Equilibrium Search and Tax Credit Reform

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Background and motivation

This research concerns the equilibrium impact of tax reforms:

- UK Working Families' Tax Credit reform provides policy context
- Provides wage subsidy for low income working parents.
  [WFTC schedule]

Evaluate reforms using equilibrium search model of labour market:

- Empirically, job search behaviour is important
  [accepted wages] [wage changes] [separation rate]
- If firms set wages, search frictions provides them monopsony power
- If labour supply increases following reform, firms may adjust wages.

Background and motivation

Contributes to literature on impact of tax credit policies:

- Appear effective in raising employment of lone mothers (see Azmat (2006a), Blundell et al. (2004), Francesconi and van der Klaauw (2004), Gregg and Harkness (2003), and others)
- Less is known about equilibrium effects (exceptions include Rothstein (2008, 2009), Leigh (2008) on EITC; Azmat (2006b) on WFTC).

Emphasise role and implications of job search:

- Consider model with on-the-job search, where each firm sets a single wage which workers either accept or reject (wage posting)
- Wage posting appears good characterisation of low skilled labour market (Hall and Krueger, 2008; Manning, 2003)
- Examine impact on employment, hours of work, durations and wages; monopsonistic firm behaviour generates equilibrium effects.

Background and motivation

Paper builds on existing search literature. Two standard ways to generate dispersed wage distribution as equilibrium outcome with wage posting:

- Heterogeneity in opportunity costs of employment (Albrecht and Axell, 1984, Eckstein and Wolpin, 1990)
- On-the-job search (Mortensen, 1990, Burdett and Mortensen, 1998).

Productivity heterogeneity required to fit wage data:

- Bontemps et al. (2000) analyse model and propose simple estimation method with continuous firm productivity
- Bontemps et al. (1999) also allows for heterogeneous leisure flows (but with job arrival rates independent of work status).

This paper provides a synthesis of these models and extends them.

This paper

- Construct equilibrium wage-posting model with on-the-job search, unobserved worker and firm heterogeneity, hours responses, non-linear tax schedules
- Allow demographic heterogeneity to influence structural parameters, with all workers competing in same labour market
- Allow firms to choose job recruiting effort (determines arrival rate of job offers via matching function)
- Develop semi-parametric estimator, estimate using pre-reform Labour Force Survey data, and simulate impact of tax reforms
- Main results: *reforms raised employment with largest impact for lone mothers; equilibrium effects play a role, but impact primarily due to changing job acceptance behaviour*.

Setup and assumptions

Workers and environment:

- Workers are employed or unemployed; both search for jobs
- n_i individuals of demographic type i, with $\sum_i n_i = 1$
- Both tax system and structural parameters vary with i
- Employed worker utility flow: $\underbrace{wh - T_i^h(wh)}_{\text{net income}} - \underbrace{C_i^h}_{\substack{\text{hours} \\ \text{disutility}}}$
- Unemployed worker utility flow: $b - T_i^u$
- Leisure flow $b \sim H_i$ modelled as unobserved heterogeneity.

Setup and assumptions

Jobs and wages:

- Jobs described as wage-hours (w, h) packages; no bargaining
- Allow for part-time $(h = h_0)$ and full-time $(h = h_1)$ jobs; set $C_i^0 = 0$
- Job search frictions: workers sample offers sequentially at Poisson rates λ_{ji}^h; varies with employment state $j \in \{u, e\}$ and demographics i
- Employed workers exogenously lose their job at a Poisson rate δ_i
- Distributions of wage offers $\{F_0, F_1\}$ common to all workers
- Distributions of wages amongst employed $\{G_{0i},\ G_{1i}\}$ varies with i.

For now, treat offer distributions $\{F_0, F_1\}$ and arrival rates λ_{ji}^h as *exogenous* – will later show how they are determined in equilibrium.

Worker strategies

Optimal acceptance behaviour depends on current state, and whether a full-time or part-time offer is received. Summarise by:

- Indifference condition $q_i(w)$: $V^1_{ei}(w) = V^0_{ei}(q_i(w))$

$$\iff \quad \underbrace{wh_1 - T^1_i(wh_1) - C^1_i}_{\text{utility flow } \{w, h_1\}} = \underbrace{q_i(w)h_0 - T^0_i(q_i(w)h_0)}_{\text{utility flow } \{q_i(w), h_0\}}.$$

- Reservation wage for unemployed $\phi_i(b)$:

$$V_{ui}(b) = V^1_{ei}(\phi_i(b)) = V^0_{ei}(q_i(\phi_i(b))).$$

Worker strategies

The *reservation wage* for unemployed workers $\phi_i(b)$ solves:

$$\underbrace{\phi_i(b)h_1 - T_i^1(\phi_i(b)h_1) - C_i^1}_{\text{utility flow } \{\phi_i(b), h_1\}} = \underbrace{b - T_i^u}_{\substack{\text{utility flow} \\ \text{unemployed}}} + h_1 \int_{\phi_i(b)}^{\infty} B_i(w)dw$$

where $B_i(w)$ is defined as:

$$\underbrace{(1 - T_i^{1\prime}(wh_1))}_{\text{1-marginal tax rate}} \times \frac{(\kappa_{ui}^0 - \kappa_{ei}^0)\overline{F}_0(q_i(w)) + (\kappa_{ui}^1 - \kappa_{ei}^1)\overline{F}_1(w)}{1 + \rho_i/\delta_i + \kappa_{ei}^0\overline{F}_0(q_i(w)) + \kappa_{ei}^1\overline{F}_1(w)}$$

with $\overline{F} \equiv 1 - F$, $\kappa_{ji}^h \equiv \lambda_{ji}^h/\delta_i$, and where ρ_i is discount rate. Model with $\lambda_u = \lambda_e$ analysed in Bontemps et al. (1999).

Heterogeneity in $b \implies$ Heterogeneity in unemployed reservation wages.

Unemployment

For given offer distributions and arrival rates solve for *steady state* of model by using flow equations:

- Let $A_i(w) = H_i(\phi_i^{-1}(w))$ be the distribution of reservation wages
- Distribution of reservation wages amongst unemployed A_{ui} given by:

$$u_i A_{ui}(\phi) = \int_{-\infty}^{\phi} \frac{dA_i(w)}{1 + \kappa_{ui}^0 \overline{F}_0(q_i(w)) + \kappa_{ui}^1 \overline{F}_1(w)}.$$

- Letting $\phi \to \infty$ we obtain steady-state unemployment rate u_i.

Also let m_{0i} (m_{1i}) denote part-time (full-time) employment shares; By definition $m_{0i} + m_{1i} = 1 - u_i$.

Earnings distribution

We have the full-time between job flow equation:

$$m_{1i} g_{1i}(w) \overbrace{\left[\delta_i + \lambda^0_{ei} \overline{F}_0(q_i(w)) + \lambda^1_{ei} \overline{F}_1(w)\right]}^{\text{layoffs + voluntary quits}}$$
$$= f_1(w) \underbrace{\left[\lambda^1_{ui} u_i A_{ui}(w) + \lambda^1_{ei} m_{0i} G_{0i}(q_i(w)) + \lambda^1_{ei} m_{1i} G_{1i}(w)\right]}_{\text{hires from unemployment + job-to-job transitions}}$$

and similarly for part-time jobs.

The weighted average cross-sectional wage distributions given by:

$$m_{0i} G_{0i}(q_i(w)) + m_{1i} G_{1i}(w)$$
$$= \frac{A_i(w) - u_i A_{ui}(w) \left(1 + \kappa^0_{ui} \overline{F}_0(q_i(w)) + \kappa^1_{ui} \overline{F}_1(w)\right)}{1 + \kappa^0_{ei} \overline{F}_0(q_i(w)) + \kappa^1_{ei} \overline{F}_1(w)}.$$

Firm behaviour and equilibrium

Firm behaviour:

- Continuum of firms in each sector h with productivity $p \sim \Gamma_h$
- Workers equally productive at a given firm; marginal product ph
- Contracts posted before meeting workers; wages and recruiting effort maximise steady state profit flow:

$$\{K_h(p), v_h(p)\} = \arg\max_{(w,v)} (p - w)h \underbrace{L_h(w, v)}_{\text{steady state employment}} - \underbrace{c_h(p, v)}_{\text{vacancy flow cost}}$$

- Recruiting effort affect sampling probability: steady state employment $L_h(w, v) = \sum_i n_i l_{hi}(w, v)$ is proportional to v
- Assume vacancy flow cost given by $c_h(p, v) = c_h(p)v^2/2$.

Firm behaviour and equilibrium

Wage offer distribution:

- Optimal behaviour of firms determines equilibrium $\{F_0, F_1\}$
- In equilibrium more productive firms offer higher wages so that:

$$F_h(K_h(p)) = \int_{\underline{p}_h}^{p} \frac{v_h(p) d\Gamma_h(p)}{V_h} \quad \text{with} \quad V_h = \int_{\underline{p}_h}^{\overline{p}_h} v_h(p) d\Gamma_h(p).$$

Matching technology:

- Individual search effort denoted s_{ji}^h; $S_h = \sum_i n_i \cdot [s_{ui}^h u_i + s_{ei}^h (1 - u_i)]$ denotes aggregate search activity
- Recruiting effort affects λ_{ji}^h through aggregate matching functions:

$$\lambda_{ji}^h = \frac{s_{ji}^h}{S_h} \underbrace{M_h(V_h, S_h)}_{\substack{\text{match flow} \\ \text{in sector } h}} \quad \text{with} \quad M_h(V_h, S_h) = V_h^{\theta_h} S_h^{1-\theta_h}.$$

Semi-parametric estimation

Extend semi-parametric estimation procedure of Bontemps et al. (1999, 2000). If there were a single demographic type, then we have:

$$m_1 g_1(w) \overbrace{\left[\delta + \lambda_e^0 \overline{F}_0(q(w)) + \lambda_e^1 \overline{F}_1(w)\right]}^{\text{layoffs + voluntary quits}} = f_1(w) \underbrace{\left[\lambda_u^1 u A_u(w) + \lambda_e^1 m_0 G_0(q(w)) + \lambda_e^1 m_1 G_1(w)\right]}_{\text{hires from unemployment + job-to-job transitions}}$$

and similarly for part-time jobs.

Replace g_h on LHS with non-parametric estimates $\hat{g}_h$; numerically invert by exploiting conditional linearity in f_h and iterating.

Semi-parametric estimation

With demographic heterogeneity, flow equations averaged across types. Recover $\{F_0, F_1\}$ that induce *unconditional* empirical distributions:

$$\hat{g}_h(w) = \underbrace{\frac{\sum_i n_i m_{hi}(F_0, F_1) g_{hi}(w; F_0, F_1)}{\sum_i n_i m_{hi}(F_0, F_1)}}_{\text{weighted simulated earnings density}}.$$

Model is estimated by maximum likelihood:

- Assume parametric form for unobserved leisure flow distribution H_i
- Non-parametric estimates of F_0 and F_1 (conditional on other structural parameters) substituted into likelihood function
- F_0 and F_1 determine values of $g_{hi}(w; F_0, F_1)$, $u_i(F_0, F_1)$, $m_{hi}(F_0, F_1)$
- Confidence intervals obtained by bootstrapping estimation.

Identification (sketch)

Consider model analysed in Bontemps et al. (2000); a single sector, no reservation wage heterogeneity:

$$(1-u)G(w)\underbrace{\left[\delta+\lambda_e\overline{F}(w)\right]}_{\text{layoffs + voluntary quits}} = \underbrace{\lambda_u u F(w)}_{\text{hires from unemployment}}$$

so can use estimate of G to obtain F; accepted wage distribution by unemployed coincides with $F \implies$ *overidentification*.

With heterogeneous workers, accepted wages depends on F and A_{ui}.

- Establish non-parametric identification as we observe as many distributions as distributions which we wish to recover
- Note that A_i is only identified on observed support of wages.

▸ Formal proof

Data

Estimate using pre-reform UK Labour Force Survey data:

- Follow individuals observed in Q1 1997 for up to a year (covers the period prior to introduction of Working Families' Tax Credit)
- Individuals aged 21–55, highest qualification O-Level or below, exclude self-employed; all non-workers treated as unemployed
- Women working less (more) than 30 hours/week treated as part-time (full-time) workers; all men treated as full-time workers
- Set $h_0 = 20$, $h_1 = 40$; calculate income as if these were actual hours.

Data

Structural parameters and tax system:

- Assume leisure flow is normally distributed: $b_i \sim \mathcal{N}(\mu_i, \sigma_i^2)$
- Structural parameters vary by gender, marital status and the presence of children (47 parameters to estimate)
- For individuals in couples, condition tax schedule on (ten-point) discretized distribution of partner earnings (64 demographic groups)
- Accurate tax schedules calculated using FORTAX (Shephard, 2009); replaced with differentiable function (see MaCurdy et al., 1990)
- Standard errors calculated by bootstrapping estimation 500 times.

