The Returns to Training in a Low Income Labor Market: Evidence from a Field Experiment and Structural Model

Livia Alfonsi [BRAC], Oriana Bandiera [LSE]

Vittorio Bassi [UCL], Robin Burgess [LSE]

Imran Rasul [UCL], Munshi Sulaiman [BRAC], Anna Vitali [BRAC]

December 2016

Motivation

- transition into the labor market marks a key stage in the life cycle
- scarring literature $\Rightarrow$ transition dynamics have persistent impacts
- transition process is shaped by three factors:
  - labor supply: skills of workers
  - labor demand from firms
  - labor market: efficiency of worker-firm matches

This Paper

- experimentally varying worker skills and matching process
- shed light on L^S, matching and L^D sides of the labor market
- L^S and matching:
  - RF: SR impacts on employment, earnings outcomes during transition
  - SF: dynamics and steady state impacts on lifetime earnings
- L^D:
  - SF: firm productivity
  - RF: employment/displacement impacts and competition effects

This Paper

- context: Uganda
- use an RCT to measure causal impacts **on workers** of experimentally varying process of **entry** into the labor market:
- on-the-job-training
- provision of sector-specific vocational training
- matching:
  - matching firms to skilled workers (have received vocational training)
  - matching firms to workers that are willing to work and be trained

Research Questions 1

- how do the impacts on workers of these alternative training/matching routes compare?
- **key outcomes:** verified skills, employment, wages, hours, productivity
- what we learn:
  - comparison of training routes: vocational versus on-the-job
  - LM search costs: finding skilled workers, workers willing to work

Research Questions 2

- so far, followed workers for three years since baseline
- what are the steady **state impacts** of these training/matching routes on workers?
- structurally estimate a job ladder model of worker search: dynamics
- **key mechanisms:** search effort, job offers, wage offer distribution and reservation wages
- feed into IRR calculations of alternative transition routes into the LM

Research Questions 3

- what are the labor demand side responses?
- extend structural model to estimate productivity of firms matched to
- parallel experiment on firm side to measure displacement and competition effects

Related Literature: Training

- WB invested $9bn in 93 skills programs 2002-12, $100mn per project [Blattman and Ralston 2015]
- **high-income** settings: low returns to training [Lalonde 1995, Heckman *et al.* 1999, Burghardt and Schochet 2001, Heckman and Krueger 2003, Blundell *et al.* 2004]
- **middle-income** settings: mixed evidence of returns to such training
  - positive: Card *et al.* 2011, Attanasio *et al.* 2012, (LR: 2015)
  - zero/low: Kluve *et al.* 2014, Groh *et al.* 2015, McKenzie *et al.* 2015, 2016
- our study: extension into **low-income** country setting

Further Innovations

- most studies **combine** vocational and on-the-job training [JTPA in US, YTS in UK]
- **long run** experimental study:
  - Card *et al.* [2015] meta-analysis of 200+ ALMPs, 10% in LICs
- **methodological** innovations:
  - combine RF and SF approaches
  - joint analysis of worker and firm behavior

Context: Firms

- urban labor markets throughout Uganda
- **panel data:** 1714 workers tracked from baseline and two follow-ups
- matched to nationally representative sample of SMEs
  - $L \in [1, 15]$, $\bar{L} = 3$, operating in eight sectors:
  - welding, motor mechanics, construction,..,hairdressing
- [Table 1: The Demand for Skills, Mincerian Returns to Skills]

Table 1: The Demand For Skills, and Mincerian Returns to Skills

		Worker is skilled: reported by firm owner			Work is skilled: self-reported VTI attendance		
	Share of firms in sector	% workers skilled in sector	Coefficient and SE from worker wage regressions [USD]	Coefficient and SE from worker log(wage) regressions [USD]	% workers skilled in sector	Coefficient and SE from worker wage regressions [USD]	Coefficient and SE from worker log(wage) regressions [USD]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All Sectors		**74.4%**	**30.8***** (4.94)	**1.38***** (.086)	**31.1%**	**17.9***** (3.33)	**.521***** (.045)
Motor-mechanics	9.12%	69.6%	31.6***	1.01***	24.2%	17.2*	.303**
			(5.92)	(.205)		(9.81)	(.154)
Plumbing	2.14%	80.4%	38.7***	2.35***	49.1%	64.0***	.722**
			(45.9)	(3.90)		(19.9)	(2.84)
Catering	4.18%	80.0%	-19.9	.638**	40.2%	28.2**	.332***
			(.454)	(.284)		(12.2)	(.109)
Tailoring	10.8%	64.6%	50.9***	2.14***	41.6%	19.4*	.923***
			(10.9)	(.240)		(10.6)	(.184)
Hairdressing	35.8%	73.9%	33.4***	1.35***	29.2%	23.8***	.444***
			(10.3)	(.136)		(6.26)	(.069)
Construction	3.98%	81.85%	18.9	.378	28.8%	12.1	.292*
			(.321)	(.591)		(9.86)	(.171)
Electrical wiring	4.22%	83.3%	64.0***	1.55***	41.9%	28.7***	.489**
			(12.9)	(.417)		(7.99)	(.191)
Welding	9.87%	77.7%	44.7***	1.26***	24.9%	36.3***	.382***
			(9.55)	(.207)		(6.73)	(.085)

Context: Workers

- oversubscription design used for intervention
- targeted to poorest/disadvantaged youth
  - not the kinds of individual that can self-finance VT or OTJ training
- many job training programs target youth [Card *et al.* 2011, Attanasio *et al.* 2012]
- [Table 2: C-group Worker Characteristics and Labor Market Outcomes]

