EVALUATING THE ECONOMETRIC EVALUATIONS OF TRAIN ING PROGRAMS USING EXPERIMENTAL DATA

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INTRODUCTION

- Econometricians intend their empirical studies to reproduce the results of experiments that use random assignment without incurring their costs
- One way, then, to evaluate econometric methods is to compare them against experimentally determined results
- This paper undertakes such a comparison and suggests the means by which econometric analyses of employment and training programs may be evaluated
  - This paper compares the results from a field experiment, where individuals were randomly assigned to participate in a training program, against the array of estimates that an econometrician without experimental data might have produced
- **Goal:** to appraise the likely ability of several econometric methods to accurately assess the economic benefits of employment and training programs

I. THE EXPERIMENTAL ESTIMATES

- The National Supported Work Demonstration (NSW)
  - a temporary employment program designed to help disadvantaged workers lacking basic job skills move into the labor market by giving them word experience and counseling in a sheltered environment
  - assigned qualified applicants to training positions randomly
  - those assigned to the treatment group receive all the benefits of the NSW program, while those assigned to the control group were left to fend for themselves
- MDRC operated the NSW program in ten sites across the US
  - MDRC admitted into the program AFDC women, ex-drug addicts, ex-criminal offenders, and high school dropouts
  - For those assigned to the treatment group, the program guaranteed a job for 9 to 18 months, depending on the target group and site
  - The NSW program paid the treatment group members for their work

I. THE EXPERIMENTAL ESTIMATES

TABLE 1—THE SAMPLE MEANS AND STANDARD DEVIATIONS OF PRE-TRAINING EARNINGS AND OTHER CHARACTERISTICS FOR THE NSW AFDC AND MALE PARTICIPANTS

	Full National Supported Work Sample			
	AFDC Participants		Male Participants	
Variable	Treatments	Controls	Treatments	Controls
Age	33.37	33.63	24.49	23.99
	(7.43)	(7.18)	(6.58)	(6.54)
Years of School	10.30	10.27	10.17	10.17
	(1.92)	(2.00)	(1.75)	(1.76)
Proportion	.70	.69	.79	.80
High School Dropouts	(.46)	(.46)	(.41)	(.40)
Proportion Married	.02	.04	.14	.13
	(.15)	(.20)	(.35)	(.35)
Proportion Black	.84	.82	.76	.75
	(.37)	(.39)	(.43)	(.43)
Proportion Hispanic	.12	.13	.12	.14
	(.32)	(.33)	(.33)	(.35)
Real Earnings	$393	$395	1472	1558
1 year Before	(1,203)	(1,149)	(2656)	(2961)
Training	[43]	[41]	[58]	[63]
Real Earnings	$854	$894	2860	3030
2 years Before	(2,087)	(2,240)	(4729)	(5293)
Training	[74]	[79]	[104]	[113]
Hours Worked	90	92	278	274
1 year Before	(251)	(253)	(466)	(458)
Training	[9]	[9]	[10]	[10]
Hours Worked	186	188	458	469
2 years Before	(434)	(450)	(654)	(689)
Training	[15]	[16]	[14]	[15]
Month of Assignment	−12.26	−12.30	−16.08	−15.91
(Jan. 78 = 0)	(4.30)	(4.23)	(5.97)	(5.89)
Number of Observations	800	802	2083	2193

Note: The numbers shown in parentheses are the standard deviations and those in the square brackets are the standard errors.

- MDRC collected earnings and demographic data from both the treatment and the control group members at the baseline and every nine months thereafter, conducting up to four post-baseline interviews.
- Table 1 presents some sample statistics describing the baseline characteristics of the AFDC treatment and control groups as well as those of the male NSW participants in the other three target groups.
- As would be expected from random assignment, the means of the characteristics and pretraining hours and earnings of the experimental groups are nearly the same.

I. THE EXPERIMENTAL ESTIMATES

Year	Treatments	Controls
1975	$895	$877
	(81)	(90)
1976	$1,794	$646
	(99)	(63)
1977	$6,143	$1,518
	(140)	(112)
1978	$4,526	$2,885
	(270)	(244)
1979	$4,670	$3,819
	(226)	(208)
Number of Observations	600	585

Table 2

Year	Treatments	Controls
1975	$3,066	$3,027
	(283)	(252)
1976	$4,035	$2,121
	(215)	(163)
1977	$6,335	$3,403
	(376)	(228)
1978	$5,976	$5,090
	(402)	(227)
Number of Observations	297	425

Table 3

- The first two columns of Tables 2 and 3 present the annual earnings of the treatment and control group members.
- The earnings of the experimental groups were the same in the pre-training year 1975, diverged during the employment program, and converged to some extent after the program ended.
- The post-training year was 1979 for the AFDC females and 1978 for the males.

