Dealing with randomisation bias in a social experiment exploiting the randomisation itself: The case of ERA

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The Employment Retention and Advancement (ERA) program

ERA treatment
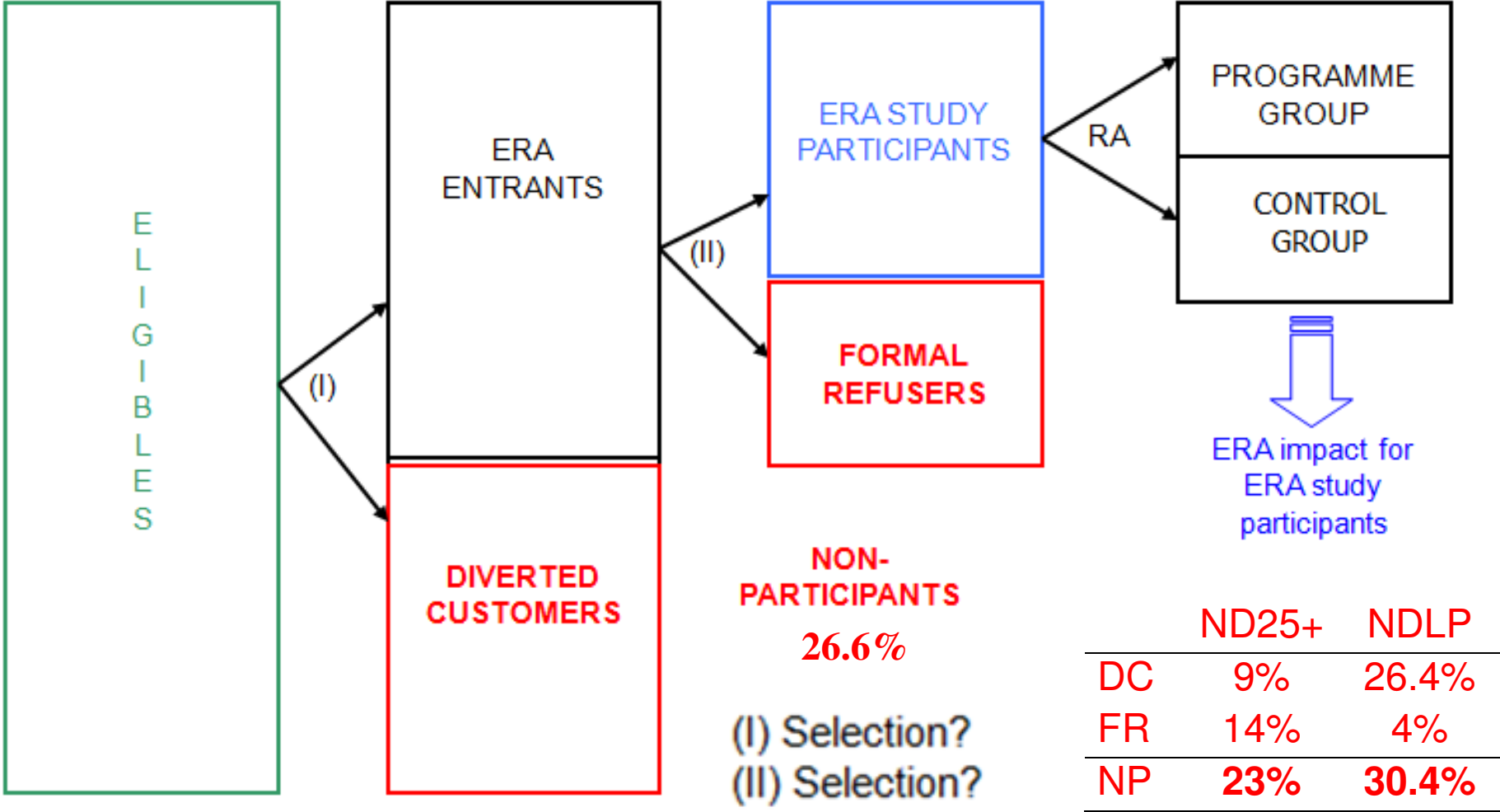
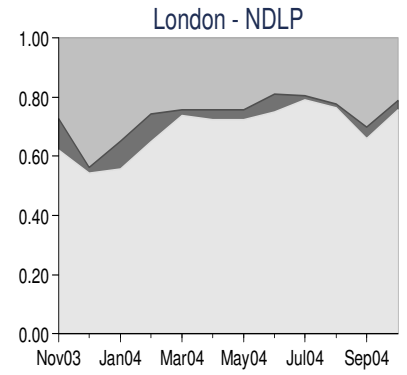*Offer* of a package of time-limited support once in work