Table 2: Baseline Balance on Labor Market Outcomes

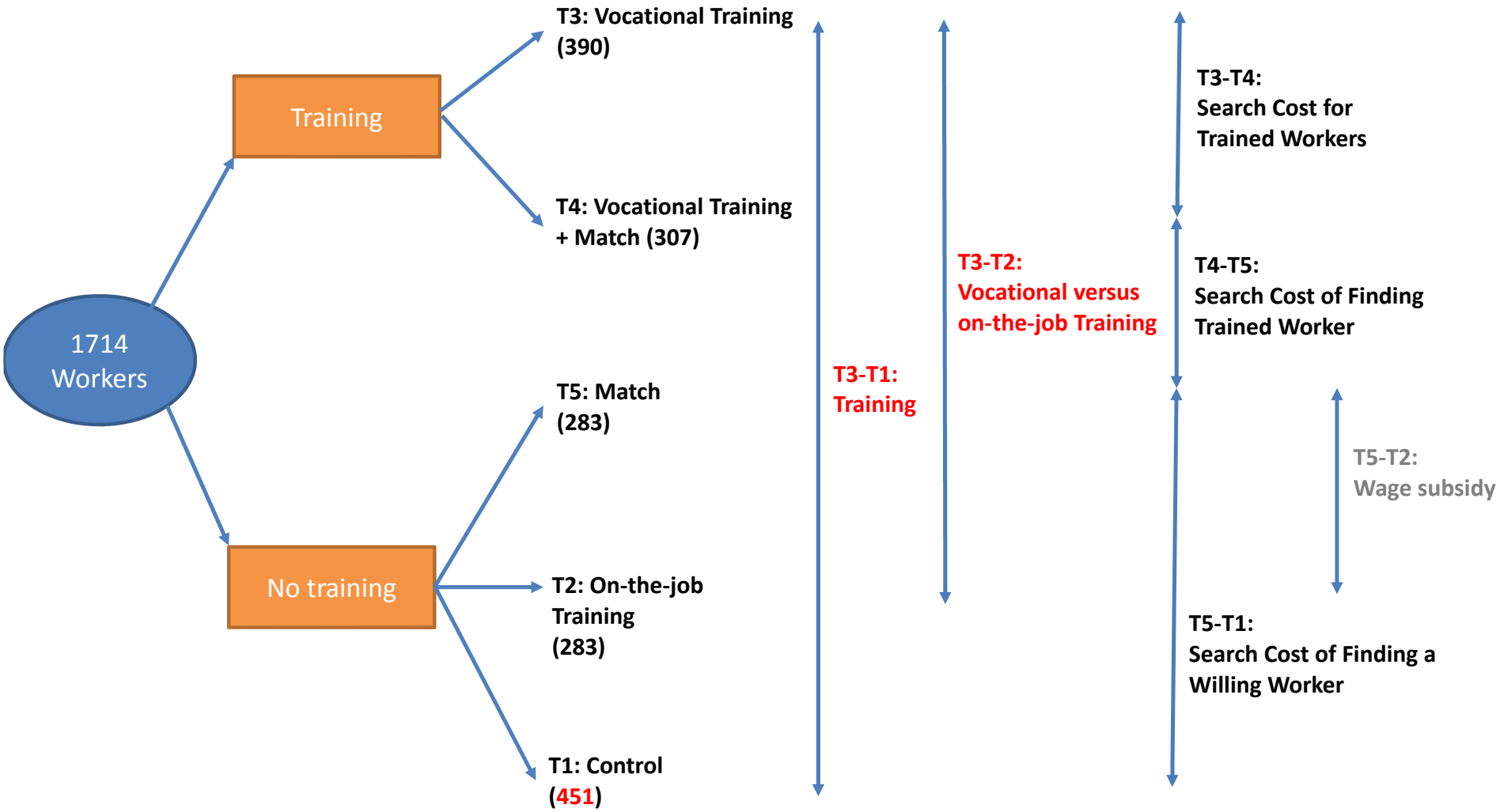
Means, robust standard errors from OLS regressions in parentheses
P-value on t-test of equality of means with control group in brackets
P-value on F-tests in braces

	Number of workers	Currently working	Has worked in the last month	Total earnings in the last month [USD]	F-test of joint significance
	(1)	(2)	(3)	(7)	(8)
T1: Control	451	.381	.401	5.11	
		(.049)	(.048)	(1.27)	
T2: On-the-job Training	283	.369	.387	6.44	{.955}
		(.035)	(.035)	(1.35)	
		[.979]	[.985]	[.239]	
T3: Vocational Training	390	.358	.389	7.29*	{.831}
		(.032)	(.032)	(1.26)	
		[.763]	[.990]	[.063]	
T4: Vocational Training + Match	307	.320	.360	5.25	{.954}
		(.033)	(.034)	(1.20)	
		[.316]	[.747]	[.758]	
T5: Match	283	.364	.367	5.58	{.996}
		(.033)	(.034)	(1.25)	
		[.707]	[.386]	[.713]	
F-test of joint significance		{.882}	{.908}	{.379}	

2.Design

[Figure 1: Summary of Experimental Design]