I. THE EXPERIMENTAL ESTIMATES

TABLE 4—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW AFDC PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–79 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Adjusted[c] (3)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1979 Unadjusted (4)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1979 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons: Without Age (6)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons: With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79: Unadjusted (8)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79: Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings: Without AFDC (10)	Controlling for All Observed Variables and Pre-Training Earnings: With AFDC (11)
Controls	2,942 (220)	−17 (122)	−22 (122)	851 (307)	861 (306)	833 (323)	883 (323)	843 (308)	864 (306)	854 (312)	–

TABLE 5—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW MALE PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–78 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Adjusted[c] (3)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1978 Unadjusted (4)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1978 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–78 Treatments Less Comparisons: Without Age (6)	Difference in Differences: Difference in Earnings Growth 1975–78 Treatments Less Comparisons: With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–78: Unadjusted (8)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–78: Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings (10)
Controls	$2,063 (325)	$39 (383)	$−21 (378)	$886 (476)	$798 (472)	$847 (560)	$856 (558)	$897 (467)	$802 (467)	$662 (506)

- Columns 2 and 3 in the first row of Tables 4 and 5 show that both the unadjusted and regression-adjusted pre-training earnings of the two sets of treatment and control group members are essentially identical.
- Therefore, because of the NSW program's experimental design, the difference between the post-training earnings of the experimental groups is an unbiased estimator of the training effect, and the other estimators described in columns 5-10(11) are unbiased estimators as well.

II. NON-EXPERIMENTAL METHOD

- **The reason for using non-experimental method in training effect**:
  - the difference between the trainees' pre- and post-training earnings was a poor estimate of the training effect.
- **Goal**:
  - estimate the earnings of the trainees not participated in the program
- **The difference compared to experimental training effect**:
  - depend on the way that the earnings and participation equations are specified
- **If there is a significant difference between the nonexperimental and the experimental estimates, the econometric model is misspecified.**

III. ONE-STEP ESTIMATES

Year	Treat-ments	Controls	Comparison Group[a,b]							
			PSID-1	*PSID*-2	*PSID*-3	*PSID*-4	*CPS-SSA*-1	*CPS-SSA*-2	*CPS-SSA*-3	*CPS-SSA*-4
1975	$895	$877	7,303	2,327	937	6,654	7,788	3,748	4,575	2,049
	(81)	(90)	(317)	(286)	(189)	(428)	(63)	(250)	(135)	(333)
1976	$1,794	$646	7,442	2,697	665	6,770	8,547	4,774	3,800	2,036
	(99)	(63)	(327)	(317)	(157)	(463)	(65)	(302)	(128)	(337)
1977	$6,143	$1,518	7,983	3,219	891	7,213	8,562	4,851	5,277	2,844
	(140)	(112)	(335)	(376)	(229)	(484)	(68)	(317)	(153)	(450)
1978	$4,526	$2,885	8,146	3,636	1,631	7,564	8,518	5,343	5,665	3,700
	(270)	(244)	(339)	(421)	(381)	(480)	(72)	(365)	(166)	(593)
1979	$4,670	$3,819	8,016	3,569	1,602	7,482	8,023	5,343	5,782	3,733
	(226)	(208)	(334)	(381)	(334)	(462)	(73)	(371)	(170)	(543)
Number of Observations	600	585	595	173	118	255	11,132	241	1,594	87

Year	Treatments	Controls	Comparison Group[a,b]					
			PSID-1	*PSID*-2	*PSID*-3	*CPS-SSA*-1	*CPS-SSA*-2	*CPS-SSA*-3
1975	$3,066	$3,027	19,056[a]	7,569	2,611	13,650	7,387	2,729
	(283)	(252)	(272)	(568)	(492)	(73)	(206)	(197)
1976	$4,035	$2,121	20,267	6,152	3,191	14,579	6,390	3,863
	(215)	(163)	(296)	(601)	(609)	(75)	(187)	(267)
1977	$6,335	$3,403	20,898	7,985	3,981	15,046	9,305	6,399
	(376)	(228)	(296)	(621)	(594)	(76)	(225)	(398)
1978	$5,976	$5,090	21,542	9,996	5,279	14,846	10,071	7,277
	(402)	(227)	(311)	(703)	(686)	(76)	(241)	(431)
Number of Observations	297	425	2,493	253	128	15,992	1,283	305