Eligibles

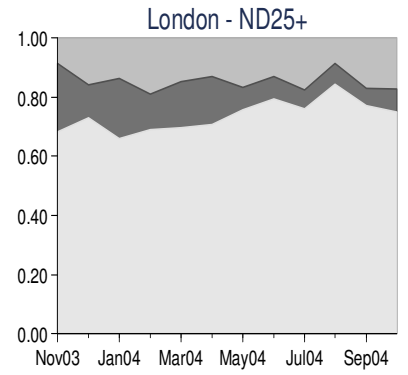1) LT unemployed mandated for ND25+
2) Unemployed volunteering for NDLP
3) [LPs on WTC working PT who volunteer for ERA]

Tested

Large-scale (*N*=16,000), multi-site (6 districts) RA social experiment
Intake: Nov 2003 – Jan 2005 (pilots end Oct 2007)

Non-participation in the ERA study

	ND25+	NDLP
DC	9%	26.4%
FR	14%	4%
NP	**23%**	**30.4%**

Scotland - ND25+

Scotland - NDLP

Wales - ND25+

Wales - NDLP

North East England - ND25+

North East England - NDLP

East Midlands - ND25+

East Midlands - NDLP

North West England - ND25+

North West England - NDLP

London - ND25+

London - NDLP

Diverted customers
Formal Refusers
Participants
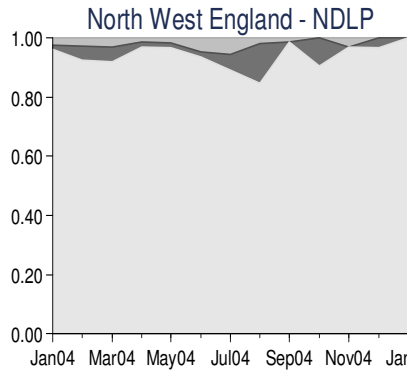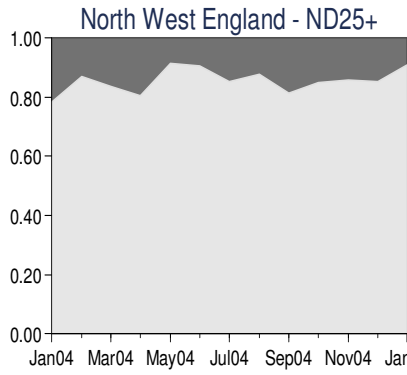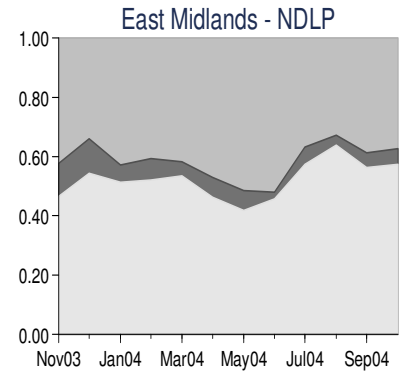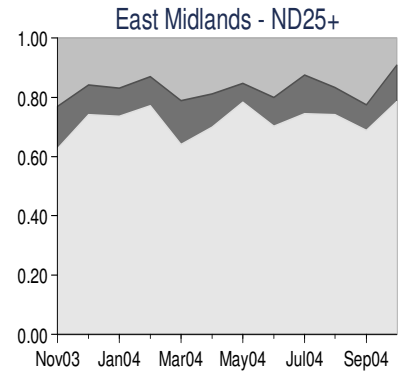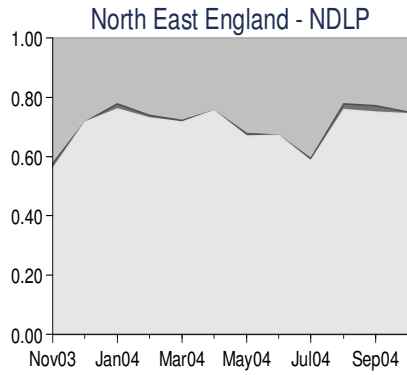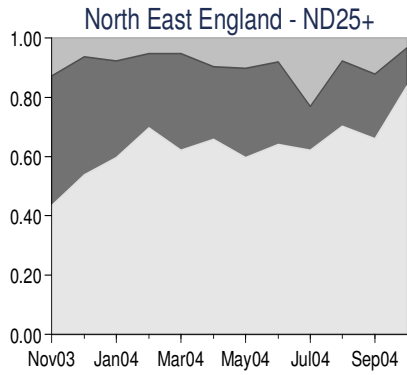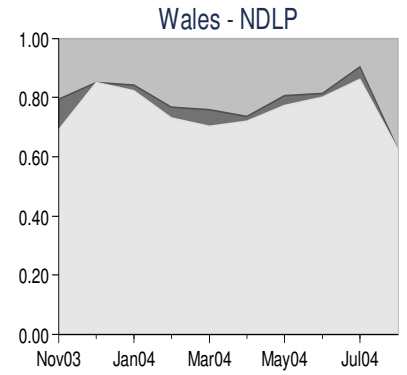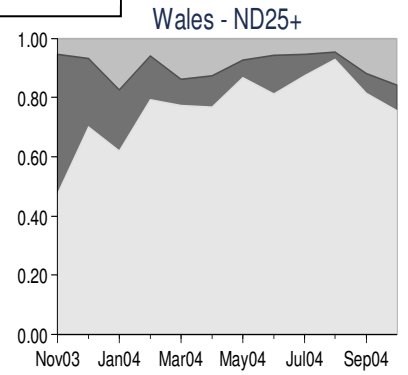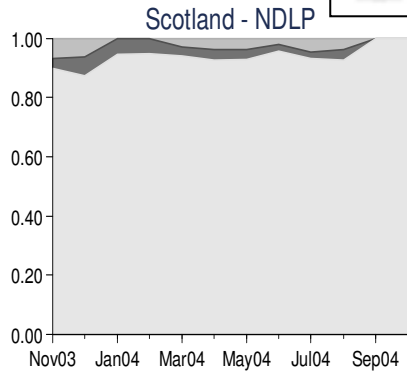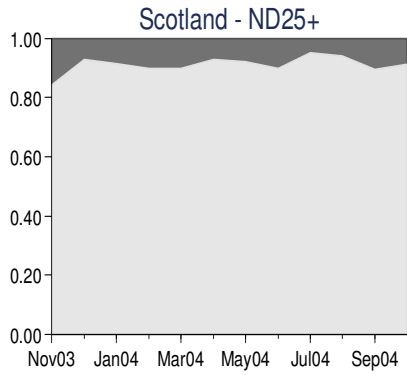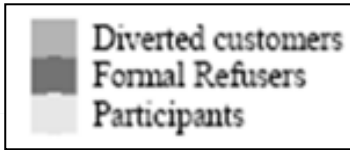
Issues raised by non-participation