Figure 1: Experimental Design



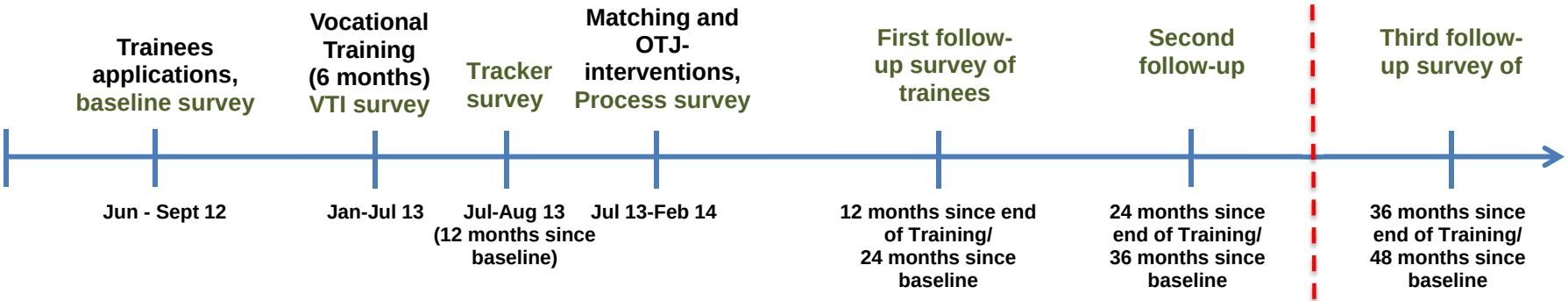
Training in VTIs

- 6 months training: sector specific skills
- in T3 and T4, BRAC covered trainees cost of training, accommodation, food and transportation to VTIs
- total cost: $470 per trainee split as,
  - VTI ($400) + worker's out-of-pocket costs ($70)
- each VTI received 50% of the total one week after training began, remaining 50% 4 months later (for trainees still enrolled)
  - VTIs incentivized to retain trainees, not to find them jobs
  - solve drop out problem associated with many training programs in low-income settings [Blattman and Ralston 2015]

OTJ Training [T2]

- firm paid 120K UGX/month = $50 (for 6 mnths) to hire an untrained worker
- inflexible wage subsidy with designated split: 30K to owner, 90K to worker
  - subsidy rate for unskilled workers (subsidy/average wage): 69% [de Mel *et al.* 2010, SR=50%]
  - untrained worker has to be hired from a matched list [as in T4]
- wage subsidy lasted 6 months, conditional on the trainee remaining in the firm
- BRAC monitored use of wage subsidies
- [Figure 2: Timeline]

Figure 2: Timeline



Timing of Treatments

- workers are observationally equivalent at point of application to VTI
- we present ITT estimates based on random assignment to each treatment at point of application
- VT offered 6 months earlier than OTJ-T and matching treatments
  - ensures workers make transition into labor market at same time
  - selective non-compliance by worker ability
- selection into OTJ-T and match treatments also depends on firm's willingness to accept trainee
  - no such **supply-side selection** for vocational training
  - SM informative of productivity of firms employed at
- [Table A3: Firm Interest and Take-Up]

Table A3: Firm Interest and Worker Take-Up of Treatments

	Vocational Training		On-the-Job Training			Matching		
	% Workers Offered Training	% Workers Who Took Up Training	% Workers Offered Treatment (as firm interested)	% Workers That Met at Least One Firm	% Workers Who Took Up Treatment	% Workers Offered Treatment (as firm interested)	% Workers That Met at Least One Firm	% Workers Who Took Up Treatment
Sample of Workers:	All Workers	Offered Training	All Workers	Offered Treatment	Worker received an offer	All Workers	Offered Treatment	Worker received an offer
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T3: Vocational Training	**96.4**	76.9	-	-	-	-	-	-
T4: Vocational Training + Match	**95.8**	85.4	-	-	-	**48.2**	16.6	15.4
T2: On-the-job Training	-	-	**39.1**	82.8	92.6	-	-	-
T5: Match	-	-	-	-	-	**64.4**	22.4	15.4

Balance and Attrition

- **randomize individuals** to treatment within strata [region (C, N, E, W), gender, education]
- balance on characteristics and labor market outcomes
- 14% attrition rate by 36-month follow-up
- to correct for selective attrition:
  - weight ITT estimates using IPW
  - conditional Lee bounds [Lee 2009]

Estimation

- observe worker i in treatment group d in strata s in survey wave $t = 0, 1, 2$
- estimate the following ANCOVA specification in survey waves $t = 1, 2$:

$$y_{ist} = \sum_j \beta_j T_i + \gamma y_{i0} + \delta \mathbf{x}_{i0} + \lambda_s + \vartheta_{t=2} + u_{ist}$$

- worker i's assigned treatment T_i (j treatments)
- coefficient of interest β_j : ITT estimates (averaged over $t = 1, 2$)
- λ_s: strata fixed effects
- $\vartheta_{t=2} = 1$ if observation is in wave $t = 2$
- randomization at worker level (i): robust standard errors

Spillovers: Size of Labor Markets

- market (sector-region combination): 156 employed workers, 40 firms (initial firm census)
- we matched an average of 8 workers per market (or 5% of total workers) in the matching interventions
- workers are geographically and sectorally mobile
- **implications:**
  - do not expect C-group to be contaminated by treated workers in the same labor market $\longrightarrow$ SUTVA holds
  - but might be spillover effects onto workers *not* in our evaluation sample [GE effects]
- **later exploit parallel experiment:** examine *displacement effects* within firms that hire a treated worker

4.Results: RF Impacts on Skills and Employment

Skills Test

- map productivity impacts to **measurable skills**
- has not been done often in training literature [Ibarran *et al.* 2014, Berniell and de la Mata 2016]
- conducted a (neutral) skills test on workers (incl. C), administered at second follow-up