- **Step 1: select a comparison group whose earnings ca n be compared to the earnings of the trainee**
  - Mean annual earnings of female and male comparison gr oups drawn from the **Panel Study of Income Dynam ics (PSID)** and **Westat's Matched Current Populat ion Survey - Social Security Administration File (CPS-SSA)**
  - The PSID-1 and the CPS-SSA-1 groups are **large, stratif ied random samples** from populations of household h eads and households
  - **Smaller and comparison groups**: composed of indivi duals whose characteristics are consistent with some of the eligibility criteria used to admit applicants into the N SW program

III. ONE-STEP ESTIMATES

- **Step2: specify a model of earnings and program participation to adjust for differences between the train ees and comparison group members**
- Equation (1)-(4): conventional model of earnings and program participation

$$(1) \quad y_{it} = \delta D_i + \beta X_{it} + b_i + n_t + \varepsilon_{it}$$

$$(2) \quad \varepsilon_{it} - \rho \varepsilon_{it-1} = \nu_{it}$$

$$(3) \quad d_{is} = y_{is} + \gamma Z_{is} + \eta_{is}$$

$$(4) \quad D_i = 1 \quad \text{if } d_{is} > 0; \quad D_i = 0 \quad \text{if } d_{is} < 0.$$

II. ONE-STEP ESTIMATES

- **Restrictions on the training model**
  - **Common restriction : unobservable in the earnings and participation equations are uncorrelated**
    - → restrictions can be tested provided the nonexperimental data base has sufficient information on the pre- training earnings and demographic characteristics of the trainees and comparison group members
    - **An econometrician is unlikely to take seriously an estimate based on a model that failed one of these specification tests**
      → the results of such tests can often aid the researcher in choosing among alternative estimate
  - **In practice, the available data affect the composition of the comparison groups and the flexibility of the econometric specification**
    - Ex. we cannot evaluate all of the econometric procedures that have been used in the literature, nor can we test all of the econometric specifications analyzed in this paper with the non-experimental data alone

II. ONE-STEP ESTIMATES

TABLE 4—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW AFDC PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

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	2,942	−17	−22	851	861	833	883	843	864	854	–
Controls	(220)	(122)	(122)	(307)	(306)	(323)	(323)	(308)	(306)	(312)	
PSID-1	713	−6,443	−4,882	−3,357	−2,143	3,097	2,657	1746	1,354	1664	2,097
	(210)	(326)	(336)	(403)	(425)	(317)	(333)	(357)	(380)	(409)	(491)
PSID-2	1,242	−1,467	−1,515	1,090	870	2,568	2,392	1,764	1,535	1,826	–
	(314)	(216)	(224)	(468)	(484)	(473)	(481)	(472)	(487)	(537)	
PSID-3	665	−77	−100	3,057	2,915	3,145	3,020	3,070	2,930	2,919	–
	(351)	(202)	(208)	(532)	(543)	(557)	(563)	(531)	(543)	(592)	
PSID-4	928	−5,694	−4,976	−2,822	−2,268	2,883	2,655	1,184	950	1,406	2,146
	(311)	(306)	(323)	(460)	(491)	(417)	(434)	(483)	(503)	(542)	(652)
CPS-SSA-1	233	−6,928	−5,813	−3,363	−2,650	3,578	3,501	1,214	1,127	536	1,041
	(64)	(272)	(309)	(320)	(365)	(280)	(282)	(272)	(309)	(349)	(503)
CPS-SSA-2	1,595	−2,888	−2,332	−683	−240	2,215	2,068	447	620	665	–
	(360)	(204)	(256)	(428)	(536)	(438)	(446)	(468)	(554)	(651)	
CPS-SSA-3	1,207	−3,715	−3,150	−1,122	−812	2,603	2,615	814	784	−99	1,246
	(166)	(226)	(325)	(311)	(452)	(307)	(328)	(305)	(429)	(481)	(720)
CPS-SSA-4	1,684	−1,189	−780	926	756	2,126	1,833	1,222	952	827	–
	(524)	(249)	(283)	(630)	(716)	(654)	(663)	(637)	(717)	(814)	

- **Column4**
  - simple difference of post- and pre- training earnings
- **Column5**
  - Earnings difference **controlling for age, schooling, and race**
- **Column6**
  - Difference between the two nonexperimental groups' pre- and post-training earnings growth
  - Estimator allows for an **unobserved individual fixed effect**
  - The cross-sectional estimator described in column 5 is now biased since the training dummy variable is correlated with the error in the earnings equation
  - To solve the problem: Differencing the earnings equation removes the fixed effect