- Policymaker interested in impact of offering ERA for all those eligible to receive the offer. (ERA as an integral component of the New Deal)

- But… ERA tested only on a potentially selective subset of the eligibles

2 ways to view non-participation

1. **Impact of offering ERA eligibility on the *eligibles*** (in the 6 districts)
   → Assess the scope for **randomisation bias** (Heckman, 1992 and Heckman *et al.*, 1999) in the experimental estimate for the parameter of interest

2. **Impact of offering ERA eligibility on the *study participants*** (in the 6 districts)
   → Has non-participation affected the extent of **external validity** of the experimental results, and hence their representativeness and policy relevance?

ERA study offers rare chance to look at this issue!

- offer (ITT)
- whole population (ATE)
- admin data

Research questions

- Impact on all eligibles
    - Impact on the non-participants
- Impact on all eligibles *versus* experimental impact on the participants

Methodology & "What's new"

Moving beyond an experiment's limitations by climbing on its shoulders

- Impact estimates under **selection-on-observables** (CIA)

  → matching and re-weighting estimators

- When follow-up data for non-participants available

  → exploit experiment to assess whether CIA is corroborated
  (plus help with choice of how to summarise X)

  → in cases where not, use information from experiment to adjust the non-experimental estimates

- When follow-up data for non-participants not available:

  → deal with additional issue of survey/item non-response

  → exploit experiment for subgroups for whom
    - admin earnings outcomes are available
    - equivalent survey and admin earnings outcomes are available

Sample and data

	ND25			NDLP		
Eligibles	7,796	100.0%		7,261	100.0%	
– Study non-participants	1,790	23.0%		2,209	30.4%	
– Study participants	6,006	77.0%	100.0%	5,052	69.6%	100.0%
– with survey outcome	1,840		30.6%	1,745		34.5%
– without survey outcome	4,166		69.4%	3,307		65.5%