Estimation results

Transitional parameters:

- Job destruction rates highest for lone mothers; lowest for married men, and married women without children
- Job offers arrive most frequently for men; total arrival rate $\hat{\lambda}^0_{ui} + \hat{\lambda}^1_{ui}$ for childless women similar to $\hat{\lambda}^1_{ui}$ for men
- But job offer arrival rates are much lower for women with children
- Typically obtain $\hat{\lambda}^h_{ei} < \hat{\lambda}^h_{ui}$ but for some groups can not reject null hypothesis that they are the same. ▸ Estimation results

Work costs and reservation wages:

- $\hat{C}^1_i$ broadly similar across groups (around £30 – £40/week)
- Considerable reservation wage heterogeneity. ▸ ϕ distribution

Model fit

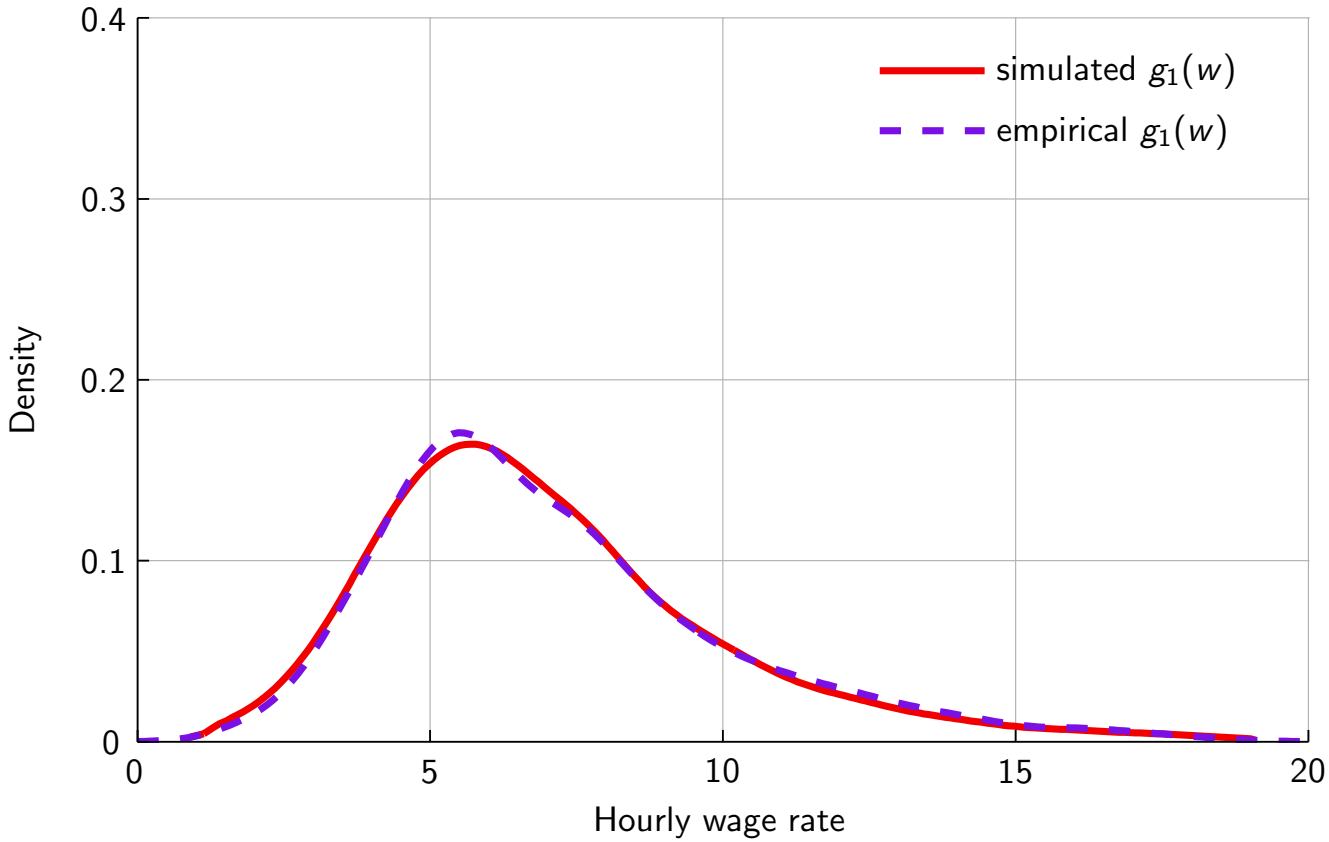
Table: Empirical and Predicted Employment States

	Empirical			Predicted		
	u_i	m_{0i}	m_{1i}	u_i	m_{0i}	m_{1i}
single men	0.366	–	0.634	0.346	–	0.654
married men, no kids	0.186	–	0.814	0.178	–	0.822
married men, kids	0.224	–	0.776	0.211	–	0.789
single women	0.319	0.115	0.566	0.307	0.119	0.574
lone mothers	0.623	0.235	0.142	0.610	0.244	0.146
married women, no kids	0.244	0.244	0.512	0.241	0.254	0.505
married women, kids	0.432	0.364	0.204	0.419	0.370	0.211

Notes: Predicted states are calculated using the maximum likelihood estimates. Employment states may not sum to one due to rounding.

Model fit

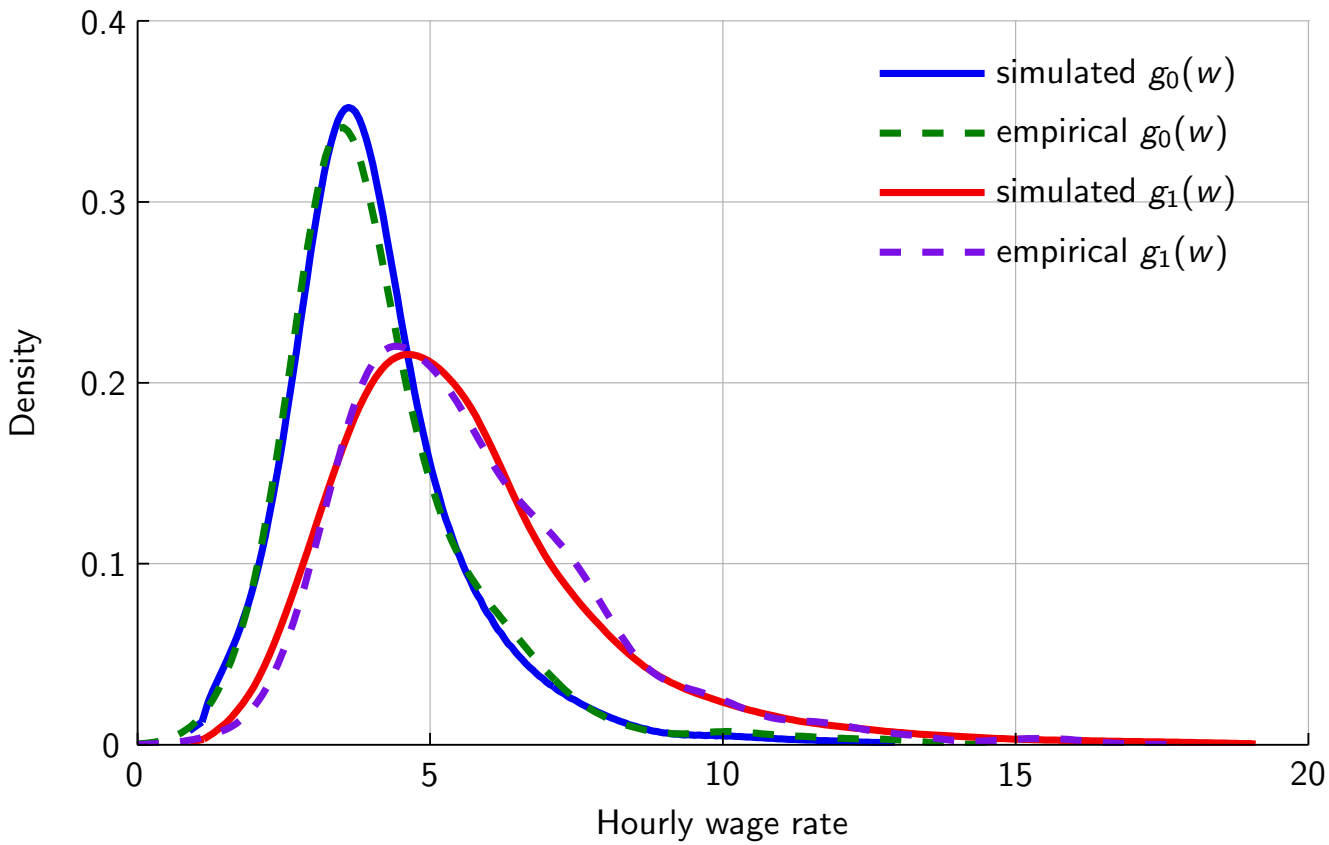
Figure: Simulated and empirical earnings, married men with kids



Notes: Empirical distributions are calculated using a Gaussian kernel with a bandwidth of 0.6.

Model fit

Figure: Simulated and empirical earnings, lone mothers



Notes: Empirical distributions are calculated using a Gaussian kernel with a bandwidth of 0.6.

WFTC reform

Working Families' Tax Credit (WFTC) was introduced in October 1999 replacing Family Credit:

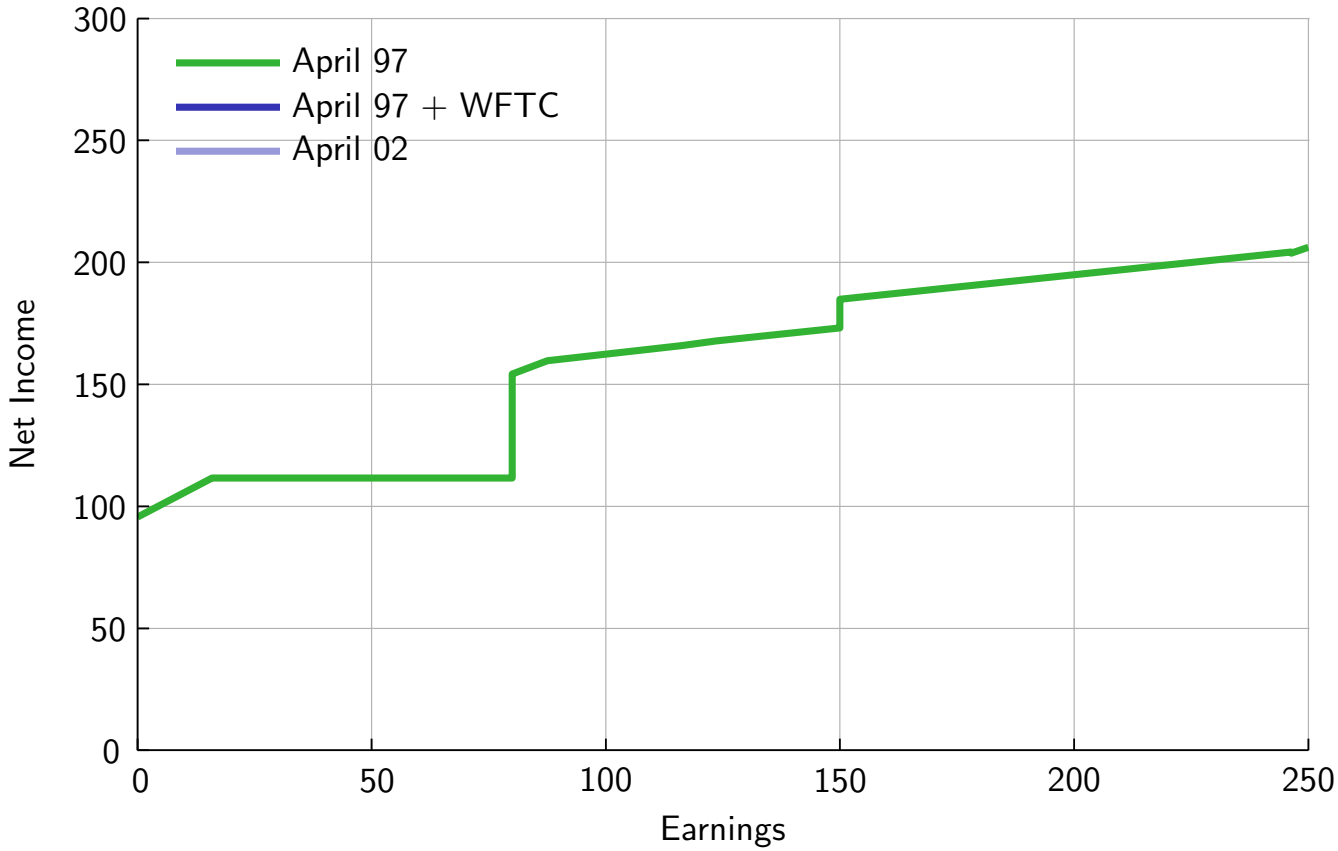
- Main form of in-work support for families with children
- Similar eligibility: hours requirement, credit reduced with earnings
- But it was more generous: higher credits and lower phase-out rate
- Accompanied by change in payment mechanism (not in model)
- It was a large reform: tax credit expenditure increased from £2.8 billion in 1998/99 to £6.3 billion in 2002/03.

At the same time, there were other important changes to the tax and transfer system (more later).

Skip figure

WFTC reform

Figure: Example budget constraint, lone-parent with one child



Notes: Assumes hourly wage of £3.50. No housing or childcare costs, average band C Council Tax. Incomes expressed in April 1997 prices. Calculated using FORTAX.

WFTC reform

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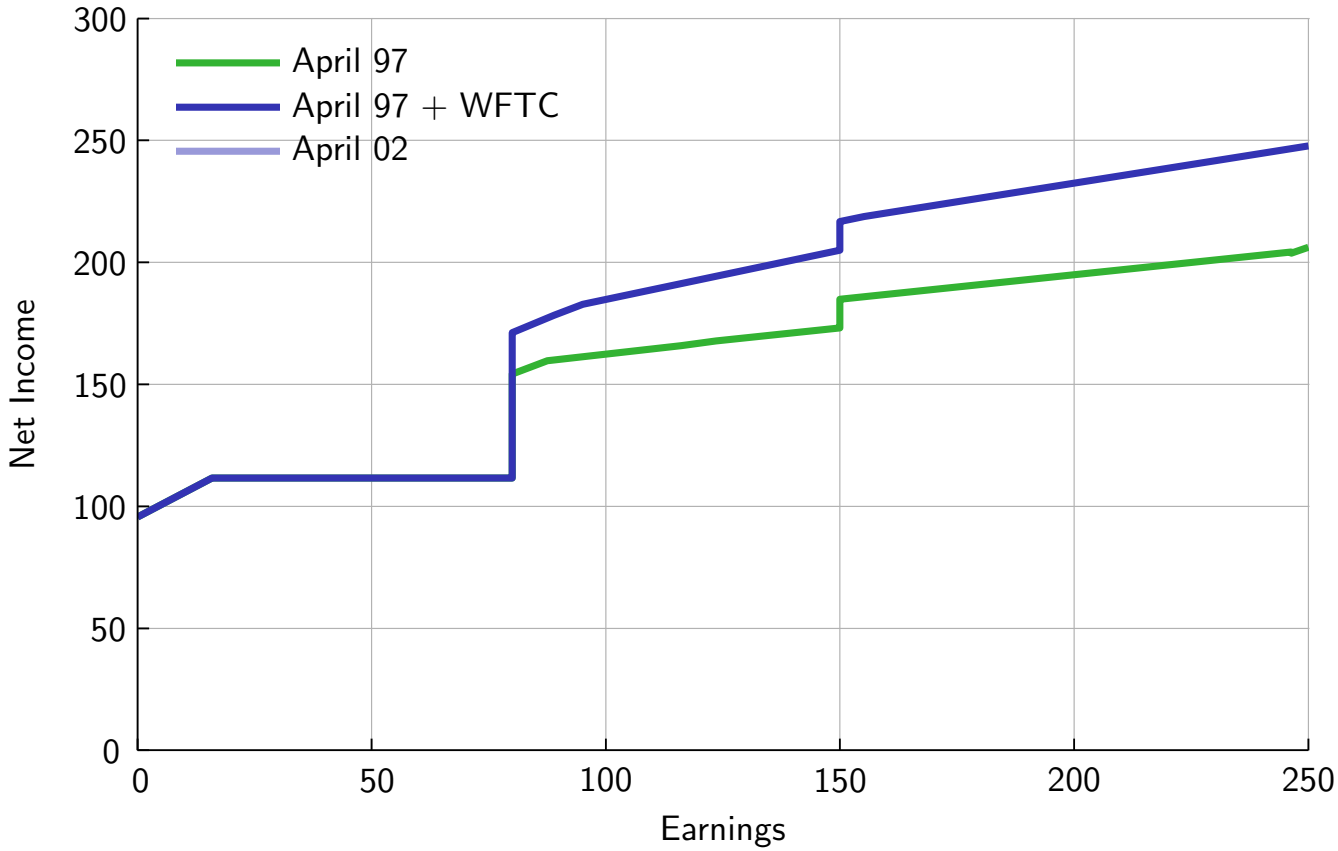