1. MOTOR-MECHANICS

1	*multiple-choice* What are you advised to do when servicing the engine by changing oil?	A. Top up lubricating oil B. Replace oil filter C. Over hand engine D. Over hand cylinder head **Correct Answer: B**
2	*multiple-choice* What immediate remedy can you give to a vehicle with a problem of excessive tyre wear in the center more than other parts?	A. Increase tyre pressure B. Reduce tyre pressure C. Inflate pressure D. Remove the vehicle tire **Correct Answer: B**
3	*multiple-choice* If a customer reports to you that his/her vehicle charging system works at lower rate, how can you help him?	A. Replacing the charging system B. Adjusting the alternator tension C. Replacing alternator housing D. Renewing wire insulator **Correct Answer: B**
4	*multiple-choice* Which of the following set of systems or component call for mechanical adjustment during general vehicle service?	A. Tyres, cooling system, master cylinder B. Break shoes, alternator, and valve clearance C. Distributor, radiator, propeller shaft D. Tank, crank shaft, Turbo charger **Correct Answer: B**
5	*multiple-choice* What solution would you give a customer with a vehicle engine producing blue smoke?	A. Top up lubricant B. Time the engine C. Replace piston rings D. Remove carbon deposits **Correct Answer: C**
6	*matching* What should you do to stop the following vehicle troubles?	1 Battery over charging — A Leaking fuel tank 2 Engine over heating — B Renew regulator 3 Lubricant leakage — C Reduce oil to the correct level 4 Smoke in exhaust — D Renew piston rings 5 Engine fails to start — E Charge the battery **Correct Answer: 1B, 2A, 3C, 4D, 5E**
7	*order* When changing engine oil, in which order should you perform the following steps?	A. Drain oil through drain plug B. Remove oil filter cup C. Run engine to check leaks D. Fill new oil through filler cup to level E. Remove oil filter F. Warm up the engine **Correct Answer: B, E, A, D, F, C**

Table 3: Skills

OLS regression coefficients, IPW estimates, robust standard errors in parentheses
Lee [2009] Bounds in brackets

	Skills Test			
	Report No Skills	All	45th Quantile	75th Quantile
	(1)	(2)	(3)	(4)
T2: On-the-job Training	-.112**	3.21	2.26	3.37
	(.044)	(2.15)	(2.20)	(3.94)
	[-.095 ; -.078]	[1.46 ; 3.23]		
T3: Vocational Training	-.314***	**8.14*** **	14.5***	8.77***
	(.036)	(1.90)	(1.46)	(2.08)
	[-.303 ; -.259]	[5.93 ; 11.2]		
T4: Vocational Training + Match	-.323***	7.95***	12.8***	7.99***
	(.037)	(2.15)	(1.42)	(2.67)
	[-.283 ; -.264]	[7.88 ; 9.89]		
T5: Match	-.004	1.49	.399	-.543
	(.045)	(2.17)	(1.80)	(2.57)
	[-.049 ; -.003]	[2.65 ; 3.61]		
Mean (SD) Outcome in Control Group	.443	**29.2 (23.5)**		
Control for Baseline Value	No	No	No	No
P-values on tests of equality:				
OTJ Training = Vocational Training	.000***	.023**	.000***	.185
Vocational Training = Vocational Training + Match	.780	.931	.373	.776
N. of observations	1,174	1,174	1,174	1,174

Table 4: Extensive Margin Impacts on Employment

OLS regression coefficients, IPW estimates, robust standard errors in parentheses

Lee [2009] Bounds in brackets

	Has done any paid work in the last month	Has done any wage employment in the last month	Employed at firm they were matched to
	(1)	(2)	(5)
T2: On-the-job Training	.079***	.071**	**.159*** **
	(.030)	(.028)	**(.017)**
	[.075 ; .093]	[.047 ; .067]	**[.149 ; .150]**
T3: Vocational Training	.095***	.058**	
	(.027)	(.025)	N/A
	[.077 ; .123]	[.042 ; .092]	
T4: Vocational Training + Match	.083***	.066**	.005
	(.029)	(.028)	(.005)
	[.085 ; .112]	[.053 ; .085]	[.003 ; .003]
T5: Match	.053*	.025	.005
	(.029)	(.026)	(.004)
	[.040 ; .063]	[.010 ; .027]	[.003 ; .004]
Mean Outcome in Control Group	.396	.260	0
Control for Baseline Value	Yes	Yes	No
P-values on tests of equality:			
OTJ Training = Vocational Training	.606	.642	N/A
Vocational Training = Vocational Training + Match	.692	.771	N/A
N. of observations	2,683	2,683	2,245