Outcomes

- 12-month follow-up
- employment (ever employed and days) – admin data
- annual earnings – survey data
- fiscal year 2004/05 earnings – admin data

Control variables

ERA district	
Inflow month	District-specific month from random assignment start when the individual started the ND25 Gateway or volunteered for NDLP
Local conditions	Total New Deal caseload at office, share of lone parents in New Deal caseload at office, quintiles of the index of multiple deprivation, local unemployment rate
Demographics	Gender, age, ethnic minority, disability, partner (ND25+), number of children (NDLP), age of youngest child (NDLP)
Current spell	Not on benefits at inflow (NDLP), employed at inflow (indicator of very recent/current employment), time to show up (defined as the time between becoming mandatory for ND25+ and starting the Gateway or between being told about NDLP and volunteering for it), early entrant into ND25+ programme (Spent <540 days on JSA before entering ND25+)
Labour market history (3 years pre-inflow)	Past participation in basic skills, past participation in voluntary programmes (number of previous spells on: NDLP, New Deal for Musicians, New Deal Innovation Fund, New Deal Disabled People, WBLA or Outreach), past participation in ND25+
	Active benefit history, inactive benefit history, employment history: (1) parsimonious summary (2) monthly employment dummies (3) dummies for sequences of employment/benefits/neither states; 90% of sample (4) dummies for ever employed in 12m window at any time in the past

Methodology
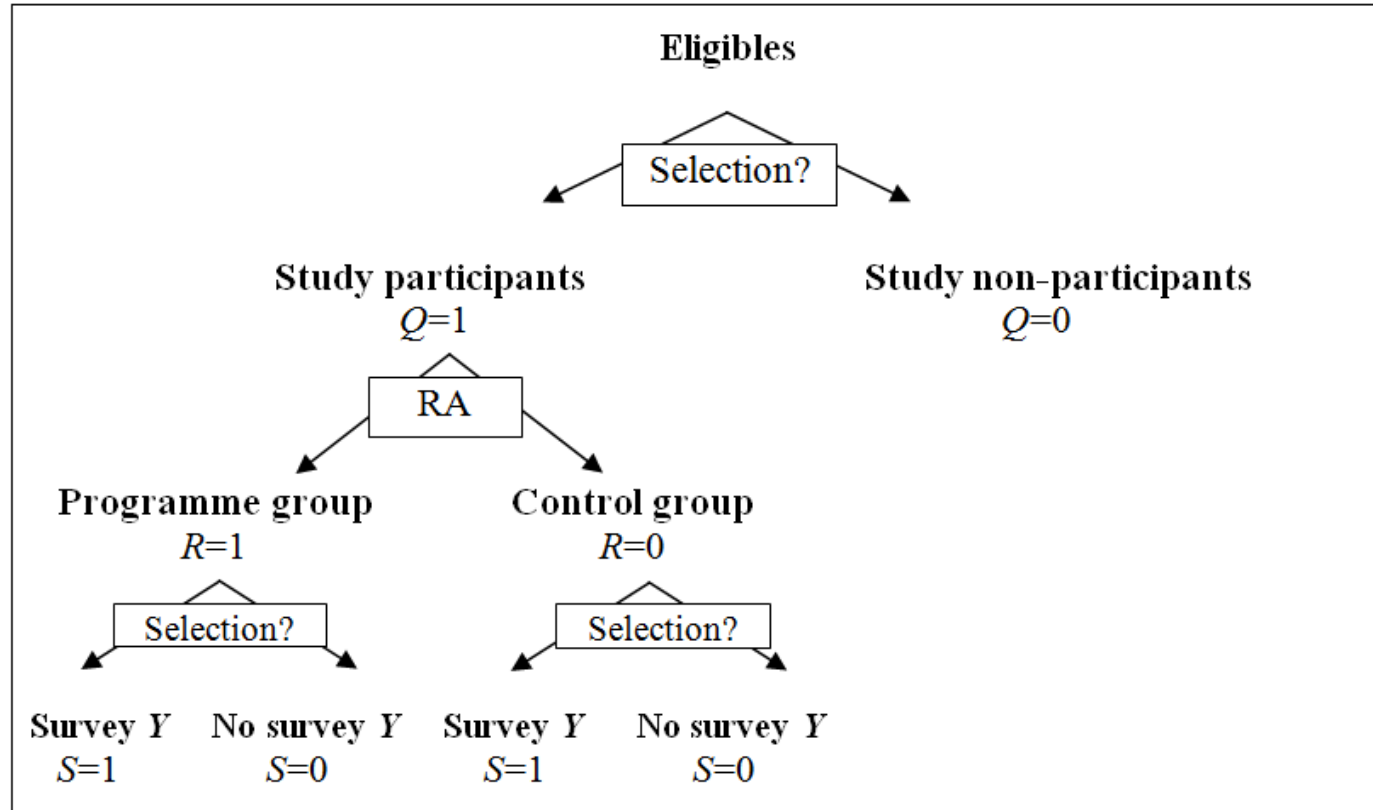
Average effect on participants $\quad ATE_1 \equiv E(Y_1 - Y_0 \mid Q{=}1)$