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WFTC reform

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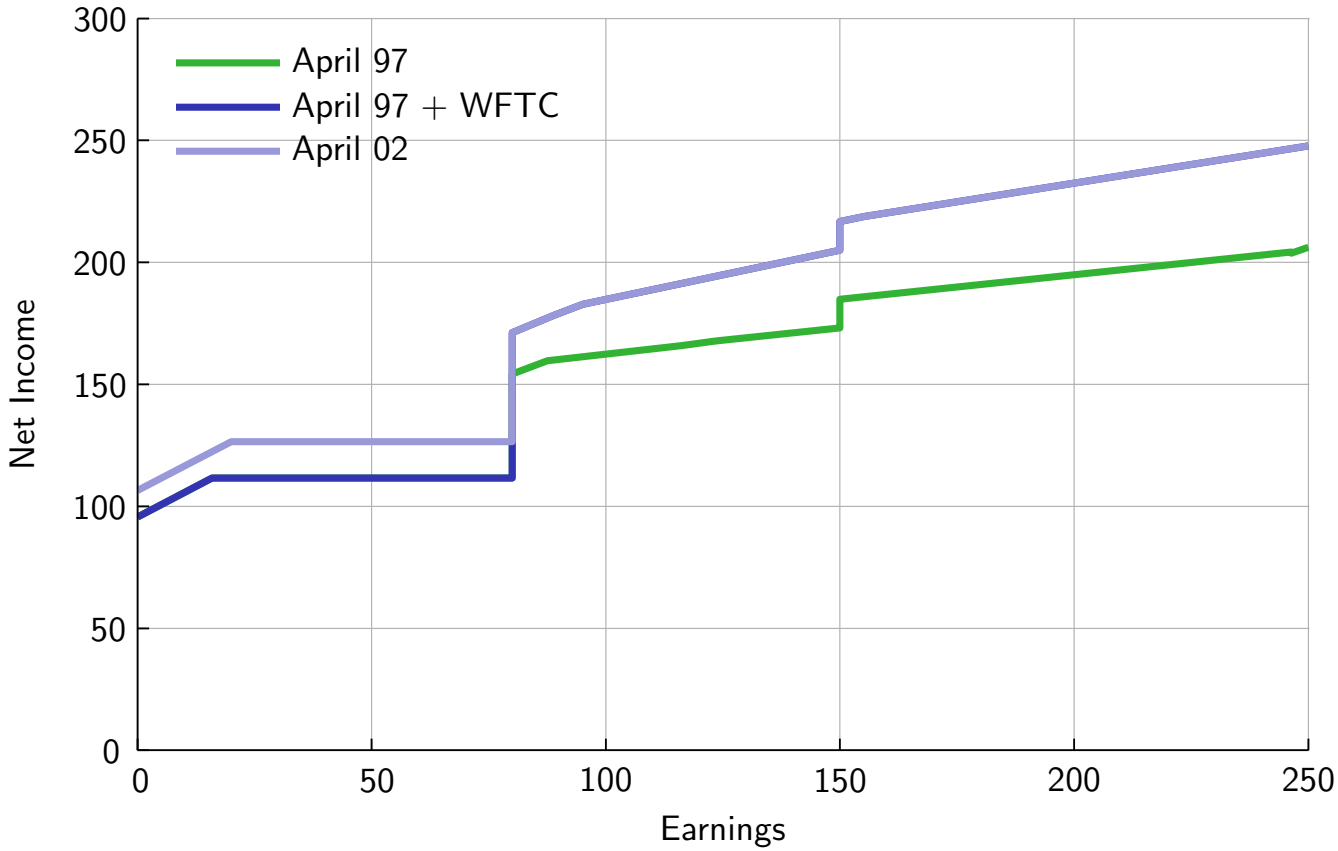


Notes: Assumes hourly wage of £3.50. No housing or childcare costs, average band C Council Tax. Incomes expressed in April 1997 prices. Calculated using FORTAX.

Reform simulations

Simulate impact of actual tax reforms:

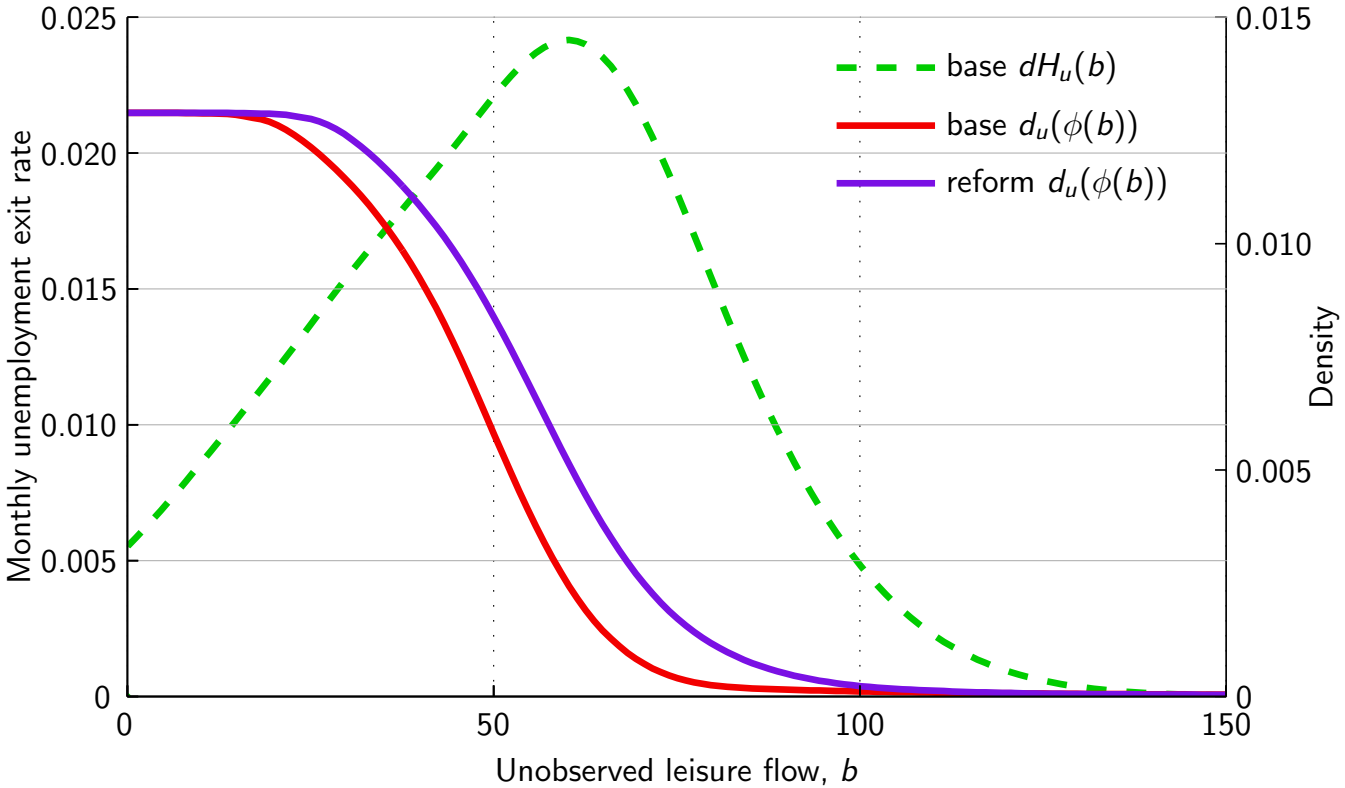
- Use model to recover distribution of firm productivity
  [productivity distribution] [pre-reform wage policy]
- Holding productivity fixed, replace system in pre-reform period with April 2002 tax and transfer system (last year of WFTC)
- Also reflects reductions in income tax and payroll tax, increase in child benefit, changes in income support and unemployment benefit.

Present results in two stages:

- The *direct* effect (holding F_0, F_1 and arrival rates constant)
- The *equilibrium* effect (when these may vary).

Reform simulations: lone mothers

Figure: Monthly unemployment exit rate

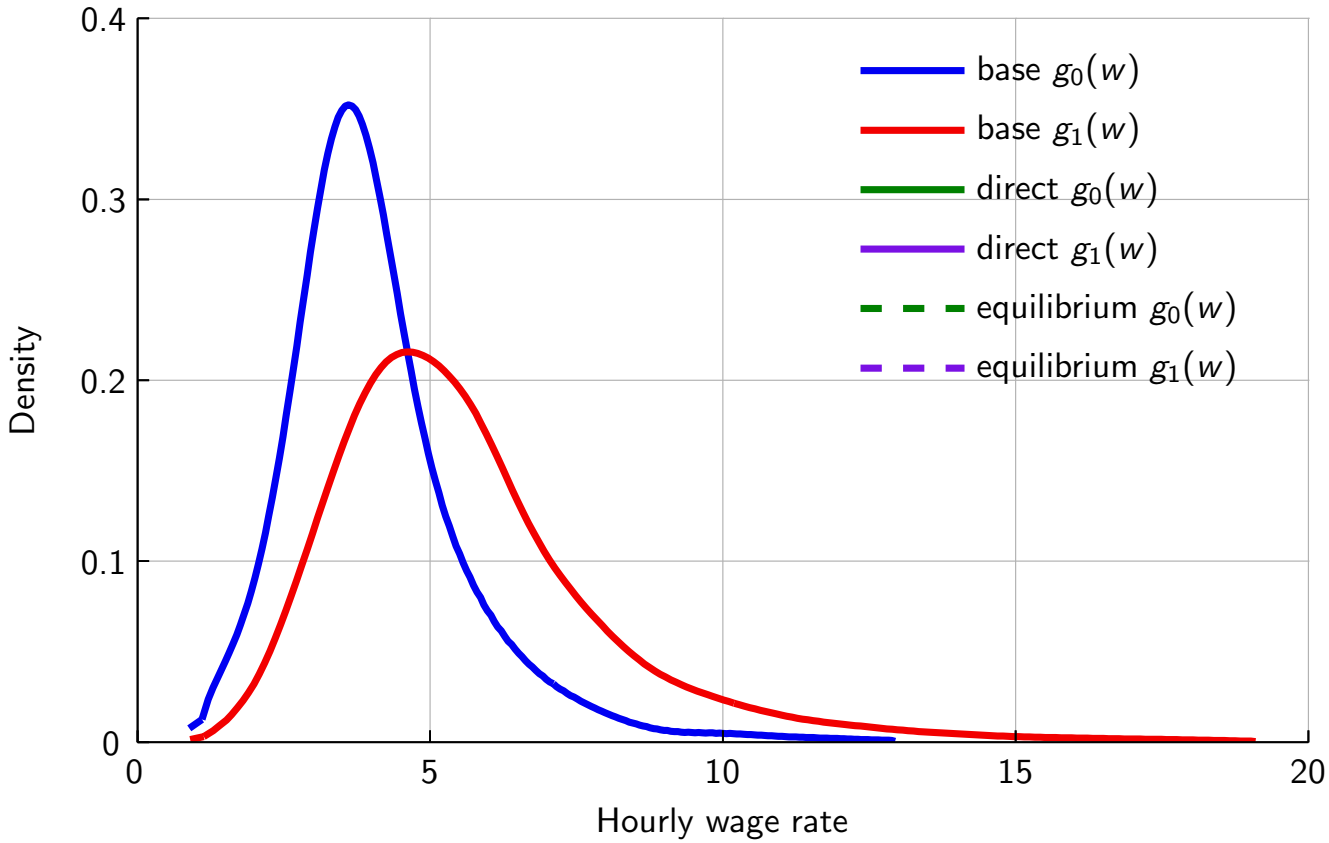


Notes: Figure shows monthly unemployment exit rate $d_u(\phi_i(b)) = \lambda_{ui}^0 \overline{F}(q_i(\phi_i(b))) + \lambda_{ui}^1 \overline{F}(\phi_i(b))$ as function of unobserved leisure flow b. Right axis measures density of leisure flow distribution amongst unemployed.