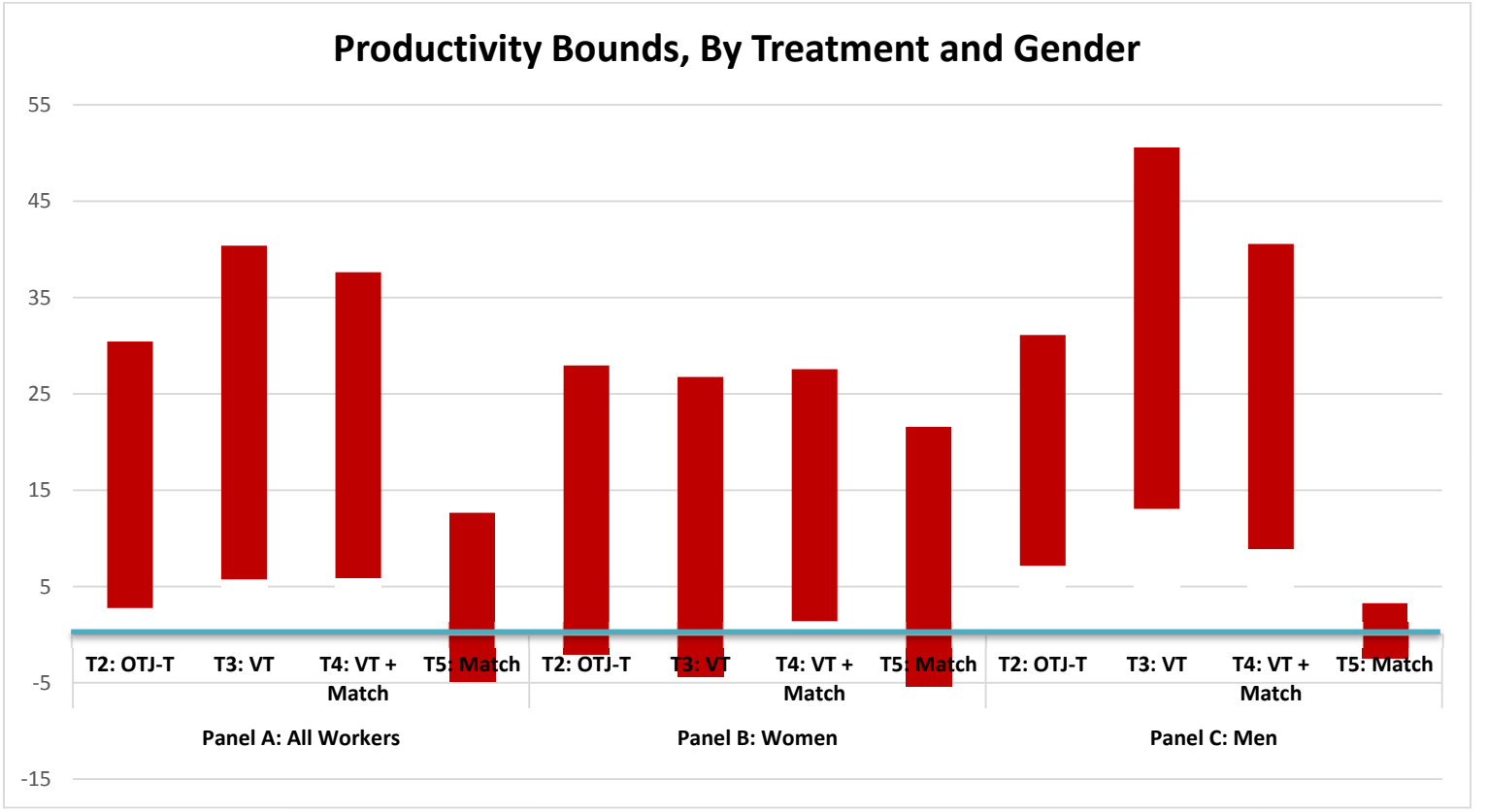
Table 5: Total Effect Impacts on Employment

OLS regression coefficients, IPW estimates, robust standard errors in parentheses
Lee [2009] Bounds in brackets

	Number of hours worked in wage employment in the last week	Number of months worked in the last year	Hourly wage rate [USD]	Total earnings in the last month [USD]
	(1)	(2)	(3)	(4)
T2: On-the-job Training	2.97	.557*	.060*	7.49**
	(1.84)	(.299)	(.032)	(3.56)
	[1.22 ; 2.50]	[.468 ; .681]	[.001 ; .055]	[1.32 ; 9.00]
T3: Vocational Training	3.07*	.944***	.042*	10.2***
	(1.77)	(.269)	(.022)	(3.15)
	[.666 ; 4.47]	[.696 ; 1.30]	[.004 ; .058]	[5.68 ; 12.1]
T4: Vocational Training + Match	4.61**	.600**	.034*	9.28***
	(1.95)	(.299)	(.020)	(3.44)
	[2.95 ; 5.90]	[.616 ; .989]	[.002 ; .040]	[7.43 ; 11.0]
T5: Match	.770	.551*	-.013	1.91
	(1.83)	(.299)	(.019)	(3.16)
	[.120 ; 1.64]	[.249 ; .568]	[-.009 ; -.008]	[-.784 ; 1.88]
Mean Outcome in Control Group	16.4	3.90	.110	30.8
Control for Baseline Value	Yes	No	Yes	Yes
P-values on tests of equality:				
OTJ Training = Vocational Training	.960	.210	.544	.477
Vocational Training = Vocational Training + Match	.460	.270	.714	.799
N. of observations	2,581	2,683	2,556	2,574

Productivity and Composition Effects

- overall treatment impact on earnings combines:
  - employment effect: Δprob(employed)
  - composition effect: Δcomposition of those employed (EM)
  - productivity effect: Δearnings of those employed
- follow Attanasio *et al.* [2011] in estimating **bounds** for the treatment effect on productivity
- [Fig A3, Table A7: Productivity Bounds]


Productivity Bounds, By Treatment and Gender
55
45
35
25
15
5
-5
-15
T2: OTJ-T
T3: VT
T4: VT + Match
T5: Match
T2: OTJ-T
T3: VT
T4: VT + Match
T5: Match
T2: OTJ-T
T3: VT
T4: VT + Match
T5: Match
Panel A: All Workers
Panel B: Women
Panel C: Men

Underlying Market Failure

- with such high returns from training, why do workers not self-invest in their HK?
- credit constraints likely bind in this sample
  - total cost: \$470 per trainee split as VTI (\$400) + out-of-pocket costs (\$70)
  - also prevents workers paying for OTJ (even though no binding min. wage)
- worker beliefs (imperfect information)?
  - individuals are imperfectly informed about returns to skills in low-income labor markets [Jensen 2009, Kaufmann 2014]
  - [later results from SM]

External Validity

- we have documented large impacts of training relative to studies in middle- and high-income countries: **why?**
  - low-income setting [Card et al. 2015]
  - worker selection into evaluation sample
  - treatment intensity
  - VTI quality (interacting with imperfect information of workers)

5.Structural Model of Job Search

Value Added of a Structural Model

- pinpoint mechanisms driving steady state employment impacts:
  - search/likelihood of job offers
  - distribution of offered and accepted wages
  - productivity of firms employed at
- **dynamic impacts** of training routes differ
- input estimated SS impacts into IRR calculations

Auxiliary Assumptions

- standard job ladder model of worker search
- homogenous and risk neutral workers (apart from training/employment status)
- workers are in steady state two by October 2014 (over a year since end of VT)
- firms do not make wage offers to u workers that would be refused

