Lecture 7 Policy Evaluation and Structural Models

Costas Meghir

February 2009

Linking Evaluation and Economic Models

- One important characteristic of the work we presented up to now is that the model focussed on some specific variable: the treatment

Linking Evaluation and Economic Models

- One important characteristic of the work we presented up to now is that the model focussed on some specific variable: the treatment
- The evaluation methods did not attempt to specify more complete models or even to try and understand the mechanisms through which the treatment effects operated

Linking Evaluation and Economic Models

- One important characteristic of the work we presented up to now is that the model focussed on some specific variable: the treatment
- The evaluation methods did not attempt to specify more complete models or even to try and understand the mechanisms through which the treatment effects operated
- A number of assumptions were made, such as the Conditional Independence assumption or the independence of some instrument from all unobservables, without reference to an explicit theoretical framework that could justify them.

Linking Evaluation and Economic Models

- One important characteristic of the work we presented up to now is that the model focussed on some specific variable: the treatment
- The evaluation methods did not attempt to specify more complete models or even to try and understand the mechanisms through which the treatment effects operated
- A number of assumptions were made, such as the Conditional Independence assumption or the independence of some instrument from all unobservables, without reference to an explicit theoretical framework that could justify them.
- Effectively there is an underlying attempt to ignore theory or at least not to be explicit about it, which gives the misleading impression of greater generality.

Linking Evaluation and Economic Models

- One important characteristic of the work we presented up to now is that the model focussed on some specific variable: the treatment
- The evaluation methods did not attempt to specify more complete models or even to try and understand the mechanisms through which the treatment effects operated
- A number of assumptions were made, such as the Conditional Independence assumption or the independence of some instrument from all unobservables, without reference to an explicit theoretical framework that could justify them.
- Effectively there is an underlying attempt to ignore theory or at least not to be explicit about it, which gives the misleading impression of greater generality.
- The aim in this section is to go back to viewing evaluation through the prism of economic theory

- Consider the following idea taken from the work of Marschak:

- Consider the following idea taken from the work of Marschak:
    - Now suppose we wish to estimate the impact of introducing an indirect tax.

- Consider the following idea taken from the work of Marschak:
    - Now suppose we wish to estimate the impact of introducing an indirect tax.
    - We translate the way the reform affects the environment as a change in price say from p to $(1+t)p$.

- Consider the following idea taken from the work of Marschak:
  - Now suppose we wish to estimate the impact of introducing an indirect tax.
  - We translate the way the reform affects the environment as a change in price say from p to $(1 + t)p$.
  - We now search in the support of prices a time/region where the price was equal to the new after tax price.

- Consider the following idea taken from the work of Marschak:
    - Now suppose we wish to estimate the impact of introducing an indirect tax.
    - We translate the way the reform affects the environment as a change in price say from p to $(1+t)p$.
    - We now search in the support of prices a time/region where the price was equal to the new after tax price.
    - If all else was equal we can then read off the quantity demanded and predict the effects of the reform.

- Consider the following idea taken from the work of Marschak:
  - Now suppose we wish to estimate the impact of introducing an indirect tax.
  - We translate the way the reform affects the environment as a change in price say from p to $(1+t)p$.
  - We now search in the support of prices a time/region where the price was equal to the new after tax price.
  - If all else was equal we can then read off the quantity demanded and predict the effects of the reform.
- Of course the key problem here is the "*all else being equal*" assumption. This is where econometric methods come in as well as the issues relating to identification

Contrasting Treatment effect models and Structural models

- Structural Models aim to separate "deep" preference and technology parameters that can be thought of as being invariant to policy, from budget constraints.

Contrasting Treatment effect models and Structural models

- Structural Models aim to separate "deep" preference and technology parameters that can be thought of as being invariant to policy, from budget constraints.
- Policy analysis is then carried out by being explicit about how a policy can change the environment/budget constraints and simulating changes in behaviour

Contrasting Treatment effect models and Structural models

- Structural Models aim to separate "deep" preference and technology parameters that can be thought of as being invariant to policy, from budget constraints.
- Policy analysis is then carried out by being explicit about how a policy can change the environment/budget constraints and simulating changes in behaviour
- The interpretation of the results is explicitly reliant on theory in a way that all assumptions on which the interpretation is predicated are explicitly stated.

Contrasting Treatment effect models and Structural models

- Structural Models aim to separate “deep” preference and technology parameters that can be thought of as being invariant to policy, from budget constraints.
- Policy analysis is then carried out by being explicit about how a policy can change the environment/budget constraints and simulating changes in behaviour
- The interpretation of the results is explicitly reliant on theory in a way that all assumptions on which the interpretation is predicated are explicitly stated.
- The effects of a policy is then estimated and the mechanisms by which it operates (income and substitution effects for example) are uncovered

Contrasting Treatment effect models and Structural models

- By contrast the treatment effects models lead to an overall estimate in such a way that the effect will *not be invariant* to changes in circumstances

Contrasting Treatment effect models and Structural models

- By contrast the treatment effects models lead to an overall estimate in such a way that the effect will *not be invariant* to changes in circumstances
- The Marginal Treatment Effect is a step towards linking the heterogeneous treatment effects model to the notion of a structural parameter because the estimate we obtain does not depend on the instrument or the specific circumstances that led to treatment choice. However, a full structural model, leading to the identification and estimation of policy invariant parameters requires a complete specification of the underlying economic models.

- Suppose an evaluation wishes to ask the question of how an intervention, such as training will affect earning.

Randomised Experiments and earnings

- Suppose an evaluation wishes to ask the question of how an intervention, such as training will affect earning.
- The evaluation approach is to offer training randomly to a sunset of a group of volunteers

- Let S stand for earnings, R for randomisation status (0,1) and P for work status sometime after the experiment.