Reform simulations: lone mothers

Figure: Impact on earnings and employment

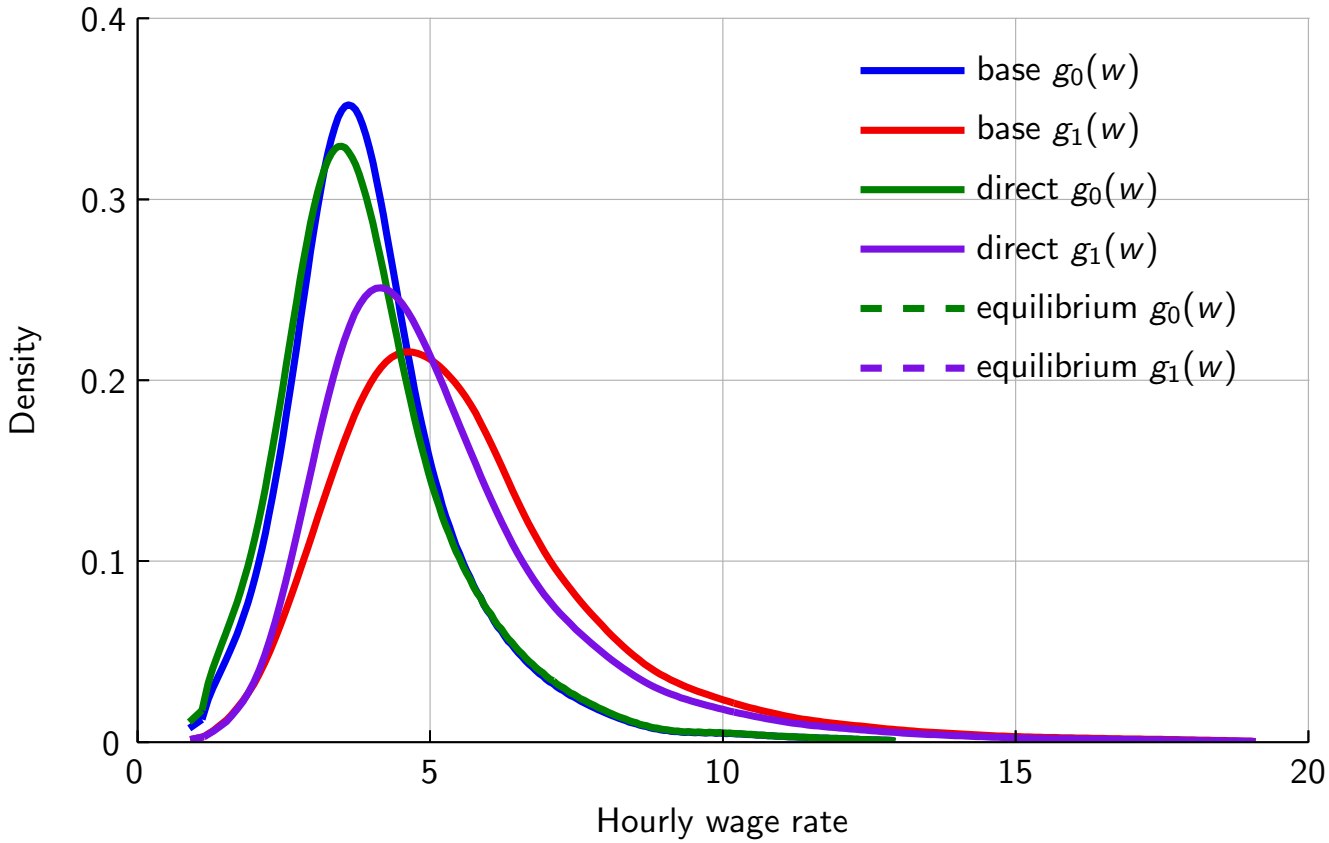
Skip to wage offers



Pre-reform: $u_i = 0.610$ $m_{0i} = 0.244$ $m_{1i} = 0.146$

Reform simulations: lone mothers

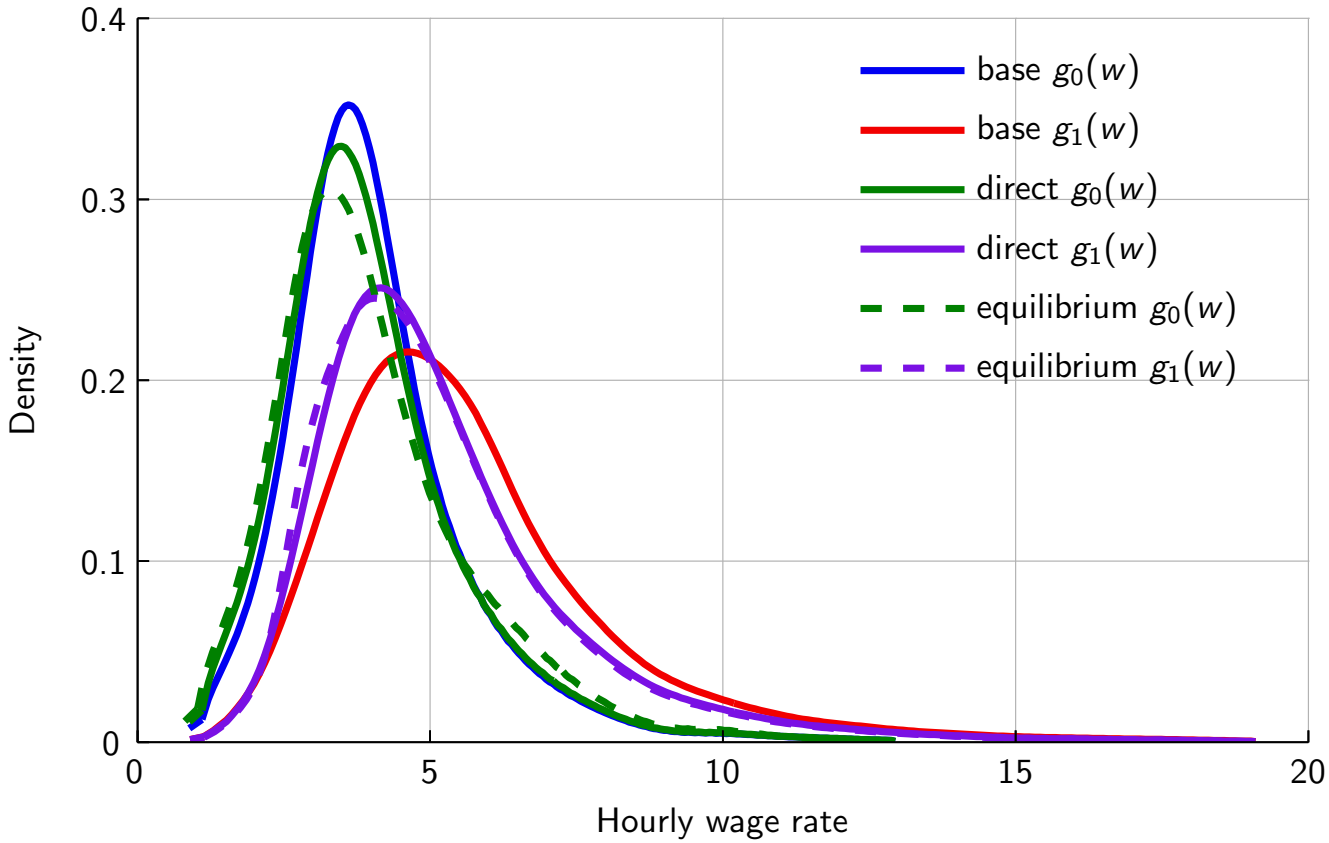
Figure: Impact on earnings and employment Skip to wage offers



Pre-reform:	$u_i = 0.610$	$m_{0i} = 0.244$	$m_{1i} = 0.146$
Direct impact:	$\Delta u_i = -0.056$	$\Delta m_{0i} = -0.005$	$\Delta m_{1i} = +0.061$

Reform simulations: lone mothers

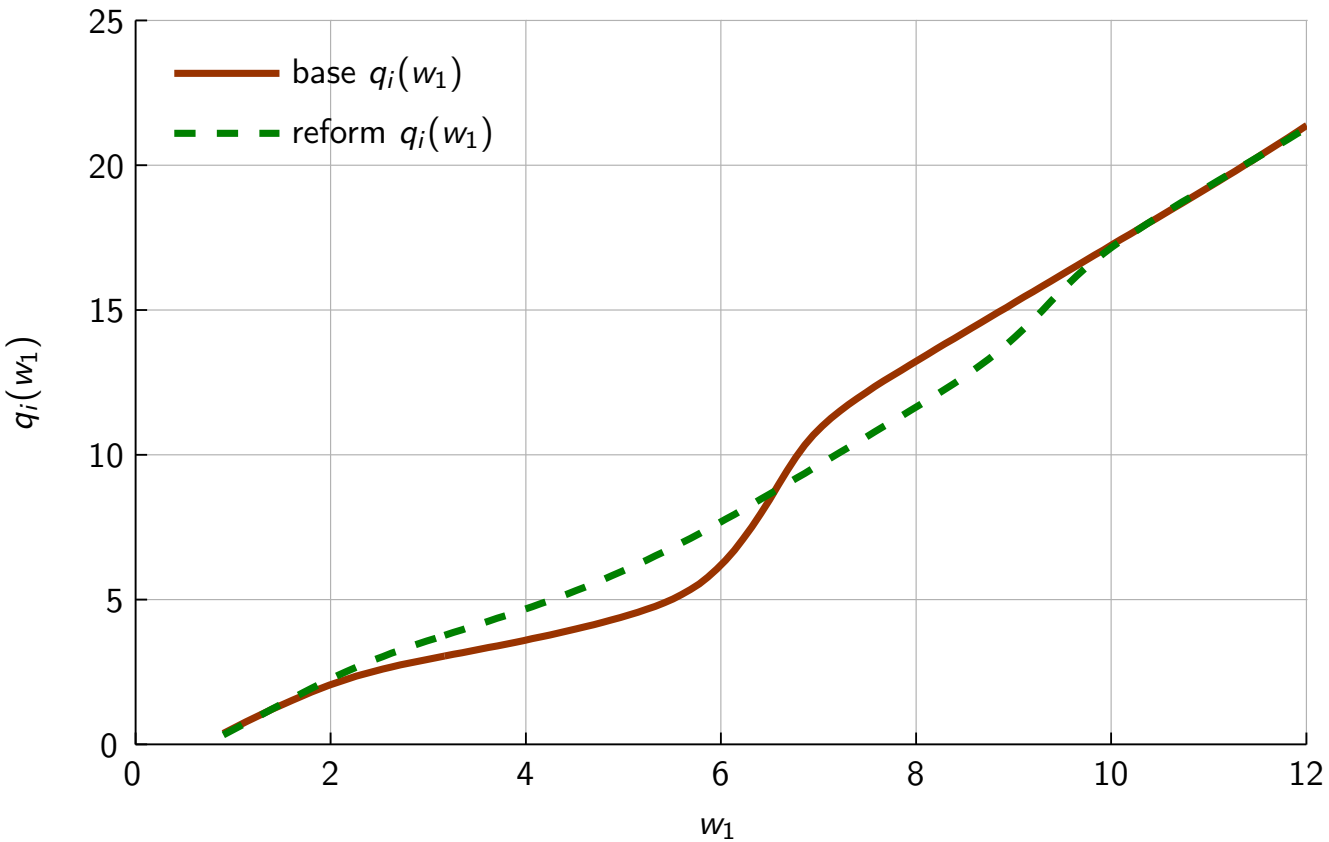
Figure: Impact on earnings and employment Skip to wage offers



Pre-reform:	$u_i = 0.610$	$m_{0i} = 0.244$	$m_{1i} = 0.146$
Direct impact:	$\Delta u_i = -0.056$	$\Delta m_{0i} = -0.005$	$\Delta m_{1i} = +0.061$
Equilibrium impact:	$\Delta u_i = -0.053$	$\Delta m_{0i} = -0.011$	$\Delta m_{1i} = +0.064$

Reform simulations: lone mothers

Figure: Impact on indifference condition (lone mother, 2 kids)



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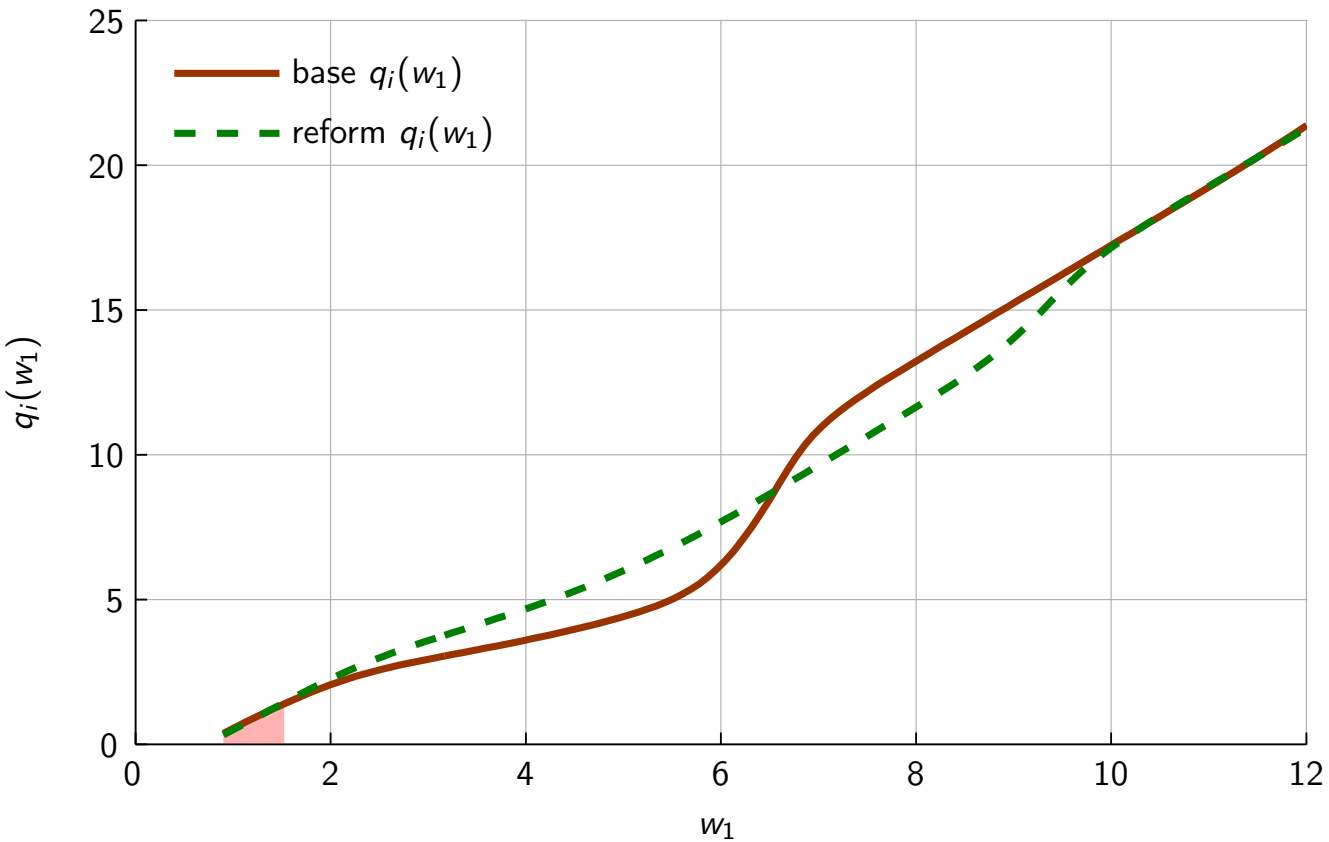

At very low wages, the increase in tax credit income results in other means-tested benefits being withdrawn at h_1 (but not at h_0).

Reform simulations: lone mothers

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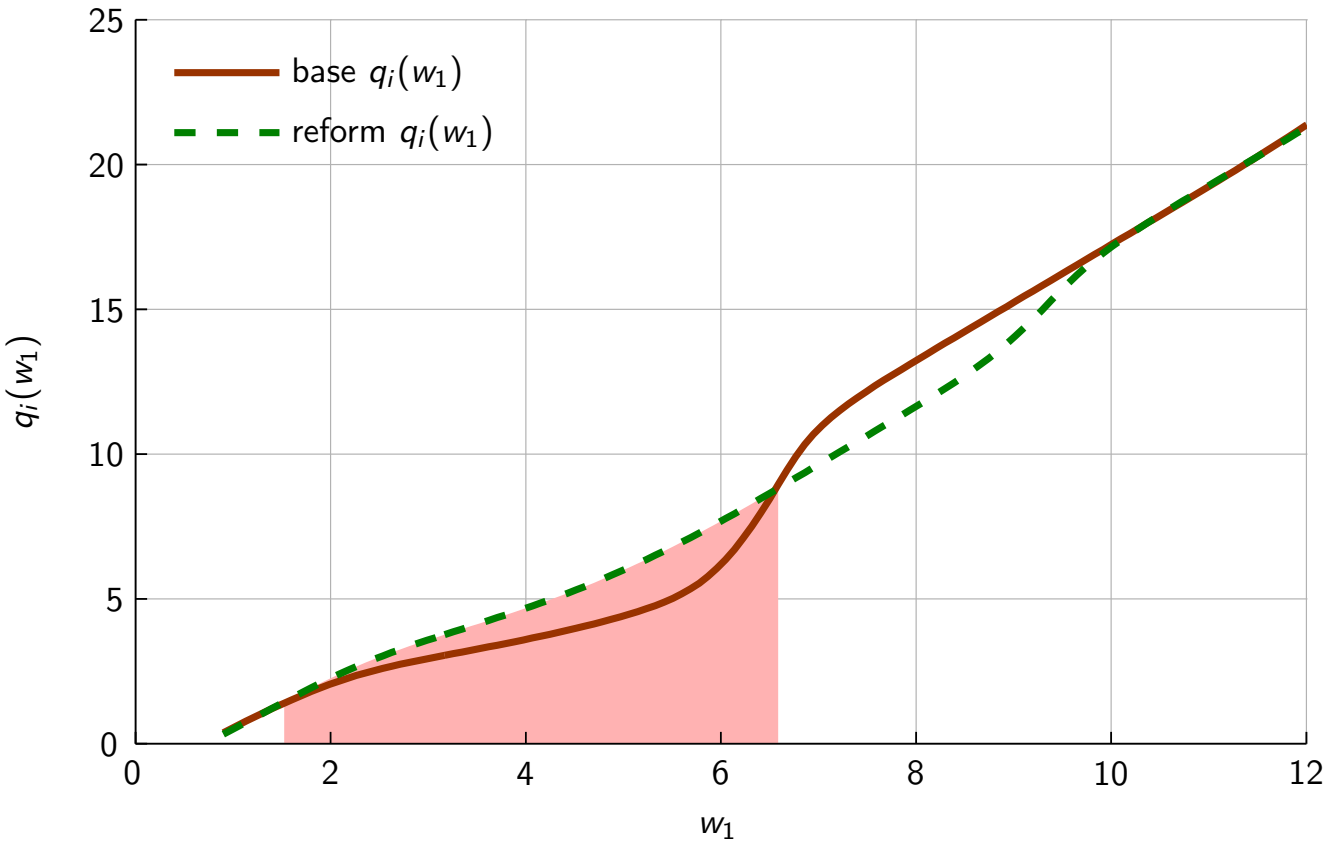

At moderate wages (most workers), the reduction in tax credit taper results in greater income gain at h_1.