Average effect on non-participants $\quad ATE_0 \equiv E(Y_1 - Y_0 \mid Q{=}0)$

Average effect on *all* eligibles $\qquad ATE \equiv E(Y_1 - Y_0) = (1{-}p){\cdot}ATE_1 + p{\cdot}ATE_0 \qquad p{\equiv}\Pr\{Q{=}0\}$

Follow-up data

$ATE = (1-p) \cdot \{E(Y \mid R=1) - E(Y \mid R=0)\} + p \cdot \{\color{red}{E(Y_1 \mid Q=0)} - E(Y \mid Q=0)\}$

Akin to getting the **ATNT** using matching methods

Assume (CIA-1)

(CIA-1) $E(Y_1 \mid Q=0, X) = E(Y_1 \mid Q=1, X)$ and   (CS)

Implementation

Match to each non-participant one or more similar programme group member(s) based on $p(x) \equiv P(Q=0 \mid X) = P(Q=0 \mid Q=0 \vee Q=1, X)$ or $P(Q=0 \mid Q=0 \vee R=1, X)$.

Test (CIA-0)

(CIA-0) $E(Y_0 \mid Q=0, X) = E(Y_0 \mid Q=1, X)$ i.e. $E(Y \mid Q=0, X) = E(Y \mid R=0, X)$

By OLS or matching

Robustness analysis / adjustment

If (CIA-0) not met: $E(Y_0 \mid Q=0, X) = \theta_0\, E(Y_0 \mid Q=1, X)$ $\theta_0 \neq 1$

Relax identifying (CIA-1) by allowing participants and non-participants with the same X to differ in terms of some unobservable translating into a proportional difference of θ

(CIA-1) $E(Y_1 \mid Q=0, X) = \theta\, E(Y_1 \mid Q=1, X)$ in particular, set $\theta = \theta_0$

No follow-up data

$$ATE = (1-p) \cdot ATE_1 + p \cdot E(Y_1 - Y_0 \mid Q=0)$$

Akin to **attrition**

$\rightarrow$ reweigh Y of the participants on the basis of the X of the eligibles to make them representative – in terms of X – of the full eligible population

Motivation: Survey earnings

- all we had originally
- clean definition of components, incl. all part-time and self-employed
- same horizon (and all post-treatment)

Assume (CIA-1 & CIA-0)

(CIA) $E(Y_1 - Y_0 \mid Q=1, X) = E(Y_1 - Y_0 \mid Q=0, X)$ hence $= E(Y_1 - Y_0 \mid X)$

Implementation

The empirical counterpart can be derived in several ways:

1) <u>**Reweighting**</u>

Directly weigh the outcomes of the (responding) participants so as to reflect the distribution of X in the eligible population.

Ignoring survey/item non-response

$$A\hat{T}E = \left[\frac{(1-p)p_R}{\#(R=1)} \sum_{i \in \{R=1\}} \frac{y_i}{(1-p(x_i))\, p_R(x_i)} \right] - \left[\frac{(1-p)(1-p_R)}{\#(R=0)} \sum_{i \in \{R=0\}} \frac{y_i}{(1-p(x_i))(1-p_R(x_i))} \right]$$

where $p_R \equiv P(R=1 \mid Q=1)$ and $p_R(x) \equiv P(R=1 \mid Q=1, x)$

Allowing for survey/item non-response (selective non-response based on X)

$$A\hat{T}E = \left[\frac{1}{\#(R=1,S=1)} \sum_{i \in \{R=1,S=1\}} \frac{(1-p)p_{RS1}}{(1-p(x_i))\, p_{RS1}(x_i)} y_i \right] - \left[\frac{1}{\#(R=0,S=1)} \sum_{i \in \{R=0,S=1\}} \frac{(1-p)p_{RS0}}{(1-p(x_i))\, p_{RS0}(x_i)} y_i \right]$$

where $p_{RS1} \equiv P(R=1, S=1 \mid Q=1)$, $p_{RS0} \equiv P(R=0, S=1 \mid Q=1)$ and $p_{RS1}(x)$ and $p_{RS0}(x)$ are the corresponding probabilities conditional on x