- Let S stand for earnings, R for randomisation status (0,1) and P for work status sometime after the experiment.
- Now consider what the randomised experiment identifies

$$E(S_i|R_i = 1) - E(S_i|R_i = 0) =$$

$$[E(S_i|R_i = 1, P_i = 1) - E(S_i|R_i = 0, P_i = 1)] \Pr(P_i = 1|R_i = 0)$$

$$+ [\Pr(P_i = 1|R_i = 1) - \Pr(P_i = 1|R_i = 0)] E(S_i|R_i = 1, P_i = 1)$$

- Let S stand for earnings, R for randomisation status (0,1) and P for work status sometime after the experiment.
- Now consider what the randomised experiment identifies

$$E(S_i|R_i=1)-E(S_i|R_i=0)=$$

$$[E(S_i|R_i=1,P_i=1)-E(S_i|R_i=0,P_i=1)]\Pr(P_i=1|R_i=0)$$

$$+[\Pr(P_i=1|R_i=1)-\Pr(P_i=1|R_i=0)]E(S_i|R_i=1,P_i=1)$$

- Thus earnings increases will occur because of increased employment (the last term) and/or because of the increased earnings of those employed.

- Suppose we find that the last term is zero (training had no effect on employment) but that nevertheless earnings increased.

- Suppose we find that the last term is zero (training had no effect on employment) but that nevertheless earnings increased.
- In this case we still cannot tell whether productivity increased. This would require us to assume that the *composition* of individuals working is independent of training.

- Suppose we find that the last term is zero (training had no effect on employment) but that nevertheless earnings increased.
- In this case we still cannot tell whether productivity increased. This would require us to assume that the *composition* of individuals working is independent of training.
- However, there is nothing to say that those who are offered training *and* decide to work come from the same part of the heterogeneity distribution with respect to productivity as those who are not offered training and decide to work.

- Suppose we find that the last term is zero (training had no effect on employment) but that nevertheless earnings increased.
- In this case we still cannot tell whether productivity increased. This would require us to assume that the *composition* of individuals working is independent of training.
- However, there is nothing to say that those who are offered training *and* decide to work come from the same part of the heterogeneity distribution with respect to productivity as those who are not offered training and decide to work.
- Even if the proportions working end up the same we can say nothing about the effect of the experiment on productivity.

- Suppose we find that the last term is zero (training had no effect on employment) but that nevertheless earnings increased.
- In this case we still cannot tell whether productivity increased. This would require us to assume that the *composition* of individuals working is independent of training.
- However, there is nothing to say that those who are offered training *and* decide to work come from the same part of the heterogeneity distribution with respect to productivity as those who are not offered training and decide to work.
- Even if the proportions working end up the same we can say nothing about the effect of the experiment on productivity.
- This would require a model (theory) of employment.

A simple structural model of labour supply

Reading: Meghir and Phillips, Labour Supply and Taxes, in Mirrlees Review
http://www.ifs.org.uk/wps/wp0804.pdf

- We can start by a very simple argument in the simplest possible labour supply model under piece-wise linear taxes.

A simple structural model of labour supply

Reading: Meghir and Phillips, Labour Supply and Taxes, in Mirrlees Review
http://www.ifs.org.uk/wps/wp0804.pdf

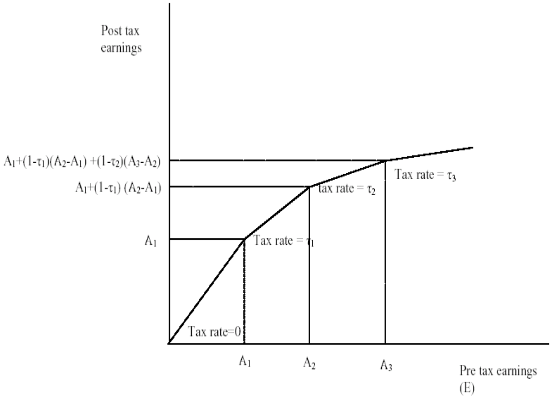
- We can start by a very simple argument in the simplest possible labour supply model under piece-wise linear taxes.
- Suppose labour supply (hours worked) can be written as

$$h = a + b \log w + c\mu + u$$

where w is the hourly wage rate, μ is non-labour income and u is unobservable tastes for work.

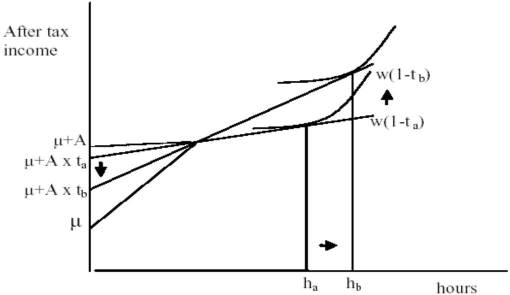
A simple structural model of labour supply

- Now consider a tax system that gives rise to a convex budget set (no fixed costs, constant or increasing marginal tax rates with earnings)



A simple structural model of labour supply and tax reform

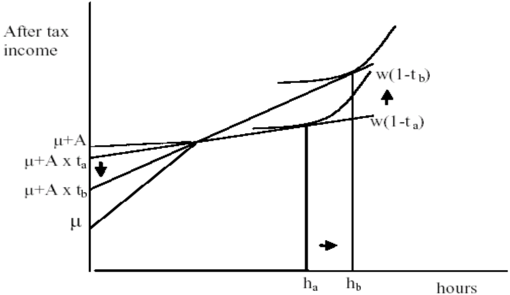
- To simplify notation we take a system with two tax brackets: on has a marginal tax rate of zero 0 and one of t.



A simple structural model of labour supply and tax reform

- To simplify notation we take a system with two tax brackets: on has a marginal tax rate of zero 0 and one of t.
- In this case we can express the optimal choice of hours of work as, where A is the level of earnings where the marginal tax rate switches from 0 to positive.

$$h = a + b \log \left[(1 - t) w \right] + c \left[\mu + tA \right] + u$$

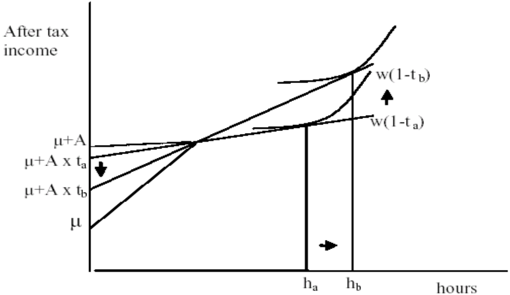


A simple structural model of labour supply and tax reform

- To simplify notation we take a system with two tax brackets: on has a marginal tax rate of zero 0 and one of t.
- In this case we can express the optimal choice of hours of work as, where A is the level of earnings where the marginal tax rate switches from 0 to positive.

$$h = a + b \log\left[(1-t)w\right] + c\left[\mu + tA\right] + u$$

- The structural parameters here are a, b, c and the distribution of u.