Reform simulations: lone mothers

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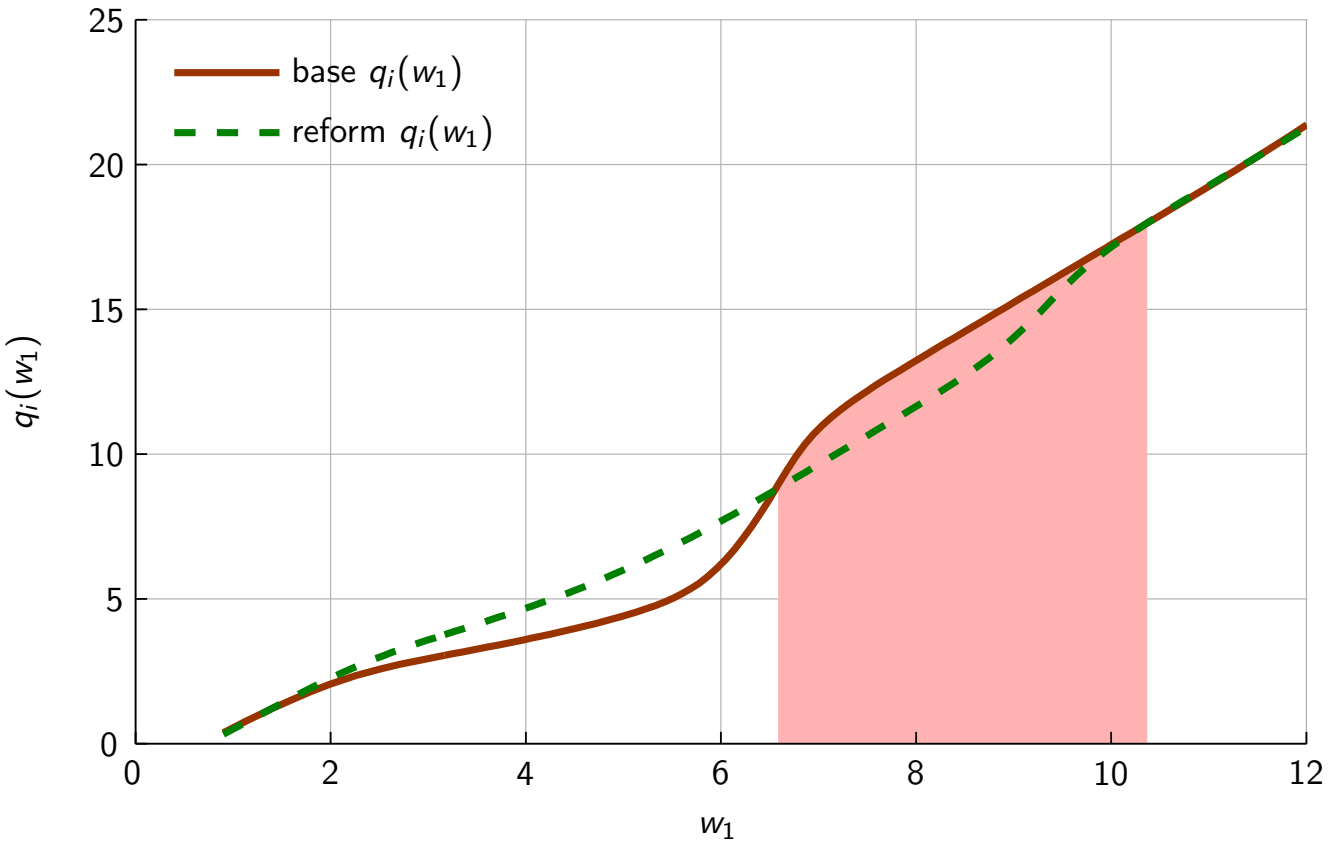

At higher wages, income gain typically larger at h_0 if become newly eligible at h_1 following reform.

Reform simulations: lone mothers

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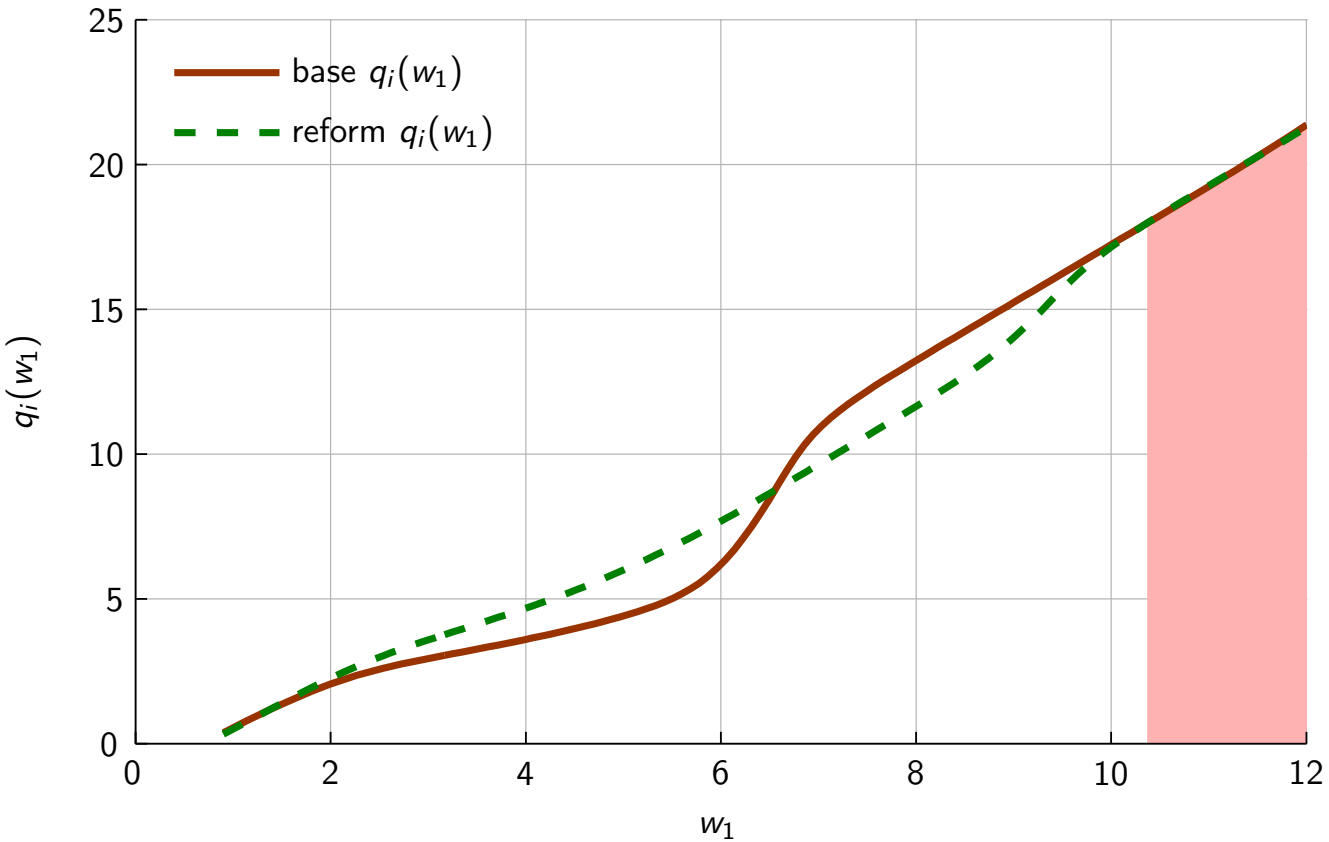
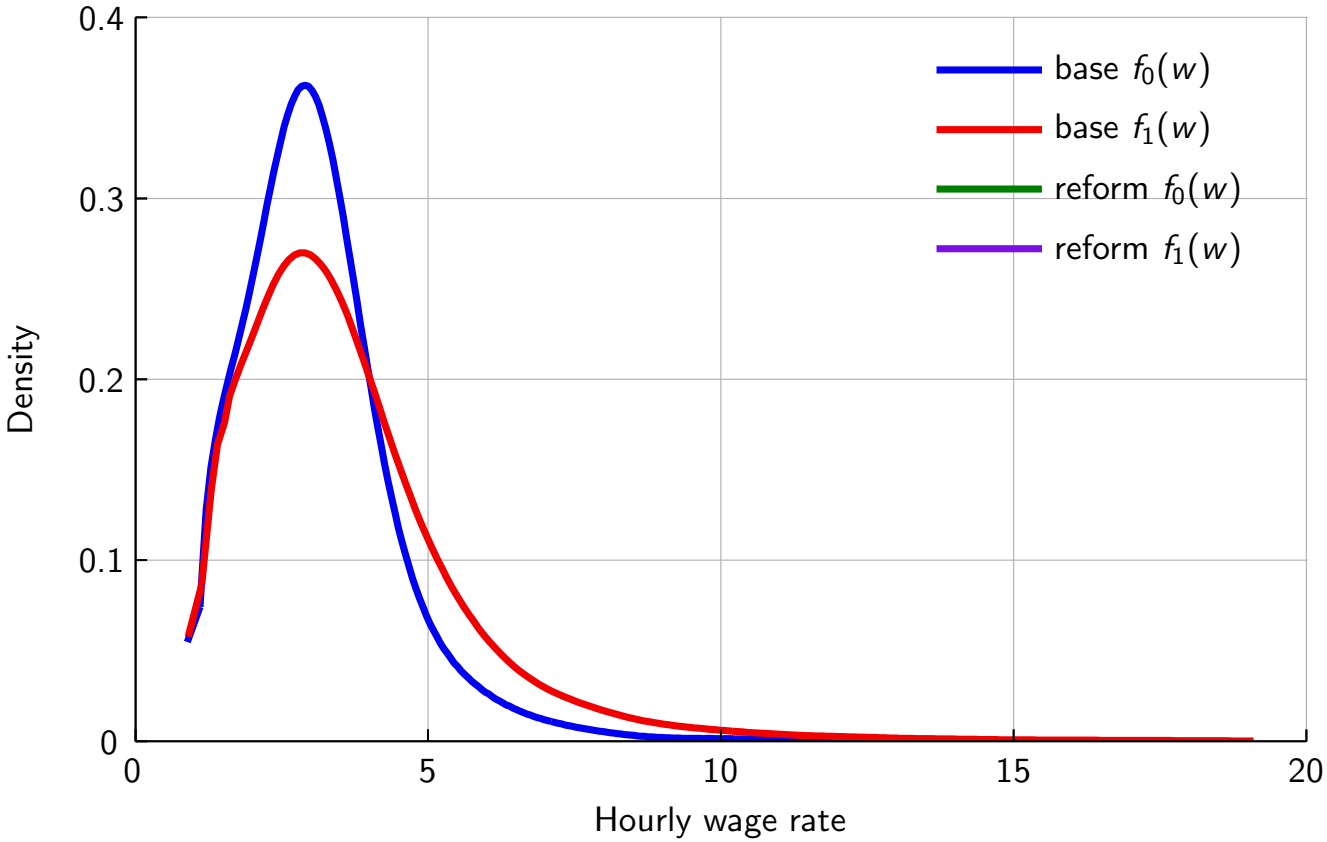


At very high wages, unaffected by tax credit reform; just experience the other smaller tax changes over this period...