II. ONE-STEP ESTIMATES

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	2,942	−17	−22	851	861	833	883	843	864	854	–
Controls	(220)	(122)	(122)	(307)	(306)	(323)	(323)	(308)	(306)	(312)	
PSID-1	713	−6,443	−4,882	−3,357	−2,143	3,097	2,657	1746	1,354	1664	2,097
	(210)	(326)	(336)	(403)	(425)	(317)	(333)	(357)	(380)	(409)	(491)
PSID-2	1,242	−1,467	−1,515	1,090	870	2,568	2,392	1,764	1,535	1,826	–
	(314)	(216)	(224)	(468)	(484)	(473)	(481)	(472)	(487)	(537)	
PSID-3	665	−77	−100	3,057	2,915	3,145	3,020	3,070	2,930	2,919	–
	(351)	(202)	(208)	(532)	(543)	(557)	(563)	(531)	(543)	(592)	
PSID-4	928	−5,694	−4,976	−2,822	−2,268	2,883	2,655	1,184	950	1,406	2,146
	(311)	(306)	(323)	(460)	(491)	(417)	(434)	(483)	(503)	(542)	(652)
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	(524)	(249)	(283)	(630)	(716)	(654)	(663)	(637)	(717)	(814)	

- **Column7**
  - The difference between the earnings growth of the two groups controlling for age (control age)
- **Column8**
  - difference between the post-training earnings of the treatment and comparison group members
- **Column9**
  - controls both for pre-training earnings and the demographic variable
  - Difference in differences estimator in columns 6 and 7 is now biased
  - Because training dummy variable is correlated with the transitory component of pre- training earnings

$$(5) \quad y_{it} - y_{is} = \delta D_i + \beta \cdot AGE_i + (\eta_t - \eta_s) + \varepsilon_{it} - \varepsilon_{is}.$$

- **Column 10, 11**
  - the estimates of the training effects controlling for all observed variables

II. ONE-STEP ESTIMATES

- **Non-experimental estimates: sensitive both to the composition of the comparison group and to the econometric procedure**

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	2,942	−17	−22	851	861	833	883	843	864	854	–
Controls	(220)	(122)	(122)	(307)	(306)	(323)	(323)	(308)	(306)	(312)	
PSID-1	713	−6,443	−4,882	−3,357	−2,143	3,097	2,657	1746	1,354	1664	2,097
	(210)	(326)	(336)	(403)	(425)	(317)	(333)	(357)	(380)	(409)	(491)
PSID-2	1,242	−1,467	−1,515	1,090	870	2,568	2,392	1,764	1,535	1,826	–
	(314)	(216)	(224)	(468)	(484)	(473)	(481)	(472)	(487)	(537)	
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PSID-4	928	−5,694	−4,976	−2,822	−2,268	2,883	2,655	1,184	950	1,406	2,146
	(311)	(306)	(323)	(460)	(491)	(417)	(434)	(483)	(503)	(542)	(652)
CPS-SSA-1	233	−6,928	−5,813	−3,363	−2,650	3,578	3,501	1,214	1,127	536	1,041
	(64)	(272)	(309)	(320)	(365)	(280)	(282)	(272)	(309)	(349)	(503)
CPS-SSA-2	1,595	−2,888	−2,332	−683	−240	2,215	2,068	447	620	665	–
	(360)	(204)	(256)	(428)	(536)	(438)	(446)	(468)	(554)	(651)	
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Controls	$2,063	$39	$−21	$886	$798	$847	$856	$897	$802	$662
	(325)	(383)	(378)	(476)	(472)	(560)	(558)	(467)	(467)	(506)
PSID-1	$2,043	−$15,997	−$7,624	−$15,578	−$8,067	$425	−$749	−$2,380	−$2,119	−$1,228
	(237)	(795)	(851)	(913)	(990)	(650)	(692)	(680)	(746)	(896)
PSID-2	$6,071	−$4,503	−$3,669	−$4,020	−$3,482	$484	−$650	−$1,364	−$1,694	−$792
	(637)	(608)	(757)	(781)	(935)	(738)	(850)	(729)	(878)	(1024)
PSID-3	($3,322	($455	$455	$697	−$509	$242	−$1,325	$629	−$552	$397
	(780)	(539)	(704)	(760)	(967)	(884)	(1078)	(757)	(967)	(1103)
CPS-SSA-1	$1,196	−$10,585	−$4,654	−$8,870	−$4,416	$1,714	$195	−$1,543	−$1,102	−$805
	(61)	(539)	(509)	(562)	(557)	(452)	(441)	(426)	(450)	(484)
CPS-SSA-2	$2,684	−$4,321	−$1,824	−$4,095	−$1,675	$226	−$488	−$1,850	−$782	−$319
	(229)	(450)	(535)	(537)	(672)	(539)	(530)	(497)	(621)	(761)
CPS-SSA-3	$4,548	$337	$878	−$1,300	$224	−$1,637	−$1,388	−$1,396	$17	$1,466
	(409)	(343)	(447)	(590)	(766)	(631)	(655)	(582)	(761)	(984)