Treatment Effects and Structural Parameters in the Labour Supply Example

- Now consider a reform that changes the tax rate from t_1 to t_2. Suppose for the sake of argument that the new tax rate is randomised. What treatment effect would we estimate according to this simple model?

Treatment Effects and Structural Parameters in the Labour Supply Example

- Now consider a reform that changes the tax rate from t_1 to t_2. Suppose for the sake of argument that the new tax rate is randomised. What treatment effect would we estimate according to this simple model?
- Following the randomised experiment we would compute the effect of the tax rate change as the change in the average hours worked, i.e. $\bar{h}_2 - \bar{h}_1$ or we might also normalise by the size of the tax change: $\frac{\bar{h}_2 - \bar{h}_1}{t_2 - t_1}$. Given the randomisation *this is the causal effect* of **this** tax reform. What is the external validity of this estimate.

Treatment Effects and Structural Parameters in the Labour Supply Example

- Now consider a reform that changes the tax rate from t_1 to t_2. Suppose for the sake of argument that the new tax rate is randomised. What treatment effect would we estimate according to this simple model?
- Following the randomised experiment we would compute the effect of the tax rate change as the change in the average hours worked, i.e. $\bar{h}_2 - \bar{h}_1$ or we might also normalise by the size of the tax change: $\frac{\bar{h}_2 - \bar{h}_1}{t_2 - t_1}$. Given the randomisation *this is the causal effect* of **this** tax reform. What is the external validity of this estimate.
- In our language, how does this relate to the *structural parameters*

Treatment Effects and Structural Parameters in the Labour Supply Example

- In this model individuals can decide to work on the zero tax segment, exactly on the kink or above the kink.

Treatment Effects and Structural Parameters in the Labour Supply Example

- In this model individuals can decide to work on the zero tax segment, exactly on the kink or above the kink.
- The kink has a positive mass because all those individuals with u such that $a + b \log w + c\mu + u \geq A/w$ and $a + b \log [(1-t)w] + c[\mu + tA] + u \leq A/w$ have as preferred point the kink

Treatment Effects and Structural Parameters in the Labour Supply Example

- In this model individuals can decide to work on the zero tax segment, exactly on the kink or above the kink.
- The kink has a positive mass because all those individuals with u such that $a + b \log w + c\mu + u \geq A/w$ and $a + b \log [(1-t)w] + c[\mu + tA] + u \leq A/w$ have as preferred point the kink
- Let the proportions on each of these segments be $p_0(t)$, $p_k(t)$, $p_2(t)$ where the t denotes the tax rate under which they took this decision.

Treatment Effects and Structural Parameters in the Labour Supply Example

- In this model individuals can decide to work on the zero tax segment, exactly on the kink or above the kink.
- The kink has a positive mass because all those individuals with u such that $a + b \log w + c\mu + u \geq A/w$ and $a + b \log [(1-t)w] + c[\mu + tA] + u \leq A/w$ have as preferred point the kink
- Let the proportions on each of these segments be $p_0(t)$, $p_k(t)$, $p_2(t)$ where the t denotes the tax rate under which they took this decision.
- A change in the tax rate from t_1 to t_2 cannot change $p_0(t)$ so long as it does not become negative and the slope after the tax kink becomes steeper than the segment before. Hence the composition of preferences and wages is also invariant to this type of reform. This follows from the convexity of indifference curves.

Treatment Effects and Structural Parameters in the Labour Supply Example

- In this model individuals can decide to work on the zero tax segment, exactly on the kink or above the kink.
- The kink has a positive mass because all those individuals with u such that $a + b \log w + c\mu + u \geq A/w$ and $a + b \log [(1-t)w] + c [\mu + tA] + u \leq A/w$ have as preferred point the kink
- Let the proportions on each of these segments be $p_0(t)$, $p_k(t)$, $p_2(t)$ where the t denotes the tax rate under which they took this decision.
- A change in the tax rate from t_1 to t_2 cannot change $p_0(t)$ so long as it does not become negative and the slope after the tax kink becomes steeper than the segment before. Hence the composition of preferences and wages is also invariant to this type of reform. This follows from the convexity of indifference curves.
- However it is possible that $p_k(t)$ and hence $p_2(t)$ change.

Treatment Effects and Structural Parameters in the Labour Supply Example

- Average hours (assuming that everyone works) can be written as

$$E(h) = E(h|h < A/h)p_0 + \frac{A}{w}p_k + E(h|h > A/h)p_2$$

Treatment Effects and Structural Parameters in the Labour Supply Example

- Average hours (assuming that everyone works) can be written as

$$E(h) = E(h|h < A/h)p_0 + \frac{A}{w}p_k + E(h|h > A/h)p_2$$

- Now consider how the treatment effect can be written in terms of the model. (Δ_t means the change induced by a change in t, e.g. $\Delta_t\left[p_2(t)\right] = p_2(t_1) - p_2(t_2)$

$$E(h|t_2) - E(h|t_1) \equiv \Delta_t\left[E(h|t)\right] = A \times \Delta_t\left[p_k(t)E(\tfrac{1}{w}|t, h(t) = \tfrac{A}{w})\right]$$

$$+a\Delta_t\left[p_2(t)\right] + b\Delta_t\left[p_2(t)E(\log w|t, h(t) > \tfrac{A}{w})\right]$$

$$+c\Delta_t\left[p_2(t)E(\mu|t, h(t) > \tfrac{A}{w})\right]$$

$$+b\Delta_t\left[p_2(t)\log(1-t)\right] + cA\Delta_t\left[p_2(t)t\right] + \Delta_t\left[p_2(t)E(u|t, h(t) > \tfrac{A}{w})\right]$$