Skip to table

Reform simulations

Figure: Impact on wage offer distributions



Reform simulations

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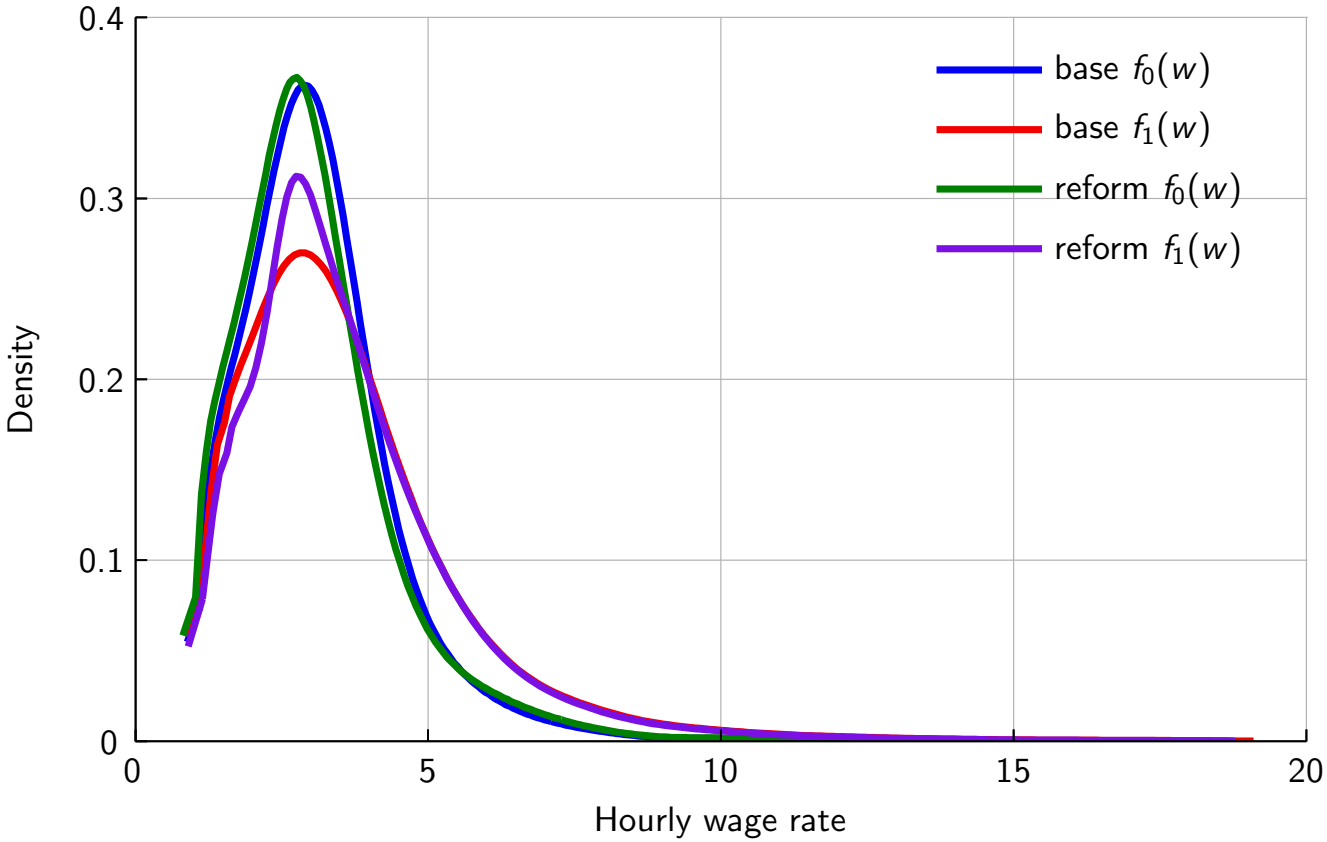
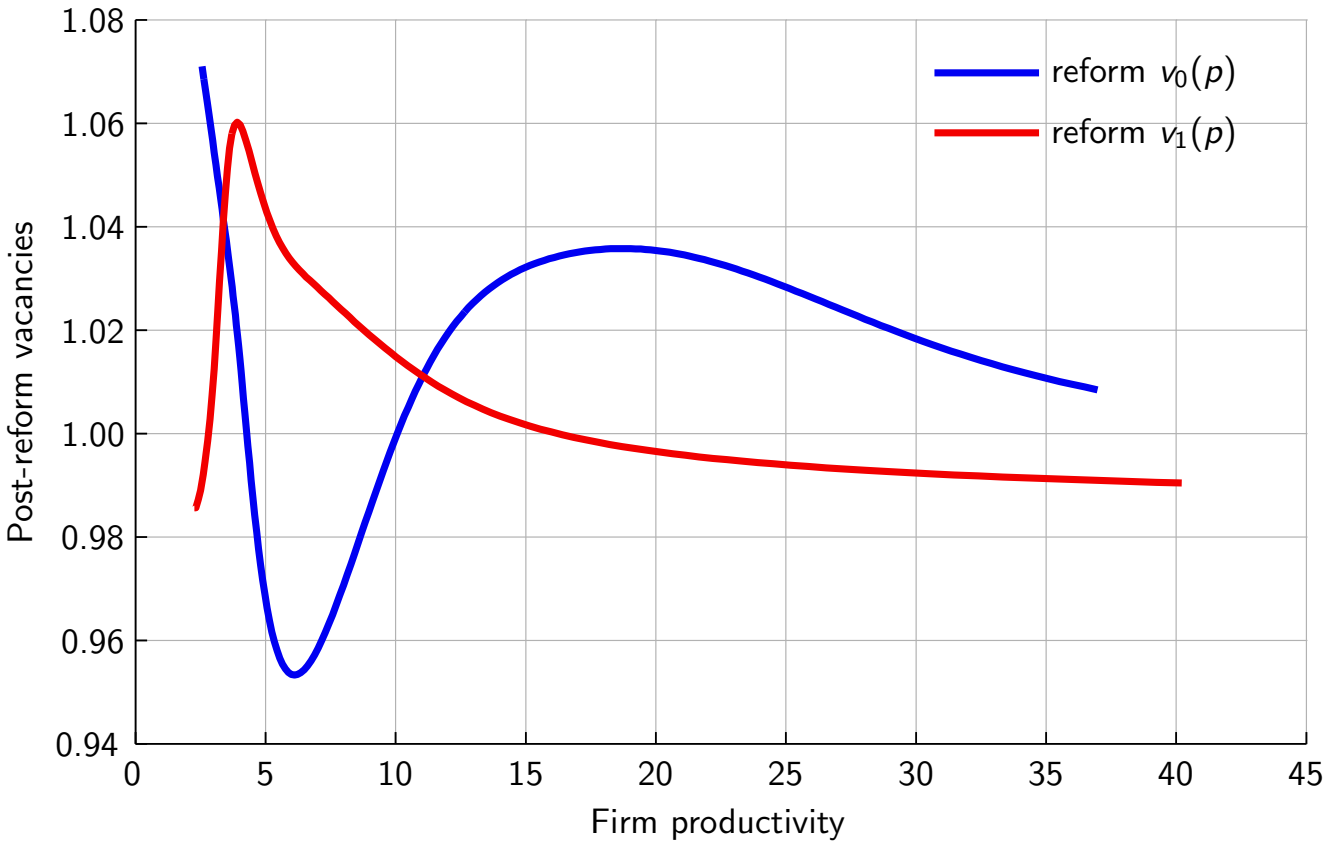


Reform simulations

Figure: Impact on job vacancies



Notes: Figure shows the level of vacancies $v_h(p)$ under with April 2002 tax and transfer system. In pre-reform period we have $v_h(p) = 1$ for all (h, p), so values greater (less) than one correspond to increases (decreases) in recruiting effort. Figure is truncated at productivities greater than $K_1^{-1}(G_1^{-1}(0.95))$ under base system.

Reform simulations

Table: Simulated Employment Impact of Reforms

	Direct Impact		
	Δu_i	Δm_{0i}	Δm_{1i}
single men	-0.010	–	0.010
married men, no kids	-0.008	–	0.008
married men, kids	-0.029	–	0.029
single women	-0.008	-0.000	0.008
lone mothers	-0.056	-0.005	0.061
married women, no kids	-0.009	-0.002	0.012
married women, kids	0.013	-0.012	-0.001

Notes: All employment responses are expressed in percentage points. Changes may not sum to zero due to rounding. The direct impact considers all changes to the tax and transfer system between April 1997 and April 2002, holding the wage offer distributions and arrival rates at their pre-reform levels. The equilibrium impact allows the wage offer distribution and arrival rates to change.

▶ Post reform comparison

Reform simulations

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	Direct Impact			Equilibrium Impact
	Δu_i	Δm_{0i}	Δm_{1i}	
single men	-0.010	–	0.010	
married men, no kids	-0.008	–	0.008	
married men, kids	-0.029	–	0.029	
single women	-0.008	-0.000	0.008	
lone mothers	-0.056	-0.005	0.061	
married women, no kids	-0.009	-0.002	0.012	
married women, kids	0.013	-0.012	-0.001	

Notes: All employment responses are expressed in percentage points. Changes may not sum to zero due to rounding. The direct impact considers all changes to the tax and transfer system between April 1997 and April 2002, holding the wage offer distributions and arrival rates at their pre-reform levels. The equilibrium impact allows the wage offer distribution and arrival rates to change.

▸ Post reform comparison

Reform simulations

Table: Simulated Employment Impact of Reforms

	Direct Impact			Equilibrium Impact		
	Δu_i	Δm_{0i}	Δm_{1i}	Δu_i	Δm_{0i}	Δm_{1i}
single men	-0.010	–	0.010	-0.012	–	0.012
married men, no kids	-0.008	–	0.008	-0.009	–	0.009
married men, kids	-0.029	–	0.029	-0.030	–	0.030
single women	-0.008	-0.000	0.008	-0.008	-0.003	0.011
lone mothers	-0.056	-0.005	0.061	-0.053	-0.011	0.064
married women, no kids	-0.009	-0.002	0.012	-0.009	-0.006	0.015
married women, kids	0.013	-0.012	-0.001	0.015	-0.015	-0.000

Notes: All employment responses are expressed in percentage points. Changes may not sum to zero due to rounding. The direct impact considers all changes to the tax and transfer system between April 1997 and April 2002, holding the wage offer distributions and arrival rates at their pre-reform levels. The equilibrium impact allows the wage offer distribution and arrival rates to change.

▶ Post reform comparison

Why aren't equilibrium effects more important?

WFTC was not introduced in isolation:

- Increase in out-of-work income for families with children reduces labour supply responses from these groups.

The WFTC reform was a *targeted* reform:

- If eligible workers operate in distinct labour market, potential for equilibrium effects is greater
- Suppose lone mothers operate in a segmented market
- Results in much larger reduction in full-time wages, and increase in recruiting effort; employment increase around 1 ppt smaller
- Equilibrium effects are *not* negligible in this case.

Conclusions

Paper has evaluated equilibrium impact of tax credit reforms by developing an empirical equilibrium search model with wage posting:

- Allows for worker and firm heterogeneity, hours responses, and non-linear tax schedules; all workers compete in same market
- Developed semi-parametric estimator, estimated model using UK data, and simulated impact of actual tax reform
- Main results: *reforms raised employment with largest impact for lone mothers; equilibrium effects play a role, but impact primarily due to changing job acceptance behaviour*.

Analysis doesn't mean these equilibrium effects should always be ignored:

- Potential to be much more important if reforms are less targeted or if labour market is appropriately segmented.

Table: Maximum Likelihood Parameter Estimates

	$1/\delta_i$	$1/\lambda^0_{ui}$	$1/\lambda^1_{ui}$	$1/\lambda^0_{ei}$	$1/\lambda^1_{ei}$
single men	94.5	–	19.7	–	32.6
	[88.4,102.3]		[15.6,24.2]		[25.9,38.6]
married men, no kids	195.4	–	14.5	–	23.9
	[176.4,217.8]		[10.8,18.7]		[19.8,29.0]
married men, kids	177.3	–	21.1	–	19.3
	[163.7,190.7]		[17.5,24.8]		[15.5,23.5]
single women	141.9	42.5	38.8	117.2	54.2
	[128.0,157.0]	[27.5,60.5]	[25.9,56.8]	[62.6,375.8]	[43.1,68.2]
lone mothers	66.1	54.0	337.7	118.4	55.2
	[60.1,72.6]	[43.0,81.5]	[188.1,664.7]	[74.1,230.9]	[41.3,72.5]
married women, no kids	171.8	23.4	68.0	147.8	74.7
	[154.2,192.2]	[16.5,32.9]	[39.1,133.1]	[100.4,250.4]	[60.3,92.2]
married women, kids	99.4	29.2	280.5	37.8	115.6
	[92.1,106.4]	[23.4,35.9]	[174.9,416.5]	[31.0,46.0]	[93.6,135.9]

Notes: All durations are monthly. The 5^{th} and 95^{th} percentiles of the bootstrap distribution of parameter estimates are presented in brackets, and are calculated using 500 replications.

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Table: Reservation wage distribution

	Percentile of full-time offer distribution $\hat{F}_1(w)$					
	0	20	40	60	80	100
single men	0.243	0.404	0.523	0.644	0.788	1.000
married men, no kids	0.145	0.340	0.503	0.651	0.811	1.000
married men, kids	0.465	0.621	0.702	0.768	0.847	1.000
single women	0.438	0.571	0.651	0.723	0.806	1.000
lone mothers	0.232	0.473	0.584	0.659	0.754	1.000
married women, no kids	0.183	0.479	0.668	0.784	0.882	1.000
married women, kids	0.270	0.548	0.699	0.793	0.870	1.000

Notes: Table shows fraction of individuals whose full-time reservation wage is below various percentiles p of the full-time wage offer distribution, $\hat{A}_i(\hat{F}_1^{-1}(p))$.

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Table: Empirical and Predicted Employment Changes

	Empirical			Predicted		
	Δu_i	Δm_{0i}	Δm_{1i}	Δu_i	Δm_{0i}	Δm_{1i}
single men	-0.030	–	0.030	-0.012	–	0.012
married men, no kids	-0.021	–	0.021	-0.009	–	0.009
married men, kids	-0.021	–	0.021	-0.030	–	0.030
single women	0.001	0.003	-0.003	-0.008	-0.003	0.011
lone mothers	-0.052	0.027	0.024	-0.053	-0.011	0.064
married women, no kids	-0.001	-0.013	0.014	-0.009	-0.006	0.015
married women, kids	-0.021	-0.006	0.028	0.015	-0.015	-0.000

Notes: Predicted changes are calculated using the maximum likelihood estimates and simulating the equilibrium effect of replacing the April 1997 system with the April 2002 system. Empirical changes refer to the observed changes in our data over this period using the sample selection as described in the paper. Changes may not sum to zero due to rounding.

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Identification proof I

For given i, distribution of full-time wages accepted by unemployed:

$$G_{1i}^{U}(w) = A_{ui}(w) - \overline{F}_1(w)\left[\int_{\underline{w}_i}^{w} \frac{dA_{ui}(x)}{\overline{F}_1(x)} + A_{ui}(\underline{w})\right].$$

Combine with density g_{1i}^{U} to eliminate term in brackets. Given $\{F_0, F_1\}$ we can then identify A_{ui} and C_i^1:

$$\begin{aligned} A_{ui}(w; F_0) &= G_{0i}^{U}(q_i(w)) + \overline{F}_0(q_i(w))g_{0i}^{U}(q_i(w))/f_{0i}(q_i(w)) \\ A_{ui}(w; F_1) &= G_{1i}^{U}(w) + \overline{F}_1(w)g_{1i}^{U}(w)/f_{1i}(w) \end{aligned}$$

Since we require $A_{ui}(w; F_0) = A_{ui}(w; F_1)$ we can also identify C_i^1

Identification proof II

Recall that between job flow equations are given by:

$$m_{1i} g_{1i}(w) \left[\delta_i + \lambda_{ei}^0 \overline{F}_0(q_i(w)) + \lambda_{ei}^1 \overline{F}_1(w)\right] = f_1(w) \left[\lambda_{ui}^1 u_i A_{ui}(w) + \lambda_{ei}^1 m_{0i} G_{0i}(q_i(w)) + \lambda_{ei}^1 m_{1i} G_{1i}(w)\right]$$

and similarly for part-time jobs.

Substitute A_{ui} expression in above; obtain system of differential equations for $\{F_0, F_1\}$ as function of $\{G_{0i}, G_{1i}, G_{0i}^U, G_{1i}^U\}$ and transitional parameters

- Separate identification obtained by using duration data
- Using model, identification of Γ_0, Γ_1 and H_i then follows.