2) **Matching**

Construct weights to realign X via matching

- exact specifications of pscore and response probabilities not needed
- can assess actual comparability

Can do it in 2 ways:
A) separately recover ATE_0 and then combine it with experimental ATE_1 to get the ATE or
B) recover ATE directly

Again, can do A) and B) both ignoring and allowing for survey and item non-response (Detailed matching protocols in Appendix)

Sensitivity analysis
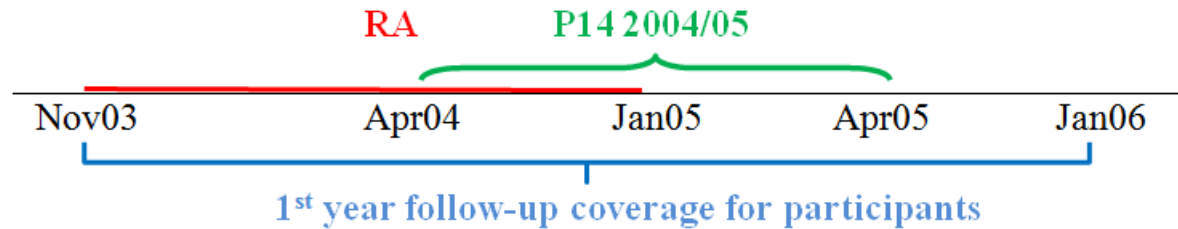
Exploit experiment for:

(I)   Subgroup for whom FY 2004/05 admin earnings *outcomes* are available
    →   **post April group** (35% of ND25+ and 41% of NDLP eligibles)

   -   Is (CIA-0) test passed for admin earnings? (Plus guidance on how to construct X)

(II)   Subgroup for whom 'equivalent' 1st-year survey and FY 2004/05 admin earnings outcomes are available (i.e. cover same horizon)
    →   **March/May group** (25% of ND25+ and NDLP eligibles)

   -   Is (CIA-0) test passed for admin earnings?

   -   experimental impacts

      ▪ admin earnings for March-May respondents *vs* admin earnings for full March-May group
      ▪ admin earnings for March-May respondents *vs* survey earnings for March-May respondents
      ▪ admin earnings for full March-May group *vs* survey earnings for March-May respondents

   -   Compare *ATE* for <u>full</u> March-May group in terms of admin earnings to *ATE* on March-May <u>respondents</u> in terms of survey earnings – taking account of non-response or not

Findings – ND25+

Days employed (admin)

| | ATE_1 | CIA-0 test | | θ_0 |
		OLS	Matching	
Raw	4.0	-9.4***		0.834
All other X's plus				
summary	4.6*	-7.9***	-9.7***	0.829
monthly employment	4.8**	-7.6***	-9.4***	0.835
ever employment	5.0**	-7.6***	-9.4***	0.835
sequence	4.8**	-7.9***	-8.8***	0.843
summary + monthly employment	4.8**	-7.7***	-9.2***	0.837
summary + ever employed	5.0**	-7.7***	-9.3***	0.837
summary + sequence	4.8**	-8.0***	-8.8***	0.843

Days employed (admin)

	p	_Formal_	_Diverted_	ATE_1	Raw	θ raw	OLS	Matching	θ_0
Scotland	8.7	_8.7_	_0.0_	8.6	-17.3	0.690	-8.2	-8.3	0.828
NE Eng	34.9	_26.1_	_8.8_	-10.3	-33.9***	0.565	-23.6***	-27.8***	0.616
NW Eng	14.6	_14.6_	_0.0_	7.5	-7.0	0.864	-1.8	-3.0	0.937
Wales	20.7	_11.1_	_9.6_	-13.6	-12.0	0.816	-16.3	-7.9	0.864
E Midls	27.5	_10.7_	_16.8_	8.0	-4.3	0.934	-5.7	-7.7	0.885
London	25.8	_11.1_	_14.8_	8.9**	-3.6	0.915	-3.7	-2.8	0.932
but NE Eng	21.0	11.5	9.5	6.5***	-5.7*	0.894	-4.7	-5.3	0.901

	p	ATE_1	ATE_0	ATE	$ATE_1 \neq ATE$
All but NE England	**0.210**	**6.5****	**9.7****	**7.2****	**not sign**
All districts			10.1***	5.9***	*
All districts, θ-adjusted	0.230	4.6*	5.3*	4.8*	not sig
NE England			8.1	-3.9	**
NE England, θ-adjusted	0.349	-10.3	-12.7**	-11.2*	not sig