Treatment Effects and Structural Parameters in the Labour Supply Example

- In the simplest world of proportional taxation with no tax allowances ($A = 0$ and $p_2(t) = 1$), we get

$$E(h|t_2) - E(h|t_1) = b\Delta_t \left[\log(1 - t)\right]$$

which does have external validity and indeed identifies the wage effect (but not the income effect)

Treatment Effects and Structural Parameters in the Labour Supply Example

- In the simplest world of proportional taxation with no tax allowances ($A = 0$ and $p_2(t) = 1$), we get

$$E(h|t_2) - E(h|t_1) = b\Delta_t \left[\log(1-t)\right]$$

  which does have external validity and indeed identifies the wage effect (but not the income effect)
- In all other cases the effect depends on the distribution of wages and non-labour income and on the structure of the tax system

Treatment Effects and Structural Parameters in the Labour Supply Example

- In the simplest world of proportional taxation with no tax allowances ($A = 0$ and $p_2(t) = 1$), we get

$$E(h|t_2) - E(h|t_1) = b\Delta_t [\log(1 - t)]$$

  which does have external validity and indeed identifies the wage effect (but not the income effect)
- In all other cases the effect depends on the distribution of wages and non-labour income and on the structure of the tax system
- However, note the tension here: A randomised experiment of this nature, even if perfectly conducted will identify very well a causal effect without any reference to theory

Treatment Effects and Structural Parameters in the Labour Supply Example

- In the simplest world of proportional taxation with no tax allowances ($A = 0$ and $p_2(t) = 1$), we get

$$E(h|t_2) - E(h|t_1) = b\Delta_t \left[\log(1-t)\right]$$

  which does have external validity and indeed identifies the wage effect (but not the income effect)
- In all other cases the effect depends on the distribution of wages and non-labour income and on the structure of the tax system
- However, note the tension here: A randomised experiment of this nature, even if perfectly conducted will identify very well a causal effect without any reference to theory
- Nevertheless our use and interpretation of such a parameter is limited by the lack of an interpretative framework and by external validity.

Treatment Effects and Structural Parameters in the Labour Supply Example

- In the simplest world of proportional taxation with no tax allowances ($A = 0$ and $p_2(t) = 1$), we get

$$E(h|t_2) - E(h|t_1) = b\Delta_t \left[\log(1-t)\right]$$

  which does have external validity and indeed identifies the wage effect (but not the income effect)
- In all other cases the effect depends on the distribution of wages and non-labour income and on the structure of the tax system
- However, note the tension here: A randomised experiment of this nature, even if perfectly conducted will identify very well a causal effect without any reference to theory
- Nevertheless our use and interpretation of such a parameter is limited by the lack of an interpretative framework and by external validity.
- Our ability to learn from data is limited without a theoretical framework with which to interpret the results.

Treatment Effects and Structural Parameters

- The Cowles agenda also expressed in Marschak is to find ways of identifying the structural parameters

Treatment Effects and Structural Parameters

- The Cowles agenda also expressed in Marschak is to find ways of identifying the structural parameters
- This will allow to identify the impact of policy in many different contexts

Treatment Effects and Structural Parameters

- The Cowles agenda also expressed in Marschak is to find ways of identifying the structural parameters
- This will allow to identify the impact of policy in many different contexts
- Orcutt & Orcutt (reading list) advocate running experiments with an express aim at identifying structural models.

Treatment Effects and Structural Parameters

- The Cowles agenda also expressed in Marschak is to find ways of identifying the structural parameters
- This will allow to identify the impact of policy in many different contexts
- Orcutt & Orcutt (reading list) advocate running experiments with an express aim at identifying structural models.
- In the example provided above, this would imply assigning randomly different wages (through variation in taxes) and different levels of non-labour income to identify the structural labour supply model

Two Alternative Evaluations of Tax Credits

- A difference in Differences approach:

Two Alternative Evaluations of Tax Credits

- A difference in Differences approach:
    - Labor Supply Response to the Earned Income Tax Credit by Nada Eissa and Jeffrey B. Liebman. The Quarterly Journal of Economics, Vol. 111, No. 2 (May, 1996), pp. 605-637

Two Alternative Evaluations of Tax Credits

- A difference in Differences approach:
  - Labor Supply Response to the Earned Income Tax Credit by Nada Eissa and Jeffrey B. Liebman. The Quarterly Journal of Economics, Vol. 111, No. 2 (May, 1996), pp. 605-637
- A Structural Approach:

Two Alternative Evaluations of Tax Credits

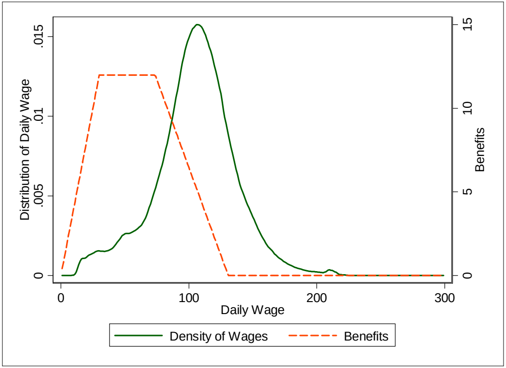
- A difference in Differences approach:
  - Labor Supply Response to the Earned Income Tax Credit by Nada Eissa and Jeffrey B. Liebman. The Quarterly Journal of Economics, Vol. 111, No. 2 (May, 1996), pp. 605-637
- A Structural Approach:
  - The Labour Market Impact of the Working Families' Tax Credit by R. Blundell, A. Duncan, J. McRae and C. Meghir, Fiscal Studies (2000) vol. 21, no. 1, pp. 75–104

Earned Income Tax Credits

- The Earned Income Tax Credit in the US is effectively a negative marginal tax rate for low earning individuals.