- Nonexperimental procedures replicate the experimental results more closely **when the nonexperimental data include pre- training e arnings rather than cross-sectional data alone** or **when evaluating female rather than male participants**

II. ONE-STEP ESTIMATES

- **Reject the nonexperimental estimates in columns 4-7 of Table 4 in favor of the ones in columns 8-11.**

TABLE 4—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW AFDC PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–79 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	Pre-Training Year, 1975 Adjusted[c] (3)	Post-Training Year, 1979 Unadjusted (4)	Post-Training Year, 1979 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons: Without Age (6)	With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79: Unadjusted (8)	Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings: Without AFDC (10)	With AFDC (11)
	2,942	−17	−22	851	861	833	883	843	864	854	–
Controls	(220)	(122)	(122)	(307)	(306)	(323)	(323)	(308)	(306)	(312)	
PSID-1	713	−6,443	−4,882	−3,357	−2,143	3,097	2,657	1746	1,354	1664	2,097
	(210)	(326)	(336)	(403)	(425)	(317)	(333)	(357)	(380)	(409)	(491)
PSID-2	1,242	−1,467	−1,515	1,090	870	2,568	2,392	1,764	1,535	1,826	–
	(314)	(216)	(224)	(468)	(484)	(473)	(481)	(472)	(487)	(537)	
PSID-3	665	−77	−100	3,057	2,915	3,145	3,020	3,070	2,930	2,919	–
	(351)	(202)	(208)	(532)	(543)	(557)	(563)	(531)	(543)	(592)	
PSID-4	928	−5,694	−4,976	−2,822	−2,268	2,883	2,655	1,184	950	1,406	2,146
	(311)	(306)	(323)	(460)	(491)	(417)	(434)	(483)	(503)	(542)	(652)
CPS-SSA-1	233	−6,928	−5,813	−3,363	−2,650	3,578	3,501	1,214	1,127	536	1,041
	(64)	(272)	(309)	(320)	(365)	(280)	(282)	(272)	(309)	(349)	(503)
CPS-SSA-2	1,595	−2,888	−2,332	−683	−240	2,215	2,068	447	620	665	–
	(360)	(204)	(256)	(428)	(536)	(438)	(446)	(468)	(554)	(651)	
CPS-SSA-3	1,207	−3,715	−3,150	−1,122	−812	2,603	2,615	814	784	−99	1,246
	(166)	(226)	(325)	(311)	(452)	(307)	(328)	(305)	(429)	(481)	(720)
CPS-SSA-4	1,684	−1,189	−780	926	756	2,126	1,833	1,222	952	827	–
	(524)	(249)	(283)	(630)	(716)	(654)	(663)	(637)	(717)	(814)	

- Based on this specification test, econometricians might reject the n onexperimental estimates in columns 4-7 of Table 4 in favor of the ones in columns 8-11.
- Because, This estimator is not consistent with **the decline in the trainees' pre-training earnings.**

II. ONE-STEP ESTIMATES

- **Reject the nonexperimental estimates**

TABLE 5—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW MALE PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–78 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Adjusted[c] (3)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1978 Unadjusted (4)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1978 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–78 Treatments Less Comparisons: Without Age (6)	Difference in Differences: Difference in Earnings Growth 1975–78 Treatments Less Comparisons: With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–78: Unadjusted (8)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–78: Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings (10)
Controls	$2,063	$39	$−21	$886	$798	$847	$856	$897	$802	$662
	(325)	(383)	(378)	(476)	(472)	(560)	(558)	(467)	(467)	(506)
PSID-1	$2,043	−$15,997	−$7,624	−$15,578	−$8,067	$425	−$749	−$2,380	−$2,119	−$1,228
	(237)	(795)	(851)	(913)	(990)	(650)	(692)	(680)	(746)	(896)
PSID-2	$6,071	−$4,503	−$3,669	−$4,020	−$3,482	$484	−$650	−$1,364	−$1,694	−$792
	(637)	(608)	(757)	(781)	(935)	(738)	(850)	(729)	(878)	(1024)
PSID-3	($3,322	($455	$455	$697	−$509	$242	−$1,325	$629	−$552	$397
	(780)	(539)	(704)	(760)	(967)	(884)	(1078)	(757)	(967)	(1103)
CPS-SSA-1	$1,196	−$10,585	−$4,654	−$8,870	−$4,416	$1,714	$195	−$1,543	−$1,102	−$805
	(61)	(539)	(509)	(562)	(557)	(452)	(441)	(426)	(450)	(484)
CPS-SSA-2	$2,684	−$4,321	−$1,824	−$4,095	−$1,675	$226	−$488	−$1,850	−$782	−$319
	(229)	(450)	(535)	(537)	(672)	(539)	(530)	(497)	(621)	(761)
CPS-SSA-3	$4,548	$337	$878	−$1,300	$224	−$1,637	−$1,388	−$1,396	$17	$1,466
	(409)	(343)	(447)	(590)	(766)	(631)	(655)	(582)	(761)	(984)