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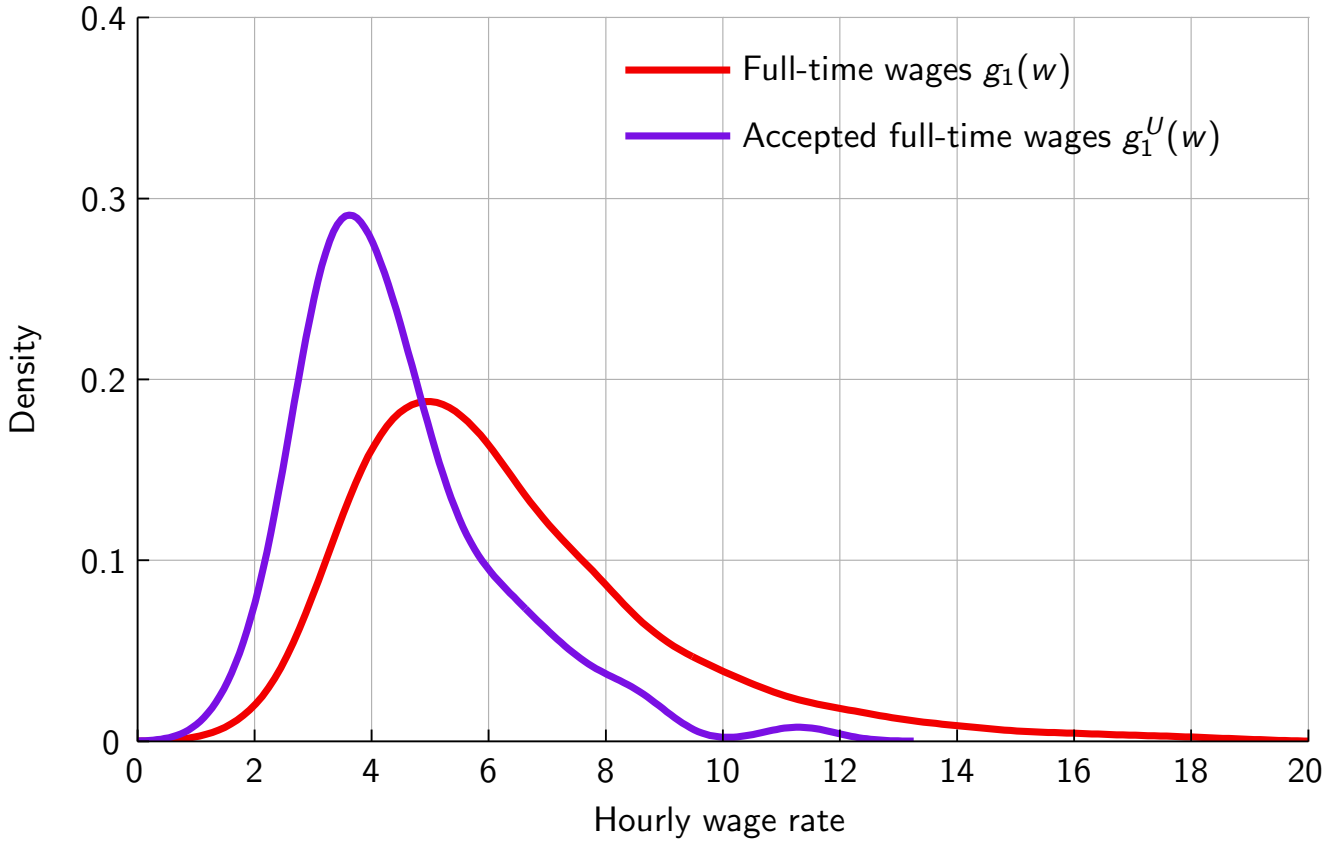
Figure: Cross-sectional and accepted wages, full-time



Notes: Figure shows distribution of wages amongst full-time workers, and the distribution of full-time wages accepted out of unemployment. Calculated using 1997 UK Labour Force Survey data. Empirical distributions are calculated using a Gaussian kernel with a bandwidth of 0.6.

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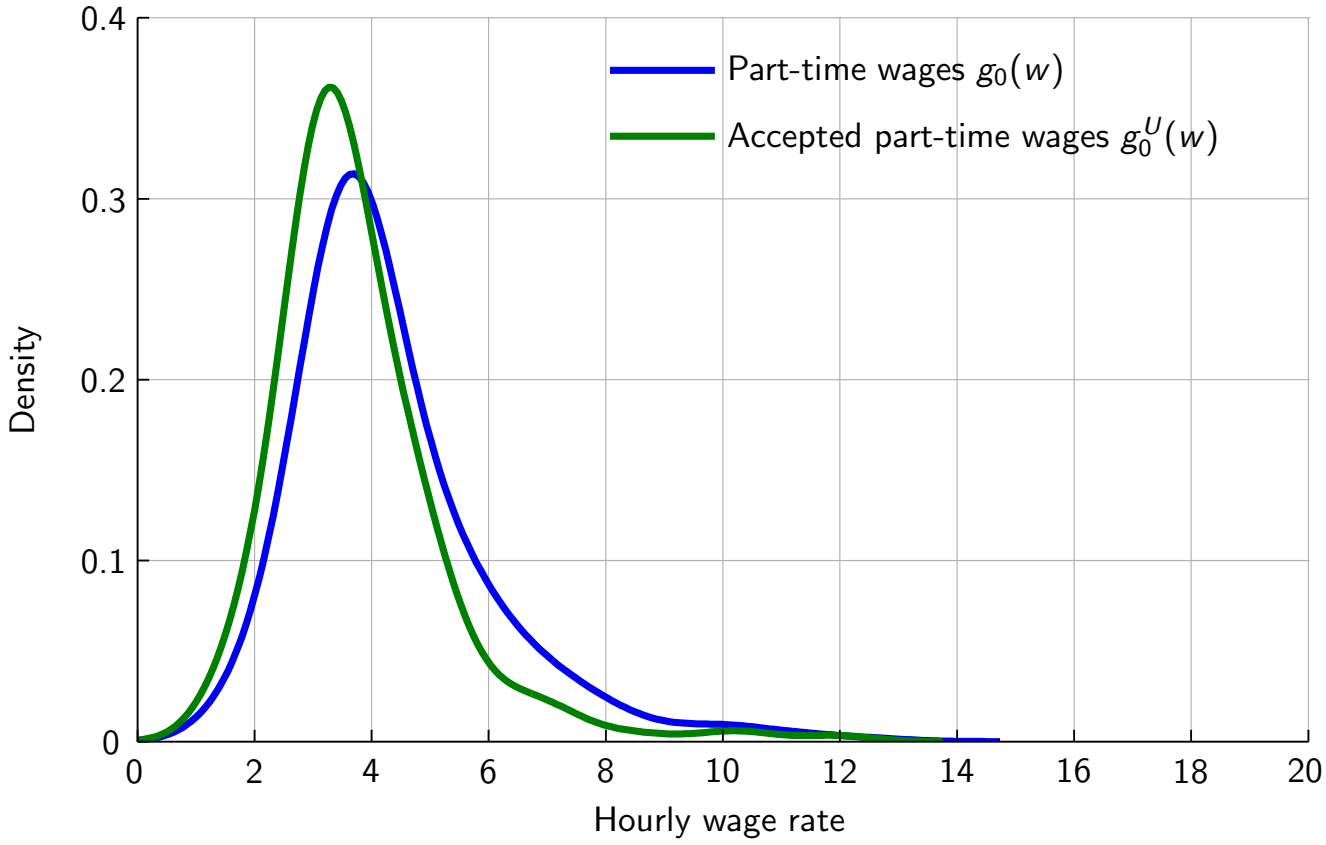
Figure: Cross-sectional and accepted wages, part-time



Notes: Figure shows distribution of wages amongst part-time workers, and the distribution of part-time wages accepted out of unemployment. Calculated using 1997 UK Labour Force Survey data. Empirical distributions are calculated using a Gaussian kernel with a bandwidth of 0.6.

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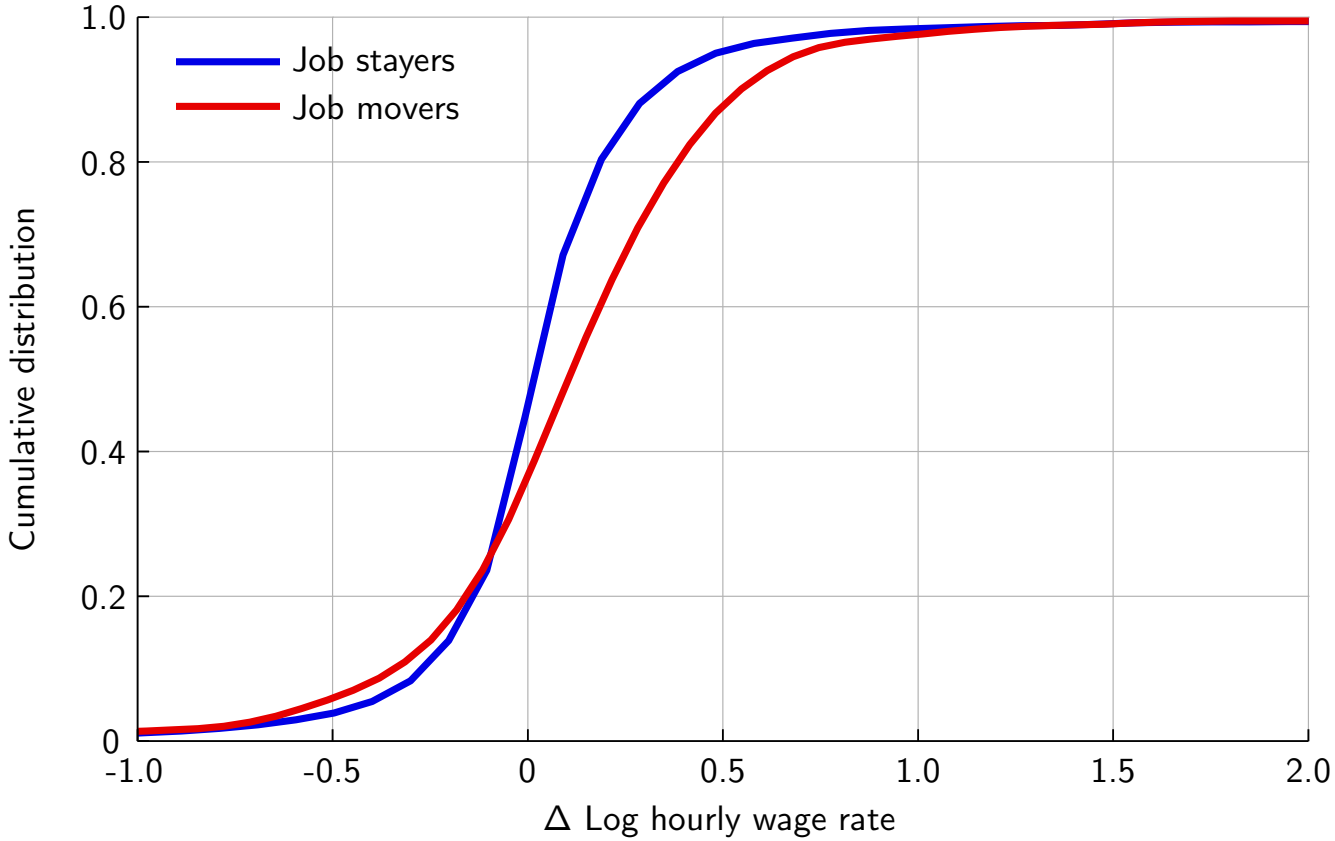
Figure: Annual wage changes amongst job movers and stayers



Notes: Figure shows cumulative distribution of log wage changes amongst job movers and stayers. Calculated using 1997 UK Labour Force Survey data using a Gaussian kernel with a bandwidth of 0.6.

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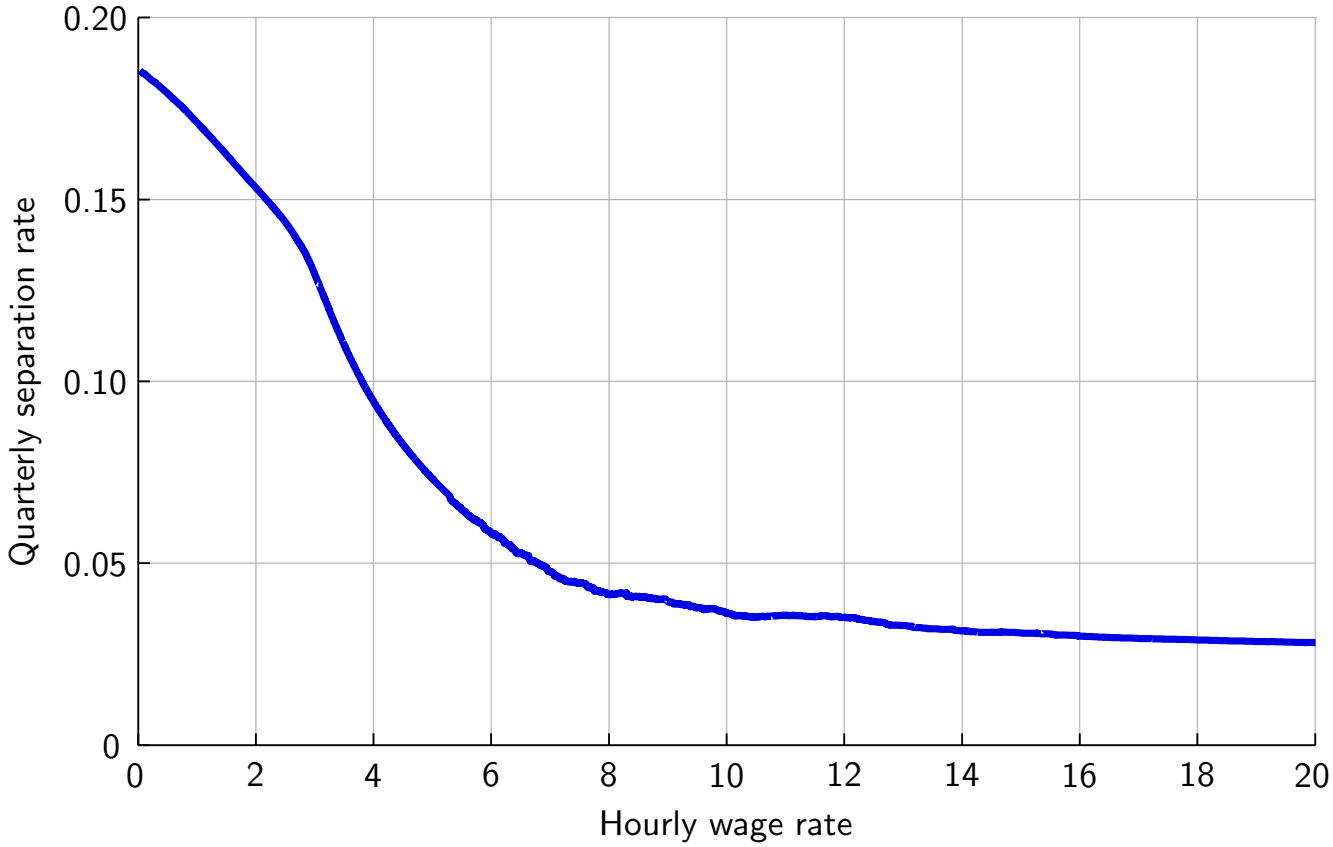
Figure: Quarterly job separation rate



Notes: Figure shows quarterly job separation rate calculated using 1997 UK Labour Force Survey data using a local linear regression with a bandwidth of 0.8.