Earned Income Tax Credits

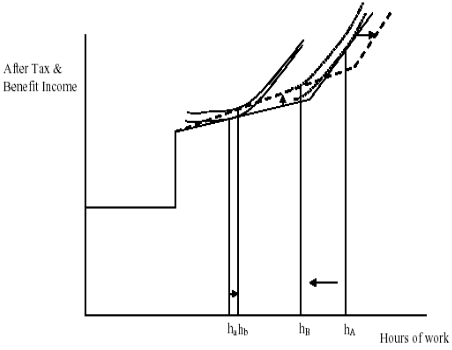
- The Earned Income Tax Credit in the US is effectively a negative marginal tax rate for low earning individuals.
- The general form of benefit looks as in the graph below



Density of Wages and In-Work Benefit Scheme

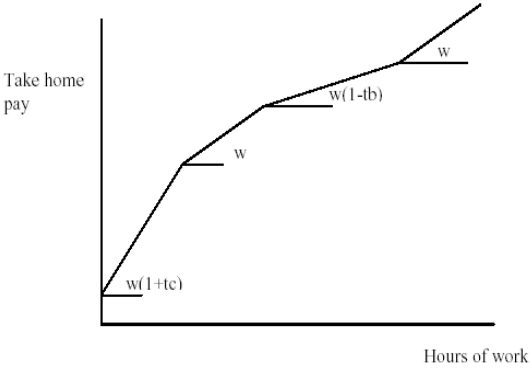
- The UK system is similar but also imposes the condition that individuals have to work at least 16 hours.

- The UK system is similar but also imposes the condition that individuals have to work at least 16 hours.
- The budget constraint under the UK system looks like



Earned Income Tax Credit

- Under the US system the budget constraint looks like:



Earned Income Tax Credit

- The specific parameters of the programme differ depending on the demographic composition of the household.

Earned Income Tax Credit

- The specific parameters of the programme differ depending on the demographic composition of the household.
- In the UK it started as a benefit for families with children.

Earned Income Tax Credit

- The specific parameters of the programme differ depending on the demographic composition of the household.
- In the UK it started as a benefit for families with children.
- In the US it replaced the AFDC (Aid for Families with Dependent Children) and aimed to improve work incentives, while helping poorer families with children..

Earned Income Tax Credit

- The specific parameters of the programme differ depending on the demographic composition of the household.
- In the UK it started as a benefit for families with children.
- In the US it replaced the AFDC (Aid for Families with Dependent Children) and aimed to improve work incentives, while helping poorer families with children..
- The key idea is that the programme transfers income to the working poor.

Earned Income Tax Credit

- The specific parameters of the programme differ depending on the demographic composition of the household.
- In the UK it started as a benefit for families with children.
- In the US it replaced the AFDC (Aid for Families with Dependent Children) and aimed to improve work incentives, while helping poorer families with children..
- The key idea is that the programme transfers income to the working poor.
- The labour supply theory predicts that such a wage subsidy will encourage participation into work but could reduce the hours of work as shown in the figure depicting the UK system.

Earned Income Tax Credit (Eissa and Liebmann)

- We can now think what is needed to evaluate such a programme or changes to it.

Earned Income Tax Credit (Eissa and Liebmann)

- We can now think what is needed to evaluate such a programme or changes to it.
- One approach is a difference in differences method as followed by Eissa and Liebman.

Earned Income Tax Credit (Eissa and Liebmann)

- We can now think what is needed to evaluate such a programme or changes to it.
- One approach is a difference in differences method as followed by Eissa and Liebman.
- They exploit an expansion of the system.

Earned Income Tax Credit (Eissa and Liebmann)

- We can now think what is needed to evaluate such a programme or changes to it.
- One approach is a difference in differences method as followed by Eissa and Liebman.
- They exploit an expansion of the system.
- Their comparison group was the group of childless women who were not eligible for the programme.

Earned Income Tax Credit (Eissa and Liebmann)

- The expansion they are considering increased the subsidy rate from 11% to 14% and increased the maximum income to which the subsidy rate applied from \$5000 to \$6080.

Earned Income Tax Credit (Eissa and Liebmann)

- The expansion they are considering increased the subsidy rate from 11% to 14% and increased the maximum income to which the subsidy rate applied from \$5000 to \$6080.
- This increased the maximum credit from \$550 to \$851

Earned Income Tax Credit (Eissa and Liebmann)

- The expansion they are considering increased the subsidy rate from 11% to 14% and increased the maximum income to which the subsidy rate applied from \$5000 to \$6080.
- This increased the maximum credit from \$550 to \$851
- The phase-out rate was reduced from 12.22% to 10%. This made individuals between \$11,000 and \$15,000 now eligible for some credit.

Earned Income Tax Credit (Eissa and Liebmann)

TABLE II
LABOR FORCE PARTICIPATION RATES OF UNMARRIED WOMEN

	Pre-TRA86 (1)	Post-TRA86 (2)	Difference (3)	Difference-in-differences (4)
A. *Treatment group:*				
With children [20,810]	0.729 (0.004)	0.753 (0.004)	0.024 (0.006)	
Control group:				
Without children [46,287]	0.952 (0.001)	0.952 (0.001)	0.000 (0.002)	*0.024 (0.006)*
B. *Treatment group:*				
Less than high school, with children [5396]	0.479 (0.010)	0.497 (0.010)	0.018 (0.014)	
Control group 1:				
Less than high school, without children [3958]	0.784 (0.010)	0.761 (0.009)	−0.023 (0.013)	*0.041 (0.019)*
Control group 2:				
Beyond high school, with children [5712]	0.911 (0.005)	0.920 (0.005)	0.009 (0.007)	*0.009 (0.015)*
C. *Treatment group:*				
High school, with children [9702]	0.764 (0.006)	0.787 (0.006)	0.023 (0.008)	
Control group 1:				
High school, without children [16,527]	0.945 (0.002)	0.943 (0.003)	−0.002 (0.004)	*0.025 (0.009)*
Control group 2:				
Beyond high school, with children [5712]	0.911 (0.005)	0.920 (0.005)	0.009 (0.007)	*0.014 (0.011)*