Job Ladder Model of Job Search

- risk neutral workers
- workers can be either trained ($t = 1$) or untrained ($t = 0$)
- at the beginning of each period, a worker can be either employed or unemployed

Value Functions

- value function for an unemployed worker is:

$$V^n(t) = -\phi(c) + \beta[\hat{\lambda}_0(c,t) max\left\{\int V(w,t)d\hat{F}(w|t), V^n(t)\right\} + (1 - \hat{\lambda}_0(c,t))V^n(t)]$$

value function for an employed worker with wage w is:

$$\begin{aligned} V(w,t) = w - \phi(c) + \beta[\delta V^n(t) + \hat{\lambda}_1(c,t) max\left\{\int V(w,t)d\hat{F}(w|t), V(w,t)\right\} \\ + (1 - \delta - \hat{\lambda}_1(c,t))V(w,t)] \end{aligned} \tag{2}$$

Treatments and Job Search

- training can affect worker behavior through two mechanisms:
  - the probabilities of receiving a job offer: ($\lambda_0(c,t)$, $\lambda_1(c,t)$)
  - the distribution of offered wages ($F(w|t)$)
- through these mechanisms training impacts endogenous choices:
  - search effort (c)
  - whether to accept or reject wage offers (reservation wage)
- matching could impact workers through the same mechanisms
- [Table 6: Worker Beliefs and Search]

Table 6: Worker Beliefs and Job Search

OLS regression coefficients, robust standard errors in parentheses
Lee [2009] Bounds in brackets

	Job Offer Probability	Offered Wages			Search Intensity
	Expected probability of finding a job in the next 6 months (0 to 10 scale)	Minimum expected monthly earnings [USD]	Maximum expected monthly earnings [USD]	Average expected monthly earnings (triangular distribution) [USD]	Has actively looked for a job in the last year
	(1)	(2)	(3)	(4)	(5)
T2: On-the-job Training	.617***	-.687	3.95	1.50	-.001
	(.154)	(3.26)	(5.61)	(4.73)	(.030)
	[.388 ; .571]	[-8.75 ; 5.99]	[-4.25 ; 15.0]	[-8.29 ; 9.89]	[-.004 ; .014]
T3: Vocational Training	1.78***	22.6***	42.0***	36.6***	.101***
	(.142)	(3.95)	(6.02)	(5.50)	(.027)
	[1.69 ; 2.07]	[2.00 ; 37.1]	[18.9 ; 70.1]	[13.1 ; 53.7]	[.074 ; .125]
T4: Vocational Training + Match	1.72***	14.3***	35.2***	26.5***	.066**
	(.152)	(3.46)	(6.32)	(5.33)	(.030)
	[1.75 ; 1.96]	[2.27 ; 30.3]	[16.7 ; 62.1]	[10.8 ; 46.2]	[.073 ; .102]
T5: Match	-.118	1.07	1.59	-1.78	-.041
	(.144)	(3.33)	(5.33)	(4.72)	(.030)
	[-.250 ; -.116]	[1.55 ; 1.52]	[-.978 ; 4.23]	[-5.67 ; 3.30]	[-.060 ; -.028]
Mean Outcome in Control Group	4.01	43.5	79.7	60.5	.420
Control for Baseline Value	Yes	Yes	Yes	Yes	No
P-values on tests of equality:					
OTJ Training = Vocational Training	.000***	.000***	.000***	.000***	.001***
Vocational Training = Vocational Training + Match	.719	.044**	.330	.097*	.239
N. of observations	2,581	1,964	1,975	1,691	2,682

Two Simplifications

- ignore search effort, so $c = \phi(c) = 0$
- workers have correct beliefs: $\hat{\lambda}_i(t) = \lambda_i(t)$ and $\hat{F}(w|t) = F(w|t)$ $i \in \{0, 1\}$
- implication: $\lambda_i(t)$ combines worker's search effort and other firm's search effort $\longrightarrow$ job offers

Accepted Versus Offered Wage Distributions

- cross sectional distribution of **job values/accepted offers among employed**, $G(.)$, differs from the offer sampling distribution $F(.)$
- $G(.)$ is readily observed in the data; $F(.)$ is not
- given u in SS, we can derive SS relationship between $F(w)$ and $G(w)$:

$$\frac{F(w) - G(w)}{(1 - F(w))G(w)} = \frac{\lambda_1}{\delta} = \kappa_1 \tag{3}$$

- G FOSD F unless if no J-J transitions $\Rightarrow \lambda_1 = 0$ and $F(w) = G(w)$
- κ_1 measures intensity of interfirm competition
  - no. outside offers received before being laid off

7.Structural Model Estimation

[Figure 3: Worker Timeline]

[Table 8: Spell Descriptives]