TABLE 4—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW AFDC PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–79 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Adjusted[c] (3)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1979 Unadjusted (4)	NSW Treatment Earnings Less Comparison Group Earnings: Post-Training Year, 1979 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons: Without Age (6)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons: With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79: Unadjusted (8)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79: Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings: Without AFDC (10)	Controlling for All Observed Variables and Pre-Training Earnings: With AFDC (11)
Controls	2,942	−17	−22	851	861	833	883	843	864	854	–
	(220)	(122)	(122)	(307)	(306)	(323)	(323)	(308)	(306)	(312)	
PSID-1	713	−6,443	−4,882	−3,357	−2,143	3,097	2,657	1746	1,354	1664	2,097
	(210)	(326)	(336)	(403)	(425)	(317)	(333)	(357)	(380)	(409)	(491)
PSID-2	1,242	−1,467	−1,515	1,090	870	2,568	2,392	1,764	1,535	1,826	–
	(314)	(216)	(224)	(468)	(484)	(473)	(481)	(472)	(487)	(537)	
PSID-3	665	−77	−100	3,057	2,915	3,145	3,020	3,070	2,930	2,919	–
	(351)	(202)	(208)	(532)	(543)	(557)	(563)	(531)	(543)	(592)	
PSID-4	928	−5,694	−4,976	−2,822	−2,268	2,883	2,655	1,184	950	1,406	2,146
	(311)	(306)	(323)	(460)	(491)	(417)	(434)	(483)	(503)	(542)	(652)
CPS-SSA-1	233	−6,928	−5,813	−3,363	−2,650	3,578	3,501	1,214	1,127	536	1,041
	(64)	(272)	(309)	(320)	(365)	(280)	(282)	(272)	(309)	(349)	(503)
CPS-SSA-2	1,595	−2,888	−2,332	−683	−240	2,215	2,068	447	620	665	–
	(360)	(204)	(256)	(428)	(536)	(438)	(446)	(468)	(554)	(651)	
CPS-SSA-3	1,207	−3,715	−3,150	−1,122	−812	2,603	2,615	814	784	−99	1,246
	(166)	(226)	(325)	(311)	(452)	(307)	(328)	(305)	(429)	(481)	(720)
CPS-SSA-4	1,684	−1,189	−780	926	756	2,126	1,833	1,222	952	827	–
	(524)	(249)	(283)	(630)	(716)	(654)	(663)	(637)	(717)	(814)	

- All but one of the difference in differences estimates in column 6 are within one standard error of the experimental estimate.
- Unlikely econometricians would report these estimates

- Even without the experimental data, a researcher would find that the estimated training effect is still sensitive to the set of variables included in the earnings equation and to the composition of the comparison group.

II. ONE-STEP ESTIMATES

- **Without additional data**
  - Without additional data it is difficult to **see how a researcher would choose a training effect** from among estimates
  - Moreover, the nonexperimental data base alone does not allow the econometrician to test whether these estimates are based on econometri c models that adequately control for differences between the earnings of the trainees and comparison group members.
  - In this case, comparisons between the experimental and nonexperimental estimates is the best specification test available.

- **Specification tests that use pre-training earnings data**
  - But! these tests are not themselves always sufficient to identify unreliable estimators

TABLE 4—EARNINGS COMPARISONS AND ESTIMATED TRAINING EFFECTS FOR THE NSW AFDC PARTICIPANTS USING COMPARISON GROUPS FROM THE *PSID* AND THE *CPS-SSA*[a,b]