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:
  - The control group does not change, hence we do not seem to have the problem relating to the Athey-Imbens bounds

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:
    - The control group does not change, hence we do not seem to have the problem relating to the Athey-Imbens bounds
    - The strongest results are obtained by looking at the most comparable results

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:
  - The control group does not change, hence we do not seem to have the problem relating to the Athey-Imbens bounds
  - The strongest results are obtained by looking at the most comparable results
- However, the baseline participation rates are completely different, with the comparison group at almost 100% participation

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:
  - The control group does not change, hence we do not seem to have the problem relating to the Athey-Imbens bounds
  - The strongest results are obtained by looking at the most comparable results
- However, the baseline participation rates are completely different, with the comparison group at almost 100% participation
- This raises the issue of whether the assumptions underlying the difference in differences estimator can possibly be valid.

Earned Income Tax Credit (Eissa and Liebmann)

- At first sight this seems to be a very strong set of results:
  - The control group does not change, hence we do not seem to have the problem relating to the Athey-Imbens bounds
  - The strongest results are obtained by looking at the most comparable results
- However, the baseline participation rates are completely different, with the comparison group at almost 100% participation
- This raises the issue of whether the assumptions underlying the difference in differences estimator can possibly be valid.
- The next point to note is that the estimated effect is a complicated function of the underlying structural parameters, the baseline and reformed tax system and the distribution of wages

Earned Income Tax Credit (Eissa and Liebmann)

- We illustrate this with the simplest possible model: one where the individual just chooses whether to work or not.

Earned Income Tax Credit (Eissa and Liebmann)

- We illustrate this with the simplest possible model: one where the individual just chooses whether to work or not.
- She has a wage if she does work that places her somewhere on the budget constraint.

Earned Income Tax Credit (Eissa and Liebmann)

- We illustrate this with the simplest possible model: one where the individual just chooses whether to work or not.
- She has a wage if she does work that places her somewhere on the budget constraint.
- She does not choose hours of work.

Earned Income Tax Credit (Eissa and Liebmann)

- We illustrate this with the simplest possible model: one where the individual just chooses whether to work or not.
- She has a wage if she does work that places her somewhere on the budget constraint.
- She does not choose hours of work.
- Her utility is

$$U^{w} = a_0 + a_1 Y^{w}(\text{tax credit, wage}) \qquad \textit{Work}$$

$$U^{nw} = b_0 + b_1 Y^{nw}(\text{out of work benefits}) + v \qquad \textit{Unemployed}$$

Earned Income Tax Credit (Eissa and Liebmann)

- We illustrate this with the simplest possible model: one where the individual just chooses whether to work or not.
- She has a wage if she does work that places her somewhere on the budget constraint.
- She does not choose hours of work.
- Her utility is

$$U^w = a_0 + a_1 Y^w(\text{tax credit, wage}) \qquad \textit{Work}$$

$$U^{nw} = b_0 + b_1 Y^{nw}(\text{out of work benefits}) + v \quad \textit{Unemployed}$$

- Assuming no aggregate growth the impact will depend on the is

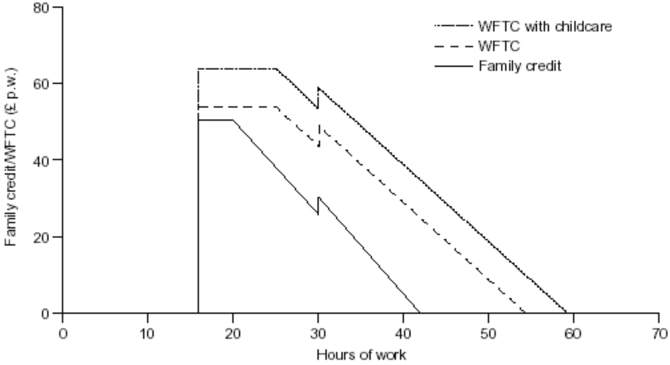
$$\begin{gathered}\textit{Effect} = \\ \int \{ \Pr[v < (a_0 - b_0) + a_1 Y^w(\text{new credit, wage}) - b_1 Y^{nw}(\text{benefits})] - \\ \Pr[v < (a_0 - b_0) + a_1 Y^w(\text{old credit, wage}) - b_1 Y^{nw}(\text{benefits})]\} dF(w)\end{gathered}$$

Working Families Tax Credit (UK)

- The UK had a similar expansion to the tax credit system in 1998.

FIGURE 1

Increased Generosity of In-Work Support



Working Families Tax Credit (UK) - Towards a Structural Model

- Assume the individual can choose to work one of H={0,10,20,30,40} hours.

Working Families Tax Credit (UK) - Towards a Structural Model

- Assume the individual can choose to work one of H={0,10,20,30,40} hours.
- Her hourly wage rate is W

Working Families Tax Credit (UK) - Towards a Structural Model

- Assume the individual can choose to work one of H=\{0,10,20,30,40\} hours.
- Her hourly wage rate is W
- At each such point the individual obtains a level of income, which is the result of taxes and benefits that correspond to each level of pre-tax earnings $W \times H$.

Working Families Tax Credit (UK) - Towards a Structural Model

- Assume the individual can choose to work one of H=\{0,10,20,30,40\} hours.
- Her hourly wage rate is W
- At each such point the individual obtains a level of income, which is the result of taxes and benefits that correspond to each level of pre-tax earnings $W \times H$.
- Denote this level of income by $Y^H(W, T)$ where T denotes the set of parameters that describe the tax and benefit system.

