between the expected FLPTR and the PTR. Columns (3) and (4) of Table 3 show the proportion of women with large (more than 5 percentage points and more than 10 percentage points) absolute differences, split by various characteristics. Perhaps most notable are the results from the perspective of the start of working life: 26 per cent of women have an absolute difference of at least 5 percentage points and 5 per cent have an absolute difference of 10 per cent or more. By education, women with intermediate education have the largest share with an absolute difference of at least 5 percentage points, and by age band it's those in their 20s.

By family type, childless singles and lone mothers have the greatest share of absolute differences that exceed 5 percentage points (both around 5 per cent), followed by childless couples (4 per cent).

Among lone mothers, more than 90 per cent of absolute differences greater than 5 percentage points involve the expected FLPTR exceeding the PTR (in other words, a forward-looking assessment of how much the reward to working now is taxed reveals a higher tax rate than the current period's average tax rate). Table 4 decomposes the expected FLPTR for this group following equation (1). Much of the difference is caused by future METRs for lone mothers being much higher than the current PTR (0.660 compared to 0.173). This reflects a structural feature of the way that the UK personal tax and transfer system affects lone mothers: thanks to generous refundable in-work tax credits, the average net tax rate on part-

Table 4. Decomposition of expected FLPTR across all of working life for lone mothers whose expected FLPTR exceeds their PTR by at least 5 percentage points

	Weight (α_{a+s})	Tax rate
Expected FLPTR	1.000	0.250
Current PTR	0.804	0.173
Future METR		
Childless single	0.053	0.501
Childless couple	0.009	0.330
Lone mother	0.108	0.660
Couple parent	0.025	0.397

Notes: authors' calculations based on simulated data. The decomposition in this table corresponds to that set out in equation (1) but where future METR terms have been grouped according to family type. The expected FLPTR is equal to the product of entries in the "Weight" and "Tax rate" columns, summed together. Average future METRs are weighted averages. Excludes a small number of cases where the difference between expected FLPTR and PTR exceeds 2.

time or low-earning jobs can be low, but when these in-work tax credits are withdrawn from those on higher incomes, the combined METR can easily exceed 60 per cent.

For women in childless couples with absolute differences greater than 5 percentage points, it is also the case that the majority (over 75 per cent) have an expected FLPTR that exceeds the PTR, meaning that a forward-looking assessment of how much the reward to working now is taxed reveals a higher tax rate than the current period's average tax rate. As with lone parents in similar situation, a decomposition of the expected FLPTR (Table 5) according to equation (1) reveals that, for these women, the PTR on current earnings is very low (0.118) in absolute terms, and certainly low compared to future METRs. For this group of women, the low current-period PTRs arise because they are likely not to be entitled to any transfer payments if they do not work (as most will be married to working men), and so their current period PTR is low, reflecting simply the average net tax rate coming from the personal tax system. Because the UK tax system has a large tax-free allowance and progressive structure, this PTR

Table 5. Decomposition of expected FLPTR across all of working life for women in childless couples whose expected FLPTR exceeds their PTR by at least 5 percentage points

	Weight (α_{a+s})	Tax rate
Expected FLPTR	1.000	0.186
Current PTR	0.689	0.118
Future METR		
Childless single	0.033	0.345
Childless couple	0.194	0.315
Lone mother	0.012	0.604
Couple parent	0.073	0.349

Notes: authors' calculations based on simulated data. The decomposition in this table corresponds to that set out in equation (1) but where future METR terms have been grouped according to family type. The expected FLPTR is equal to the product of entries in the "Weight" and "Tax rate" columns, summed together. Average future METRs are weighted averages. Excludes a small number of cases where the difference between expected FLPTR and PTR exceeds 2.

is lower than any METR that would applying to the reward to working today that accrues in future periods.

Turning to uncertainty (measured by the standard deviation of the FLPTR), on average this is low at around 0.9 percentage points and it almost never exceeds five percentage points. As expected, it is higher for younger individuals. There is relatively little variation by family type or education level (not shown). There are two explanations for why uncertainty is low. First, as with the FLRR, the FLPTR is dominated by the current period, over which there is no uncertainty: as Table 2 shows, the current-period PTR receives a weight of 88 per cent in the overall expected FLPTR decomposition, leaving only 12 per cent for future periods. Second, there is relatively little variation in the way in which the tax and transfer system treats future returns, implying little uncertainty in the FLPTR even if there is considerable uncertainty in circumstances.

5. Conclusion

In this paper, we bridge the gap between the literature on dynamic models of labour supply and on assessing the strength of work incentives. Our argument is straightforward: the insight of the forward-looking models of labour supply is that part of the return to working today is realised in future periods, usually conceptualised as acting through experience accumulation, where working today increases experience (or human capital), raising the hourly wage available tomorrow. We therefore propose two measures of the return to work and how it is taxed that incorporates dynamic considerations.

Our empiricial analysis of these measures is based on the simulated working lives of 22,000 women who are representative of new entrants to labour market in the UK over the period 1991 to 2006. The behaviour of these individuals is simulated using a sophisticated, structural dynamic model of education and labour supply that incorporates evolving family composition; a rich characterisation of the personal tax and transfer system; an education choice; and experience accumulation. We showed that the true return to working at the start

of working life is much higher than a static measure of work incentives would imply: for more than two thirds of women, the expected FLRR and RR differ by at least 5 percentage points, and for almost a third the difference exceeds 10 percentage points. These results are driven by returns to experience. The difference between the expected FLRR and the RR tends to be greater for women in families without children (because they have greater labour market attachment, on average, than those with children) and for younger women (whose experience profiles are steeper, on average, and who have more periods of working life ahead of them, than older women).

We also showed that a forward-looking perspective makes smaller differences to our impression of the effective tax rate that applies to the decision to work today. This relative lack of difference arises partly because the majority (88 percent, across all working women) of the return to work is the current-period wage (which the conventional static PTR incorporates) and, because the UK personal tax and transfer system treats the future return to working today similarly, on average, to the current-period return. Two groups where the forward-looking perspective is different from the conventional current-period PTR are for women living in couples but without children, and for lone mothers; in both cases, the more common pattern is for the FLPTR to exceed the conventional current-period PTR.

Note that there is no contradiction in finding that the expected FLPTR and PTR differ by much less than the expected FLRR and RR: the RR and FLRR are measures of work incentives, while the PTR and FLPTR are measures of the effect of taxes and benefits on work incentives. Future returns to experience from working today always act to reduce the FLRR, but their effect on the FLPTR depends on how they are treated by future tax and transfer system. What our results say, therefore, is that a forward-looking perspective makes work look considerably more attractive, on average, but our view of the distortionary impact of the personal tax and transfer systems changes little.

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