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–79 (1)	NSW Treatment Earnings Less Comparison Group Earnings: Pre-Training Year, 1975 Unadjusted (2)	Pre-Training Year, 1975 Adjusted[c] (3)	Post-Training Year, 1979 Unadjusted (4)	Post-Training Year, 1979 Adjusted[c] (5)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons Without Age (6)	Difference in Differences: Difference in Earnings Growth 1975–79 Treatments Less Comparisons With Age (7)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79 Unadjusted (8)	Unrestricted Difference in Differences: Quasi Difference in Earnings Growth 1975–79 Adjusted[c] (9)	Controlling for All Observed Variables and Pre-Training Earnings Without AFDC (10)	Controlling for All Observed Variables and Pre-Training Earnings With AFDC (11)
Controls	2,942 (220)	−17 (122)	−22 (122)	851 (307)	861 (306)	833 (323)	883 (323)	843 (308)	864 (306)	854 (312)	–
PSID-1	713 (210)	−6,443 (326)	−4,882 (336)	−3,357 (403)	−2,143 (425)	3,097 (317)	2,657 (333)	1746 (357)	1,354 (380)	1664 (409)	2,097 (491)
PSID-2	1,242 (314)	−1,467 (216)	−1,515 (224)	1,090 (468)	870 (484)	2,568 (473)	2,392 (481)	1,764 (472)	1,535 (487)	1,826 (537)	–
PSID-3	665 (351)	−77 (202)	−100 (208)	3,057 (532)	2,915 (543)	3,145 (557)	3,020 (563)	3,070 (531)	2,930 (543)	2,919 (592)	–
PSID-4	928 (311)	−5,694 (306)	−4,976 (323)	−2,822 (460)	−2,268 (491)	2,883 (417)	2,655 (434)	1,184 (483)	950 (503)	1,406 (542)	2,166 (652)

III. TWO-STEP ESTIMATES

- If the unobservables are correlated, one-step least squares procedures → *Not* consistent estimators!

$$(1) \quad y_{it} = \delta D_i + \beta X_{it} + b_i + n_t + \varepsilon_{it}$$

$$(2) \quad \varepsilon_{it} - \rho \varepsilon_{it-1} = \nu_{it}$$

$$(3) \quad d_{is} = y_{is} + \gamma Z_{is} + \eta_{is}$$

$$(4) \quad D_i = 1 \quad \text{if } d_{is} > 0; \quad D_i = 0 \quad \text{if } d_{is} < 0.$$

Need to solve correlations!

- *Negative* correlations → *High* propensity to participate means *low* earnings → *Underestimation* of training impact

III. TWO-STEP ESTIMATES

- James Heckman (1978) → Two-step estimator controlling for the correlation between unobservables
  - Using the *estimated conditional expectation* of the earnings error as a regressor in the earnings equation

$$(6)\quad E(b_i + \varepsilon_{it} | Z_i, D_i) = \rho\sigma_\varepsilon^2 \left[D_i \frac{\phi(\gamma Z_i)}{1 - \Phi(\gamma Z_i)} - (1 - D_i) \frac{\phi(\gamma Z_i)}{\Phi(\gamma Z_i)} \right] = rH_i,$$

Inverse Mill's Ratio (IMR)

$$(7)\qquad Y_{it} = \delta D_i + \beta X_{it} + rH_i + v_i^*, \quad \rightarrow \textit{Earnings Eq.}$$

  - Where, Z_i is an observed variables vector, ρ is the correlation btw. the unobservables $(\frac{\sigma_{21}}{\sigma_\varepsilon^2})$

III. TWO-STEP ESTIMATES

TABLE 6—ESTIMATED TRAINING EFFECTS USING TWO-STAGE ESTIMATOR

Variables Excluded from the Earnings Equation, but Included in the Participation Equation	Comparison Group	NSW AFDC Females: Heckman Correction for Program Participation Bias, Using Estimate of Conditional Expectation of Earnings Error as Regressor in Earnings Equation — Estimate of Coefficient for: Training Dummy	NSW AFDC Females: Estimate of Expectation	NSW Males: Training Dummy	NSW Males: Estimate of Expectation
Marital Status, Residency in an SMSA, Employment Status in 1976, AFDC Status in 1975, Number of Children	*PSID*-1	1,129	−894	−1,333	−2,357
		(385)	(396)	(820)	(781)
	CPS-SSA-1	1,102	−606	−22	−1,437
		(323)	(480)	(584)	(449)
	NSW Controls	837	−18	899	−835
		(317)	(2376)	(840)	(2601)
Employment Status in 1976, AFDC Status in 1975, Number of Children	*PSID*-1	1,256	−823	–	–
		(405)	(410)		
	CPS-SSA-1	439	−979	–	–
		(333)	(481)		
	NSW Controls	–	–	–	–
Employment Status in 1976, Number of Children	*PSID*-1	1,564	−552	−1,161	−2,655
		(604)	(569)	(864)	(799)
	CPS-SSA-1	552	−902	13	−1,484
		(514)	(551)	(584)	(450)
	NSW Controls	851	147	889	−808
		(318)	(2385)	(841)	(2603)
No Exclusion Restrictions	*PSID*-1	1,747	−526	−667	−2,446
		(620)	(568)	(905)	(806)
	CPS-SSA-1	805	−908	213	−1,364
		(523)	(548)	(588)	(452)
	NSW Controls	861	284	889	−876
		(318)	(2385)	(840)	(2601)