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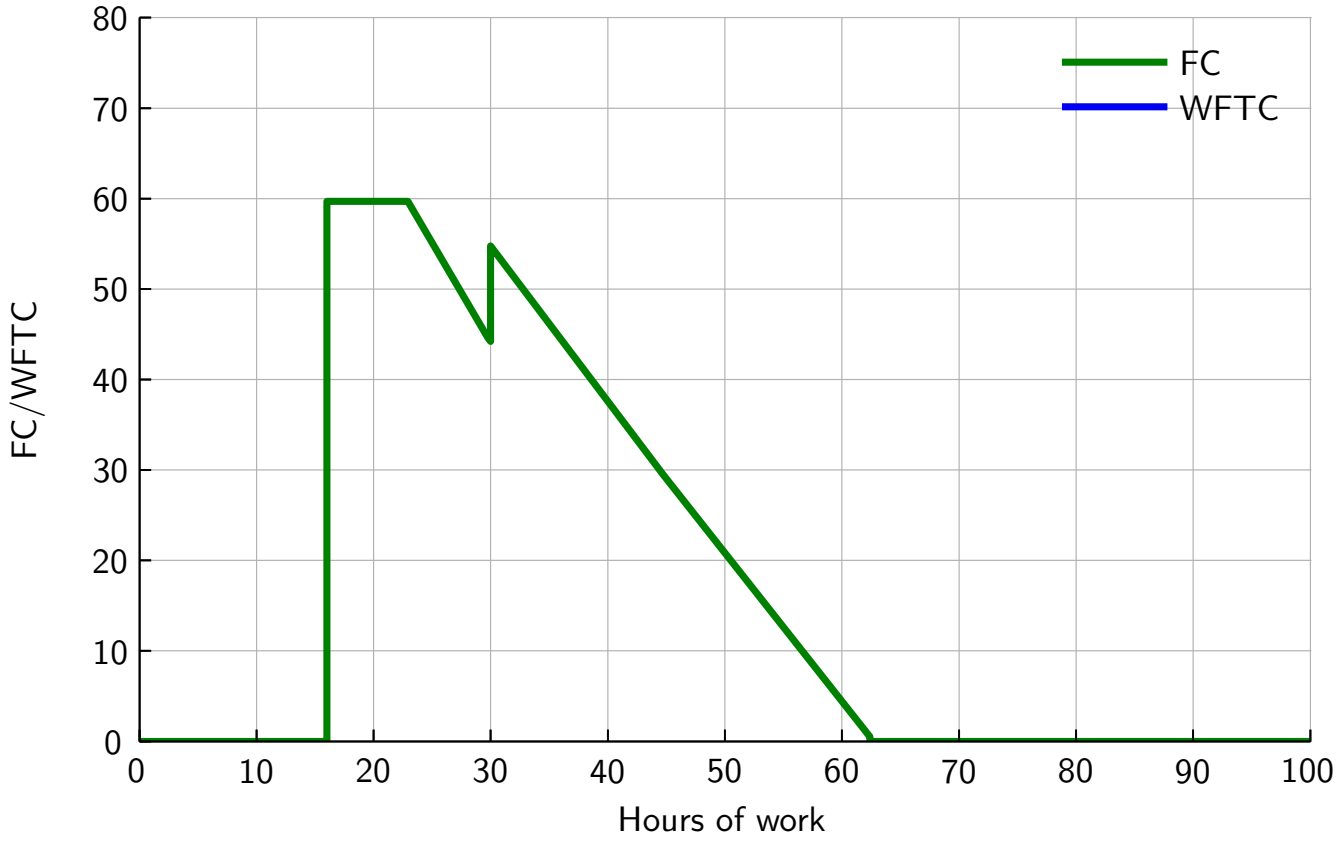
Figure: Tax Credit awards under FC and WFTC



Notes: FC refers to Family Credit as of April 1997. WFTC refers to Working Families' Tax Credit as of April 2002. Figure assumes a lone parent with a single child aged 10, and a constant hourly wage rate of £3.50. All incomes expressed in April 1997 prices.

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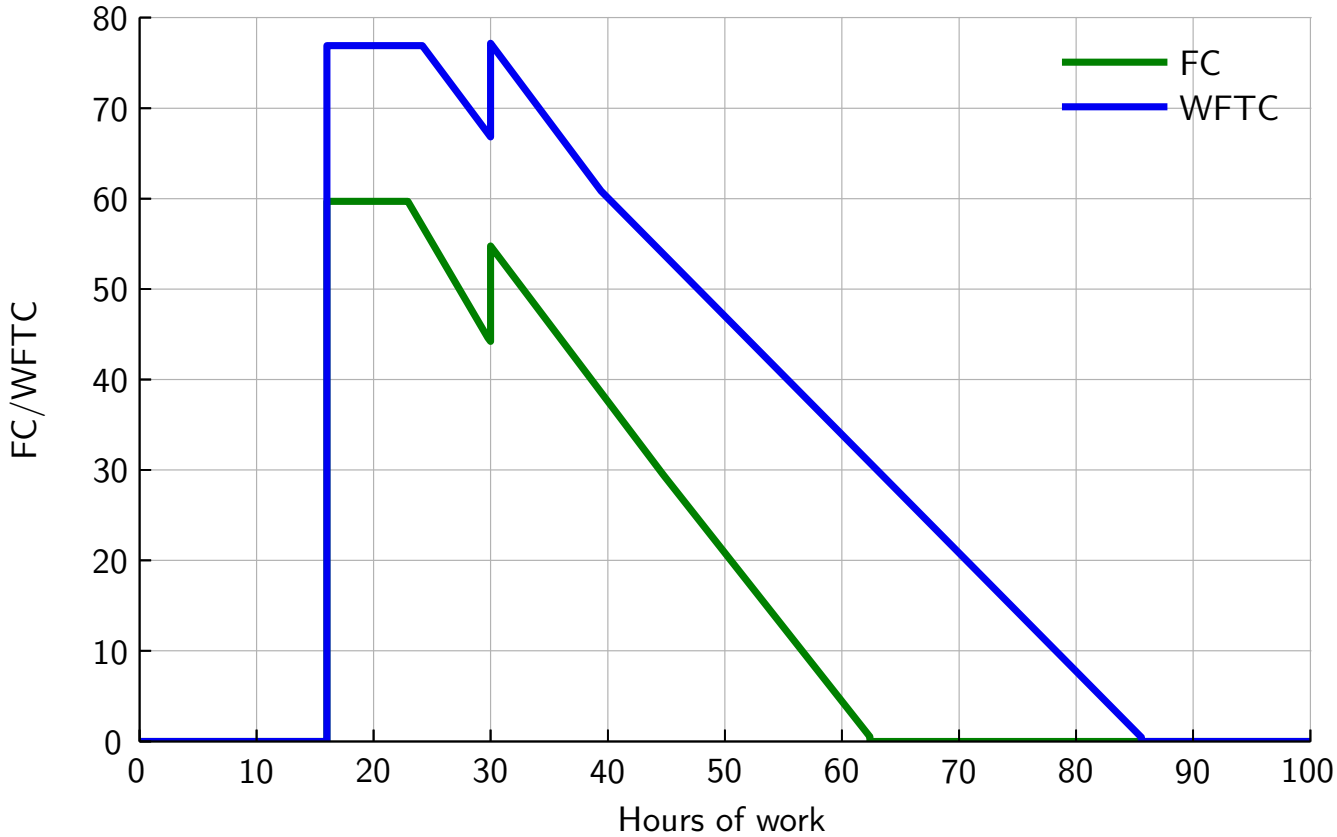
Figure: Tax Credit awards under FC and WFTC



Notes: FC refers to Family Credit as of April 1997. WFTC refers to Working Families' Tax Credit as of April 2002. Figure assumes a lone parent with a single child aged 10, and a constant hourly wage rate of £3.50. All incomes expressed in April 1997 prices.

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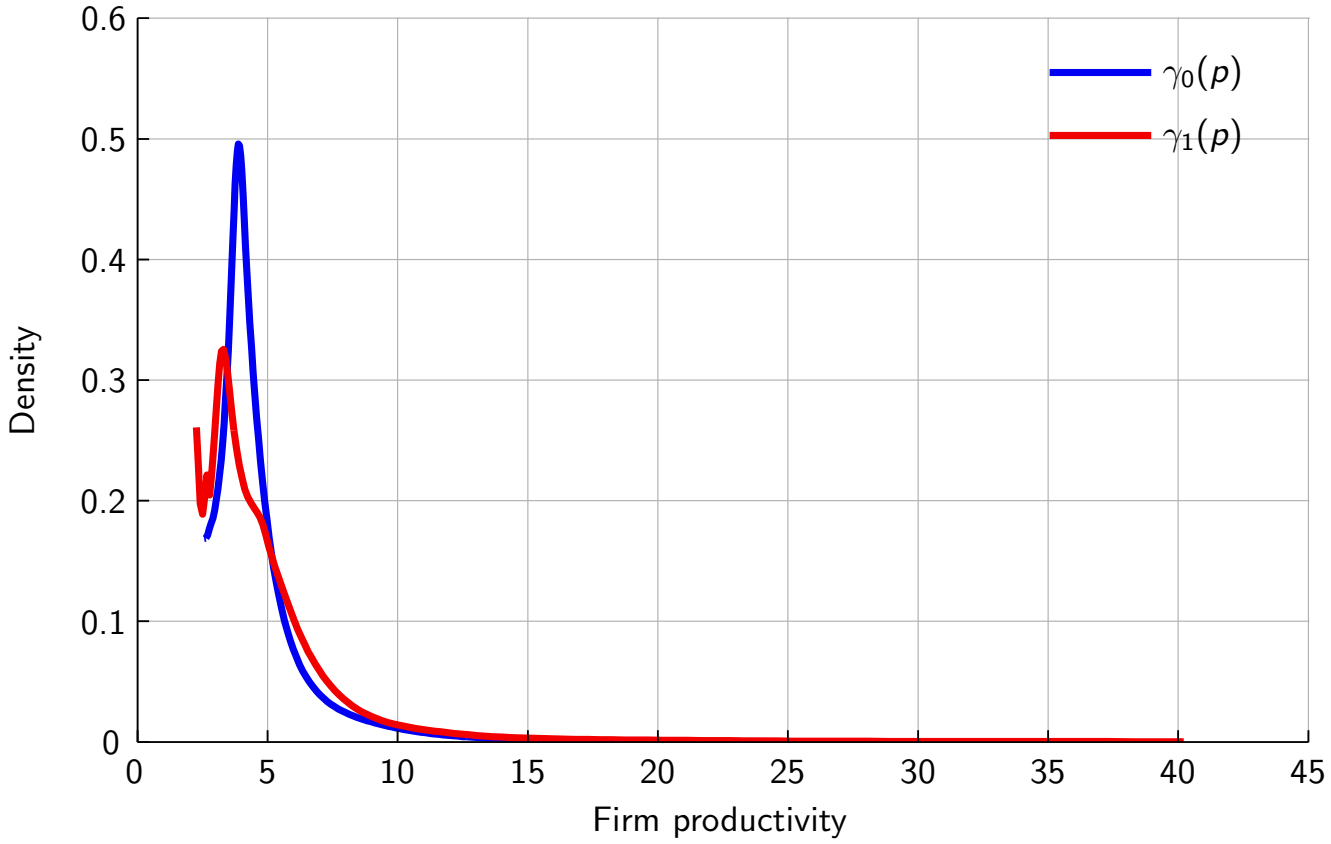
Figure: Estimated firm productivity



Notes: Distribution of firm productivity is obtained from pre-reform estimation by setting $v_h(p) = 1$ for all (h, p). Figure is truncated at productivities greater than $K_1^{-1}(G_1^{-1}(0.95))$.

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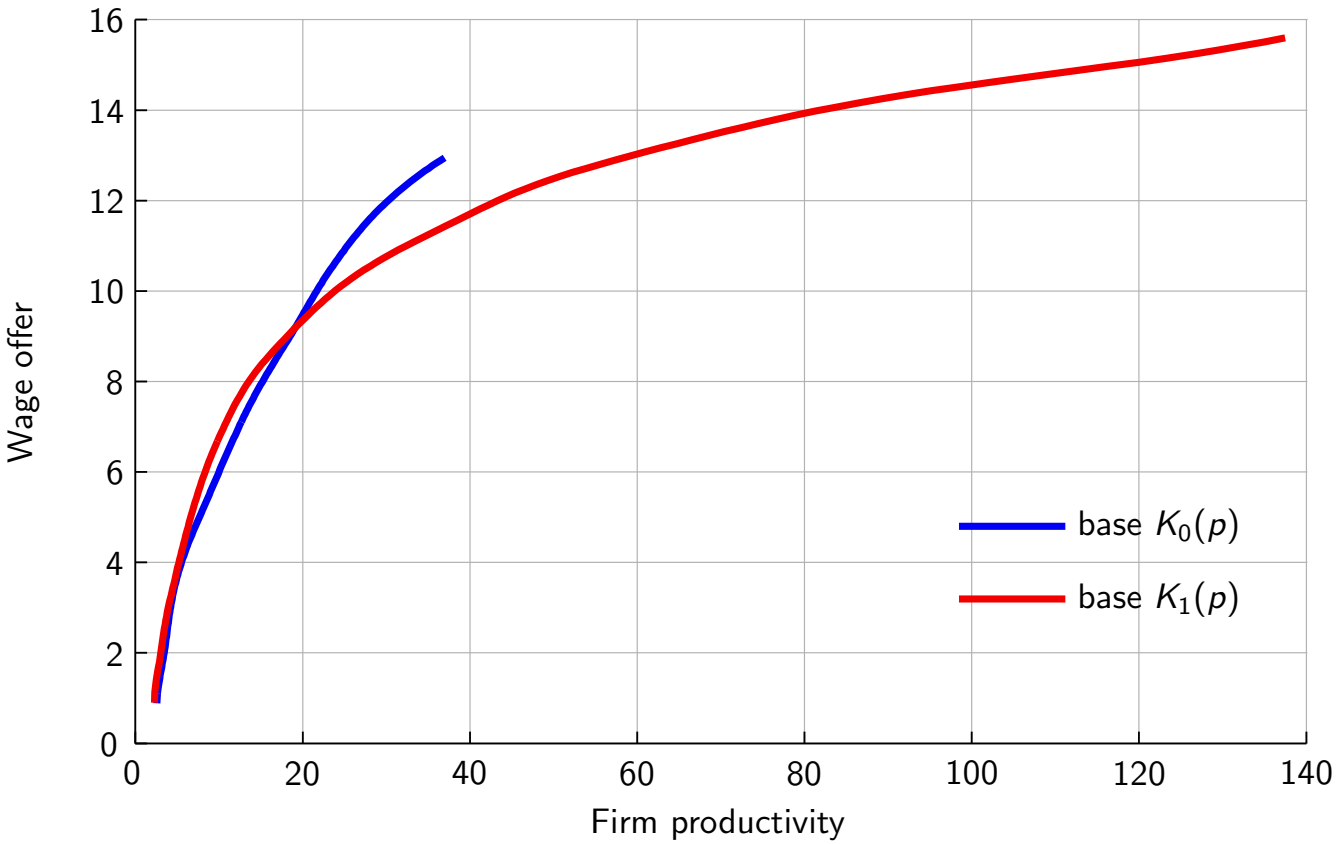
Figure: Wage policy function (pre-reform)



Notes: Figure shows how optimal wage policy $K_h(p)$ varies with firm productivity and hours sector under April 1997 tax and transfer system. Figure is truncated at productivities greater than $K_1^{-1}(G_1^{-1}(0.99))$.

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