Working Families Tax Credit (UK) - Towards a Structural Model

- Assume the individual can choose to work one of H={0,10,20,30,40} hours.
- Her hourly wage rate is W
- At each such point the individual obtains a level of income, which is the result of taxes and benefits that correspond to each level of pre-tax earnings $W \times H$.
- Denote this level of income by $Y^H(W, T)$ where Tdenotes the set of parameters that describe the tax and benefit system.
- Denote the utility of working a particular level of hours by

$$U^H = a^H(Q) + b^H(Q)Y^H(W, T) + v^H = G^H(M) + \delta^H f + e^H$$

where a^H and b^H may depend on household characteristics Q such as the number and age of children. We summarize $M = [Q, W, T]$

Working Families Tax Credit (UK) - Towards a Structural Model

- The term e^H reflects unobserved heterogeneity specific to an hours level. f reflects an unobserved component affecting preferences through the parameter δ^H

Working Families Tax Credit (UK) - Towards a Structural Model

- The term e^H reflects unobserved heterogeneity specific to an hours level. f reflects an unobserved component affecting preferences through the parameter δ^H
- Under these assumptions the probability of observing one particular hours choice $H = h$ is logistic

$$\Pr(H = h | Q, W, \ f) = \frac{\exp(G^h(M) + \delta^h f)}{\sum_{H=\{0,10,20,30,40\}} \left[\exp(G^H(M) + \delta^H f)\right]}$$

Working Families Tax Credit (UK) - Towards a Structural Model

- There are three key difficulties with this:

Working Families Tax Credit (UK) - Towards a Structural Model

- There are three key difficulties with this:
  1. Wages W are not observed for non-workers

Working Families Tax Credit (UK) - Towards a Structural Model

- There are three key difficulties with this:
  1. Wages W are not observed for non-workers
  2. Wages may depend on the unobserved component of preferences f

Working Families Tax Credit (UK) - Towards a Structural Model

- There are three key difficulties with this:
  1. Wages W are not observed for non-workers
  2. Wages may depend on the unobserved component of preferences f
  3. The unobserved component f needs to be accounted for

Working Families Tax Credit (UK) - Towards a Structural Model

- There are three key difficulties with this:
  1. Wages W are not observed for non-workers
  2. Wages may depend on the unobserved component of preferences f
  3. The unobserved component f needs to be accounted for
- In other words we need to complete the model with a specification of wages and of unobserved heterogeneity.

Working Families Tax Credit (UK) - Towards a Structural Model

- We specify a wage model of the form

$$\log W = \gamma' X + \beta(Z) + \gamma f + \varepsilon$$

where $\varepsilon \tilde{} N(0, \sigma^2)$ and where X will include education and age. Note the presence of f : This reflects the issue of endogeneity of wages for labour supply and is modelled as a one factor model.

Working Families Tax Credit (UK) - Towards a Structural Model

- We specify a wage model of the form

$$\log W = \gamma' X + \beta(Z) + \gamma f + \varepsilon$$

  where $\varepsilon \tilde{} N(0, \sigma^2)$ and where X will include education and age. Note the presence of f : This reflects the issue of endogeneity of wages for labour supply and is modelled as a one factor model.
- At this point a central issue is whether wages can vary independently of Q : This depends on having a (set of) credible instruments Z that affect wages but not labour supply.

Working Families Tax Credit (UK) - Towards a Structural Model

- In the past we have used the idea that wages vary *differentially* across education and cohort groups, but that preferences do not depend on interactions between time and cohort.

Working Families Tax Credit (UK) - Towards a Structural Model

- In the past we have used the idea that wages vary *differentially* across education and cohort groups, but that preferences do not depend on interactions between time and cohort.
- This is of course the difference in differences assumption used within a structural model, and can be expressed here as follows

$$a(Q) = a_0 + d_t + a_1' R$$

and similarly for $b(Z)$, while

$$\beta' Z = \beta_0 + \zeta d_t + a_1' (d_t \times R)$$

Constructing the Likelihood Function

- Thus, when we know the wage (i.e. for workers) the joint density of wages and the probability of the hours point is given by

$$L_i^{H\neq 0}(f) = \phi\left(\frac{\log W - \gamma' X - \beta(Z) - \gamma f}{\sigma}\right) \times \Pr(H = h | Q, W,\ f)$$

Constructing the Likelihood Function

- Thus, when we know the wage (i.e. for workers) the joint density of wages and the probability of the hours point is given by

$$L_i^{H\neq 0}(f) = \phi\left(\frac{\log W - \gamma' X - \beta(Z) - \gamma f}{\sigma}\right) \times \Pr(H = h | Q, W,\ f)$$

- If the individual is not working, her wage is not known and has to be integrated out (i.e. take the average over all possible wages):

$$L_i^{0}(f) = \int_W \phi\left(\frac{\log W - \gamma' X - \beta(Z) - \gamma f}{\sigma}\right) \times \Pr(H = h | Q, W,\ f) dW$$

- The final element of the story is integrating out unobserved heterogeneity.

Constructing the Likelihood Function

- The final element of the story is integrating out unobserved heterogeneity.
- Following Heckman and Singer it is now standard to assume that f has *discrete* distribution with two or three (or more) points of support.

Constructing the Likelihood Function

- The final element of the story is integrating out unobserved heterogeneity.
- Following Heckman and Singer it is now standard to assume that f has *discrete* distribution with two or three (or more) points of support.
- This means that $f = \{f_1, f_2, f_3\}$ say each with unknown probability $p_1,\ p_{2,}\ p_3 = 1 - p_1 - p_2$. All the fs and the ps need to be estimated.