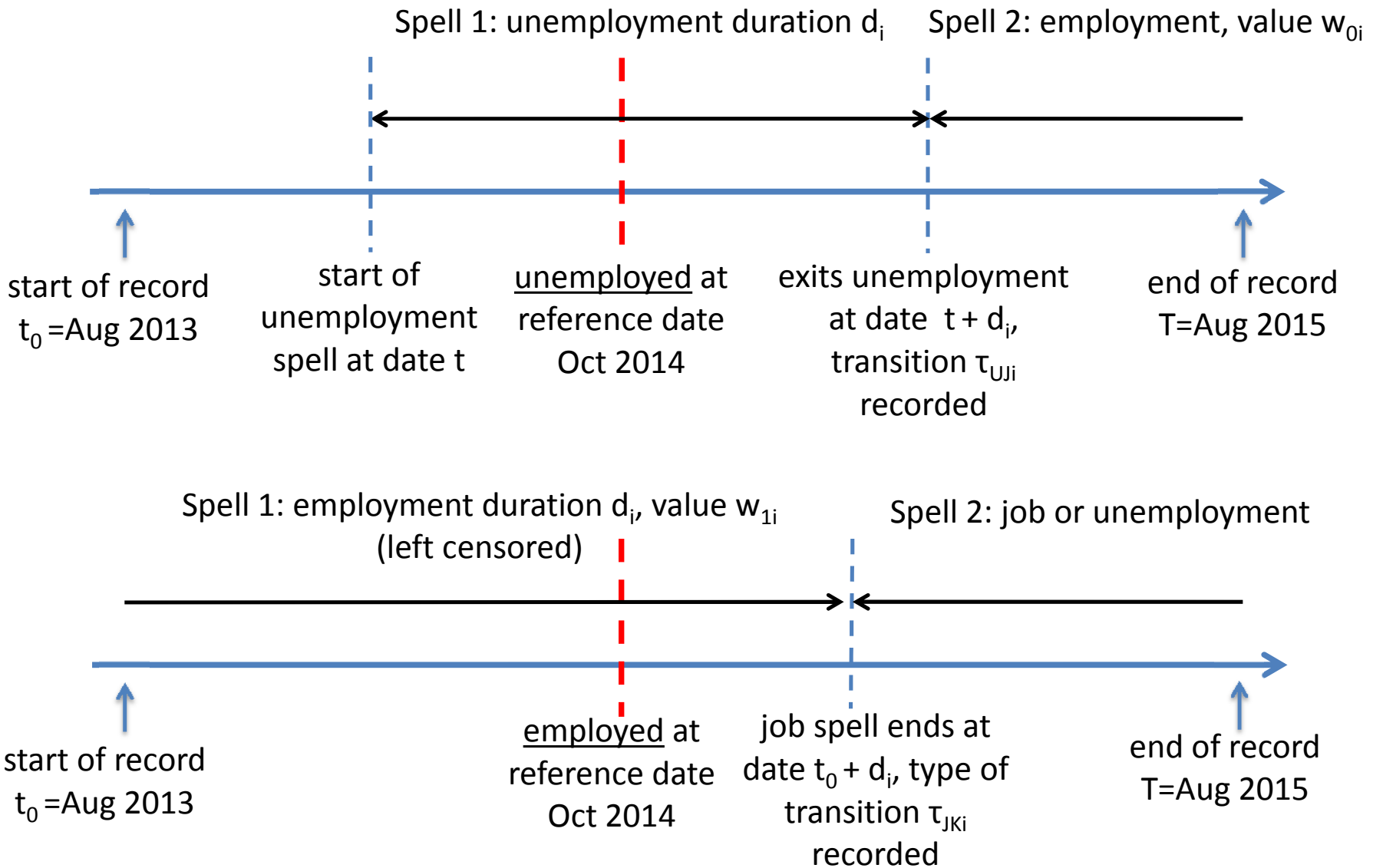
[Table 9: Estimates of the Job Ladder Model]

[Figure 4: G and F Distributions]

Data: Job Spells Format

- construct history of employment status $e_i \in \{0, 1\}$ from t_0 (August 2013: matching/OTJ interventions) to T (June-Sep 15)
- spell durations d_i (left censored at t_0, right censored at T)
- transition indicators between spells: τ_{JU_i}, τ_{JJ_i}, τ_{UJ_i}
- wage: w_i (one per employment spell)
- assume SS has been reached in October 2014
- estimate based on maximum of **two** spells since then to get SS transitions

Figure 3: Worker Spells Data



Estimation

- follow two-step procedure in Bontemps *et al.* [2000]
- **step 1:** $G(.)$ estimated non-parametrically from CDF of observed wages for those employed
- **step 2:** substitute $G(.)$ into $L(\mathbf{x}_i)$ using relationship between $G(.)$ and $F(.)$
  - λ_0, λ_1,δ are estimated, asymptotic se's calculated
- to increase precision:
  - combine C and T5 (match): Control
  - T2: OTJ-T
  - combine T3 and T4: VT

Table 7: Structural Estimates of the Job Ladder Model

Two-step estimation procedure in Bontemps, Robin and van den Berg [2000]

Panel A: Parameter Estimates

Standard error in parentheses

		Control	On-the-job Training	Vocational Training
Job destruction rate (monthy):	δ	.0249	.0253	.0242
		(.0022)	(.0034)	(.0020)
Arrival rate of job offers if UNEMPLOYED (monthly):	λ_0	.0104	.0118	.0145
		(.0009)	(.0016)	(.0012)
Arrival rate of job offers if EMPLOYED (monthly):	λ_1	.0097	.0042	.0078
		(.0034)	(.0032)	(.0028)

Table 7: Structural Estimates of the Job Ladder Model

Two-step estimation procedure in Bontemps, Robin and van den Berg [2000]

Panel A: Parameter Estimates
Standard error in parentheses

		Control	On-the-job Training	Vocational Training
Unemployment Rate	u	.7054	.6819	.6253
Interfirm competition for workers	κ_1	.3896	.1660	.3223

OTJ workers still better off in terms of employment (lower u) than C-group

Relative to counterfactual, reduction in u: **OTJ: 2.35pp (3.3%)**
VT: 8.01pp (11.4%)

Large reductions in SS unemployment from supply-side interventions

Table 7: Structural Estimates of the Job Ladder Model

Two-step estimation procedure in Bontemps, Robin and van den Berg [2000]

Panel B: Function and Income Estimates		Control	On-the-job Training	Vocational Training
Average (sd) monthly OFFERED wage [USD]	*F(.)*	80.5	89.3	88.3
		(86.4)	(89.9)	(94.5)
Average (sd) monthly ACCEPTED wage [USD]	*G(.)*	92.8	95.6	100.2
		(96.6)	(94.4)	(103.6)
Treatment Effect Impact on Annual Income [USD]			**36.9**	**122.4**
% Impact:			**11.3%**	**37.3%**