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Ever employed (admin)

	p	Formal	Diverted	ATE_1	Raw	θ raw	OLS	Matching	θ_0
All	23.0	13.6	9.4	0.017	-0.062***	0.808	-0.044***	-0.056***	0.825
Scotland	8.7	8.7	0.0	0.047	-0.096*	0.726	-0.039	-0.041	0.861
NE Eng	34.9	**26.1**	**8.8**	-0.036	-0.191***	0.541	-0.149***	-0.172***	0.571
NW Eng	14.6	14.6	0.0	0.033	-0.024	0.915	0.010	0.010	1.038
Wales	20.7	11.1	9.6	-0.035	-0.027	0.923	-0.017	-0.004	0.987
E Midls	27.5	10.7	16.8	0.031	-0.073**	0.817	-0.060**	-0.071**	0.819
London	25.8	11.1	14.8	0.022	-0.017	0.929	-0.009	-0.010	0.958
no NE,EM	18.8	11.8	7.0	0.023*	-0.041**	0.858	-0.007	-0.011	0.956

	p	ATE_1	ATE_0	ATE	$ATE_1 \neq ATE$
All but NE Eng, E Midls	**0.188**	**0.023***	**0.026***	**0.024****	**not sign**
All districts			0.056***	0.026**	***
All districts, θ-adjusted	0.230	0.017	0.003	0.014	not sig
NE England			0.092**	0.009	***
NE England, θ-adjusted	0.349	-0.036	-0.048**	-0.040	not sig
E Midlands			0.083***	0.045**	*
E Midlands, θ-adjusted	0.275	0.031	0.010	0.025	not sig

Annual earnings (survey)

		$\Delta_{S=1,X} \neq ATE$	
$\Delta_{S=1,X}$		445.4**	
	allowing for non-response, weighting	579.6**	not sig
ATE	allowing for non-response, separate CS	551.2***	not sig
	ignoring non-response, separate CS	469.4*	not sig
	ignoring non-response, joint CS	468.1*	not sig

(CIA-0) test in terms of 2004/05 earnings (admin)

	X + history	Raw	θ raw	OLS	Matching	θ_0
Post-April group	monthly employment	-147	0.937	-240	-208	0.910
March-May group	summary + monthly empl.	-465*	0.776	-275	-109	0.938

Full March-May group:

	p	ATE_1	ATE_0	ATE_a	$ATE_1 \neq ATE_a$
(A) 2004/05 earnings (admin)	**0.248**	**183.9**	**531.7****	**270.2**	**not sig**

(B) annual earnings (survey)

			$\Delta_{S=1,X} \neq ATE_b$	$ATE_a \neq ATE_b$
$\Delta_{S=1,X}$		273.1		
	allowing for non-response, weighting	819.6	not sig	not sig
ATE_b	allowing for non-response, separate CS	700.4**	not sig	not sig
	ignoring non-response, separate CS	365.6	not sig	not sig
	ignoring non-response, joint CS	377.1	not sig	not sig

Findings – NDLP

Days employed (admin)

	p	Formal	Diverted	ATE_1	Raw	θ raw	OLS	Matching	θ_0
All	30.4	4.0	26.4	-2.2	3.8	1.003	-10.4***	-11.2**	0.914
Scotland	5.3	2.8	2.5	9.6	-75.0***	0.478	-71.1***	-64.2**	0.490
NE Eng	29.2	1.0	28.2	0.0	2.7	1.023	-14.7	-18.8*	0.864
NW Eng	6.2	3.7	2.5	21.1**	38.4*	1.336	31.6*	27.6	1.224
Wales	23.6	3.6	20.1	-16.6	20.3	1.141	-4.9	-7.6	0.955
E Midls	47.1	5.9	41.2	-15.5**	4.9	1.044	-11.1*	-10.7	0.916
London	31.0	4.9	26.1	-3.5	12.9	1.127	-3.4	-6.4	0.947
NW,W,L	23.4	4.3	19.1	-1.9	13.3*	1.117	-2.9	-9.2	0.931