Constructing the Likelihood Function

- The final element of the story is integrating out unobserved heterogeneity.
- Following Heckman and Singer it is now standard to assume that f has *discrete* distribution with two or three (or more) points of support.
- This means that $f = \{f_1, f_2, f_3\}$ say each with unknown probability $p_1,\ p_{2,}\ p_3 = 1 - p_1 - p_2$. All the fs and the ps need to be estimated.
- The model likelihood becomes

$$L = \prod_{i \text{ is } nonwork} \sum_{k=1}^{3} p_k L_i^0(f_k) \times \prod_{i \text{ is } work} \sum_{k=1}^{3} p_k L_i^H(f_k)$$

Constructing the Likelihood Function

- The final element of the story is integrating out unobserved heterogeneity.
- Following Heckman and Singer it is now standard to assume that f has *discrete* distribution with two or three (or more) points of support.
- This means that $f = \{f_1, f_2, f_3\}$ say each with unknown probability $p_1, \ p_{2,} \ p_3 = 1 - p_1 - p_2$. All the fs and the ps need to be estimated.
- The model likelihood becomes

$$L = \prod_{i \text{ is } nonwork} \sum_{k=1}^{3} p_k L_i^0(f_k) \times \prod_{i \text{ is } work} \sum_{k=1}^{3} p_k L_i^H(f_k)$$

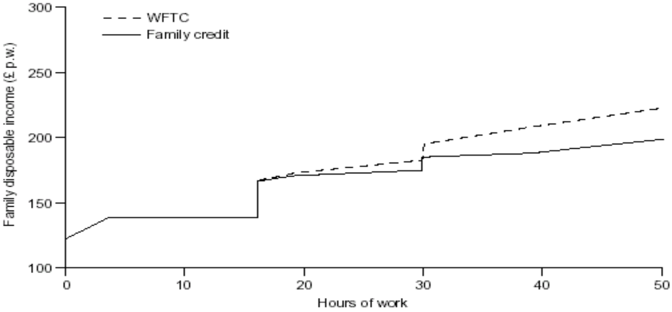
- This function is then maximised to obtain the unknown parameters in preferences, the wage equation and the distribution of unobserved heterogeneity.

Using the Model to Evaluate the Working Families Tax Credit.

- The reform tended to affect people in many different ways, some more than others.

FIGURE 3

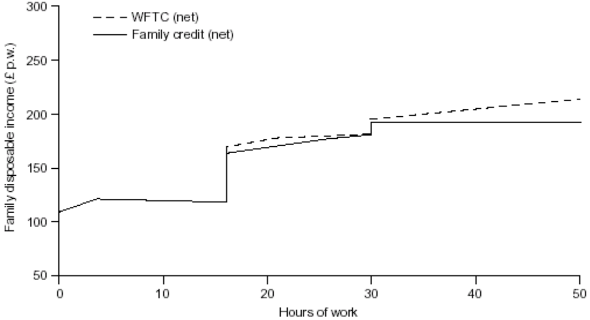
Budget Constraint for Example Lone Parent without Childcare Costs



Notes: One child aged under 11.
Hourly wage £4.39 (median for lone parents).
Rent £41.10 p.w. (median for social renters with children).
No childcare costs.

FIGURE 4

Budget Constraint for Example Lone Parent with Childcare Costs



Notes: One child aged under 11.
Hourly wage £4.39 (median for lone parents).
Rent £41.10 p.w. (median for social renters with children).
Childcare at £1.96 per hour.

FIGURE 7

Budget Constraint for Example Woman in Couple with Childcare Costs

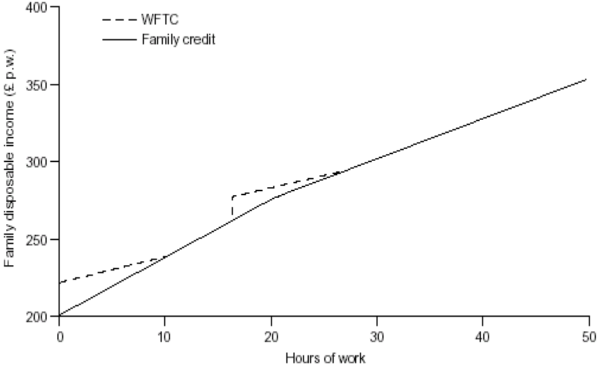


TABLE 5

Proportion of Gainers from WFTC

Per cent

	Hours of work (banded)					
	0	*1–10*	*11–20*	*21–30*	*31–40*	*41+*
Lone parents						
No pre-school children	.	.	62.1	74.0	52.2	51.1
One or more pre-school children	.	.	75.0	87.9	61.5	61.5
All women	.	.	65.2	78.2	53.8	53.4
Married, partner working						
No pre-school children	30.6	19.0	10.2	4.9	3.6	3.1
One or more pre-school children	35.9	12.7	11.7	5.3	4.4	4.1
All women	33.9	16.2	10.9	5.0	3.9	3.4
Married, partner not working						
No pre-school children	.	.	38.6	53.3	36.7	66.7
One or more pre-school children	.	.	73.1	80.0	45.0	33.3
All women	.	.	51.4	60.0	39.1	61.9

Note: Data are grouped according to observed hours of work for all household members and conditioned on observed childcare expenditure patterns.
Source: TAXBEN, based on Family Resources Survey, 1994–95 and 1995–96.

TABLE 7

Simulated Transitions among Single Parents (100% take-up of WFTC)

Transitions

Pre-reform	Out of work	*Post-reform* Part-time	Full-time	*Pre-reform %*
Out of work	58.0	0.7	1.5	60.2
Part-time	0.0	18.6	0.5	19.1
Full-time	0.0	0.2	20.6	20.7
Post-reform %	58.0	19.4	22.6	100
Change (% points)	–2.2	0.3	1.9	

TABLE 8

Simulated Transitions among Married Women with Employed Partners (100% take-up of WFTC)

Transitions

	Post-reform			*Pre-reform %*
Pre-reform	Out of work	Part-time	Full-time	
Out of work	32.2	0.1	0.1	32.4
Part-time	0.3	31.6	0.0	32.0
Full-time	0.4	0.1	35.0	35.6
Post-reform %	33.0	31.8	35.2	100
Change (% points)	0.6	–0.1	–0.4	

TABLE 9

Simulated Transitions among Married Women with Unemployed Partners (100% take-up of WFTC)

Transitions

Pre-reform	Out of work (*Post-reform*)	Part-time (*Post-reform*)	Full-time (*Post-reform*)	*Pre-reform %*
Out of work	56.8	0.4	0.9	58.1
Part-time	0.0	22.2	0.4	22.6
Full-time	0.0	0.1	19.2	19.3
Post-reform %	56.8	22.8	20.5	100
Change (% points)	−1.3	0.2	1.1	