- All of the estimates are nearly identical to the experimental results

e.g., Table 4

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–79 (1)	Pre-Training Year, 1975: Unadjusted (2)	Pre-Training Year, 1975: Adjusted[c] (3)	Post-Training Year, 1979: Unadjusted (4)	Post-Training Year, 1979: Adjusted[c] (5)
Controls	2,942	−17	−22	851	861
	(220)	(122)	(122)	(307)	(306)

Table 5

Name of Comparison Group[d]	Comparison Group Earnings Growth 1975–78 (1)	Pre-Training Year, 1975: Unadjusted (2)	Pre-Training Year, 1975: Adjusted[c] (3)	Post-Training Year, 1978: Unadjusted (4)	Post-Training Year, 1978: Adjusted[c] (5)
Controls	$2,063	$39	$−21	$886	$798
	(325)	(383)	(378)	(476)	(472)

- Uncorrelated unobservables → Estimated participation coefficients = 0 (Statistically)
- Closer to the experimental estimates than one-step estimates

III. TWO-STEP ESTIMATES

TABLE 6—ESTIMATED TRAINING EFFECTS USING TWO-STAGE ESTIMATOR

Variables Excluded from the Earnings Equation, but Included in the Participation Equation	Comparison Group	NSW AFDC Females: Heckman Correction for Program Participation Bias, Using Estimate of Conditional Expectation of Earnings Error as Regressor in Earnings Equation — Estimate of Coefficient for: Training Dummy	NSW AFDC Females: Estimate of Expectation	NSW Males: Training Dummy	NSW Males: Estimate of Expectation
Marital Status, Residency in an SMSA, Employment Status in 1976, AFDC Status in 1975, Number of Children	*PSID*-1	1,129	−894	−1,333	−2,357
		(385)	(396)	(820)	(781)
	CPS-SSA-1	1,102	−606	−22	−1,437
		(323)	(480)	(584)	(449)
	NSW Controls	837	−18	899	−835
		(317)	(2376)	(840)	(2601)
Employment Status in 1976, AFDC Status in 1975, Number of Children	*PSID*-1	1,256	−823	–	–
		(405)	(410)		
	CPS-SSA-1	439	−979	–	–
		(333)	(481)		
	NSW Controls	–	–	–	–
Employment Status in 1976, Number of Children	*PSID*-1	1,564	−552	−1,161	−2,655
		(604)	(569)	(864)	(799)
	CPS-SSA-1	552	−902	13	−1,484
		(514)	(551)	(584)	(450)
	NSW Controls	851	147	889	−808
		(318)	(2385)	(841)	(2603)
No Exclusion Restrictions	*PSID*-1	1,747	−526	−667	−2,446
		(620)	(568)	(905)	(806)
	CPS-SSA-1	805	−908	213	−1,364
		(523)	(548)	(588)	(452)
	NSW Controls	861	284	889	−876
		(318)	(2385)	(840)	(2601)

- Econometric procedure and comparison group selection are all important
  - In case of CPS-SSA-1, the estimates can be differ by as much as $1,308 of PSID-1 case (=1,747-439)
    - Econometrician should choose between a set of estimates that vary by $1,308 w/o appropriate consideration of exclusion restriction
      (e.g., place of residence, prior AFDC status, etc)
- In case of male trainees, two-step estimates are more effective
  - Biases are relatively smaller than one-step estimates
  - Estimate of expectations are significantly different from 0
    - Negative values
  - No evidence for leading econometricians to choose "wrong" estimator according to specification test results

IV. CONCLUSION

- Many of econometric procedures and comparison groups to evaluate employment and training programs can fail to yield accurate or precise estimates
  - The econometric estimates often differ significantly from the experimental results
  - Even when the econometric estimates pass conventional specification tests, they still fail to replicate the experimental results
- Policymakers should be aware of possibilities of including large and unknown biases resulting from specification errors
- Female (Male) participants → Positive (negative) and larger (smaller) than experimental estimates
- Econometric procedures → More likely to replicate the females' result
- Longitudinal data → Reduces the potential specification errors w.r.t. cross-sectional data
- Advantages of two-step procedures