Days employed (admin)

	p	ATE_1	ATE_0	ATE	$ATE_1 \neq ATE$
NW Eng, Wales, London	**0.234**	**-1.9**	**-3.8**	**0.5**	**not sig**
All districts			-2.1	-2.2	not sig
All districts, θ-adjusted	0.304	-2.2	-9.6**	-4.5	*
Scotland			72.1	12.9	not sig
Scotland, θ-adjusted	0.053	9.6	-3.7	8.9	not sig
NE England			5.7	1.7	not sig
NE England, θ-adjusted	0.292	0.0	-11.1	-3.2	not sig
East Midlands			-4.4	-10.3	not sig
East Midlands, θ-adjusted	0.471	-15.5**	-13.7	-14.7**	not sig

Ever employed (admin)

	p	Formal	Diverted	ATE_1	Raw	θ raw	OLS	Matching	θ_0
All	30.4	4.0	26.4	-0.006	0.004	1.009	-0.041***	-0.041**	0.928
Scotland	5.3	2.8	2.5	0.041	-0.130	0.786	-0.063	-0.056	0.895
NE Eng	29.2	1.0	28.2	-0.020	-0.003	0.994	-0.063**	-0.071*	0.880
NW Eng	6.2	3.7	2.5	0.063*	0.165**	1.319	0.130*	0.130	1.242
Wales	23.6	3.6	20.1	-0.044	0.031	1.049	-0.052	-0.038	0.946
E Midls	47.1	5.9	41.2	-0.036	-0.001	0.998	-0.049**	-0.043	0.923
London	31.0	4.9	26.1	0.000	0.046	1.105	-0.026	-0.030	0.942
no NE,EM	23.4	4.3	19.1	0.009	0.033	1.066	-0.018	-0.030	0.947

	p	ATE_1	ATE_0	ATE	$ATE_1 \neq ATE$
All but NE Eng, EMidls	**0.234**	**0.011**	**0.007**	**0.010**	not sig
All districts			0.015	0.000	not sig
All districts, θ-adjusted	0.304	-0.006	-0.010	-0.007	not sig
NE England			0.033	-0.005	not sig
NE England, θ-adjusted	0.292	-0.020	-0.034	-0.024	not sig
East Midlands			0.020	-0.009	**
East Midlands, θ-adjusted	0.471	-0.036	-0.020	-0.028	not sig

Annual earnings (survey)

			$\Delta_{S=1,X} \neq ATE$
$\Delta_{S=1,X}$		788.1***	
	allowing for non-response, weighting	762.1***	not sig
ATE	allowing for non-response, separate CS	708.5***	not sig
	ignoring non-response, separate CS	763.3***	not sig
	ignoring non-response, joint CS	761.8***	not sig

(CIA-0) test in terms of 2004/05 earnings (admin)

	X + history	Raw	θ raw	OLS	Matching	θ_0
Post-April group	summary	210	1.087	-82	-69	0.976
March-May group	summary	323	1.132	-10	52	1.019

Full March-May group:

	p	ATE_1	ATE_0	ATE_a	$ATE_1 \neq ATE_a$
(A) 2004/05 earnings (admin)	**0.320**	**375.9**	**621.8**	**454.7***	**not sig**

(B) annual earnings (survey)

			$\Delta_{S=1,X} \neq ATE_b$	$ATE_a \neq ATE_b$
$\Delta_{S=1,X}$		736.1		
	allowing for non-response, weighting	759.9	not sig	not sig
ATE_b	allowing for non-response, separate CS	566.0	not sig	not sig
	ignoring non-response, separate CS	863.2	not sig	not sig
	ignoring non-response, joint CS	864.2	not sig	not sig

Conclusions

Experiments
- can suffer from randomisation bias
- with admin outcome data offer ways to support non-experimental methods in addressing it

ND25+
- For employment outcomes, experimental set-up qualified conclusions from non-experimental methods in a way which was consistent throughout:
  Non-experimental methods $\rightarrow ATE_1$ under-estimates ATE
  Once 'corrected' $\rightarrow ATE_1$ representative of ATE
- Earnings results (gain) appear reliable; again ATE_1 representative of ATE

NDLP
- For employment outcomes, irrespective of correction: a zero (negative for E Midls durations) ATE_1 representative of ATE
- Earnings results appear reliable; sizeable ATE_1 representative of ATE

$\rightarrow$ ERA experiment does not seem to have suffered from randomisation bias/loss of external validity in terms of year-1 results.