% impacts on annual earnings far larger than % impacts on Δu alone

Firms

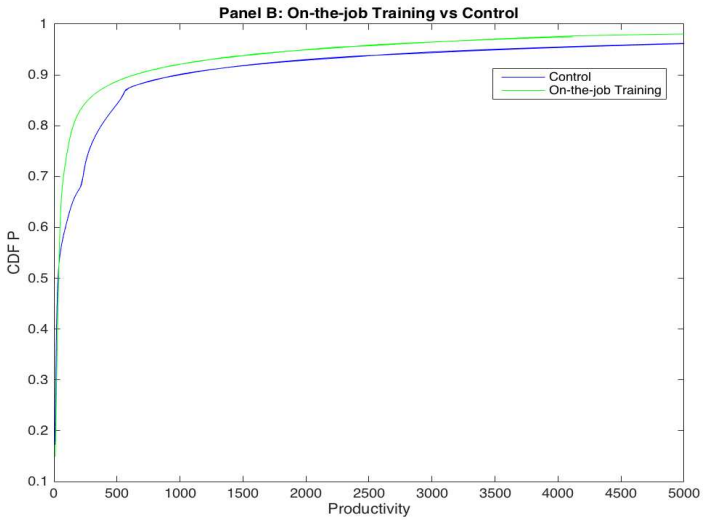
- large difference in SS returns to trained workers: $122 versus $37
- can extend job ladder model to back out distribution of firm productivity that each group of workers matches to
- cannot use RF methods to estimate bounds on firm characteristics worker are matched to
- [Table 7, Panel C: Firm Productivity]

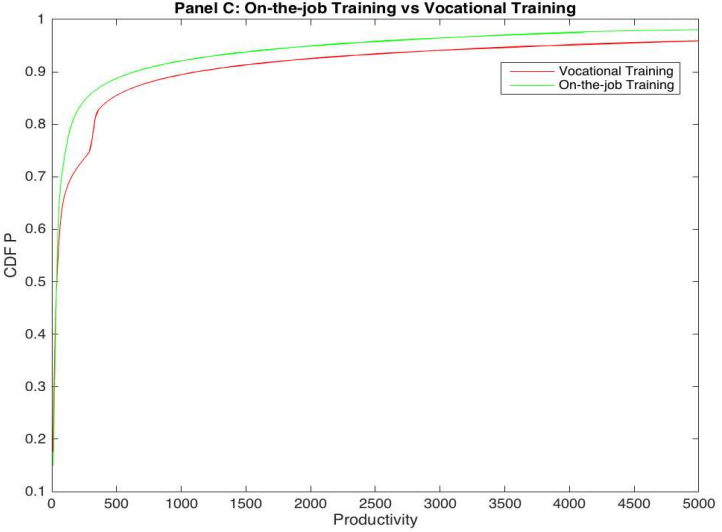
Table 7: Structural Estimates of the Job Ladder Model

Two-step estimation procedure in Bontemps, Robin and van den Berg [2000]

Panel A: Parameter Estimates

Panel C: Firm Productivity Distribution		**Control**	**On-the-job Training**	**Vocational Training**
Average (sd) firm productivity	***P(.)***	645.2	395.7	727.6
		(2152)	(1453)	(2698)
% Impact:			**-39%**	**13%**





Discussion

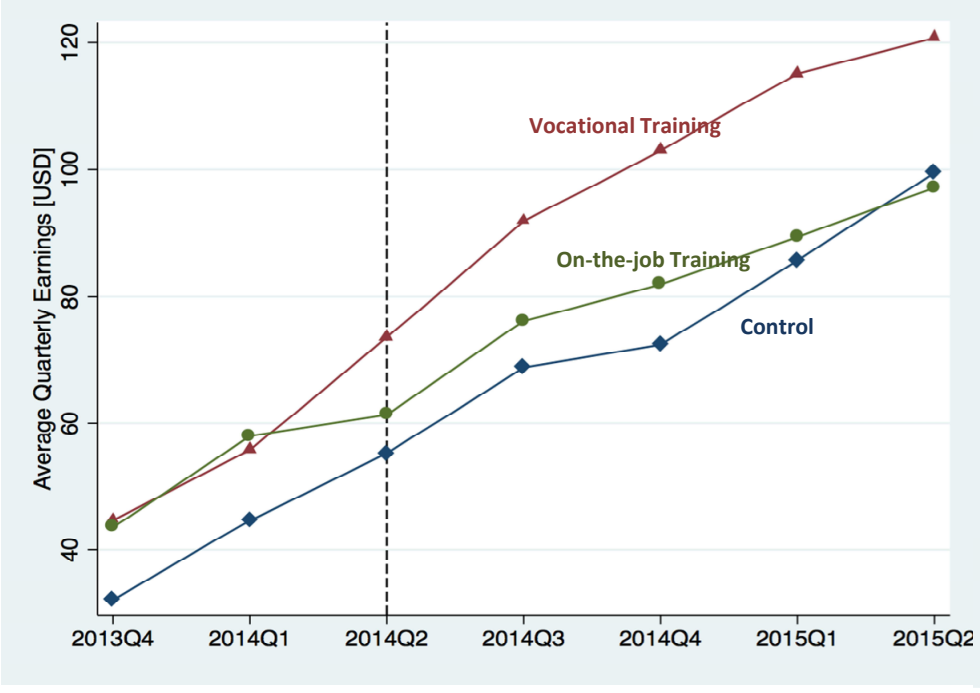
- comparing structural and reduced form impacts
- worker expectations
- IRR

Structural and RF Estimates

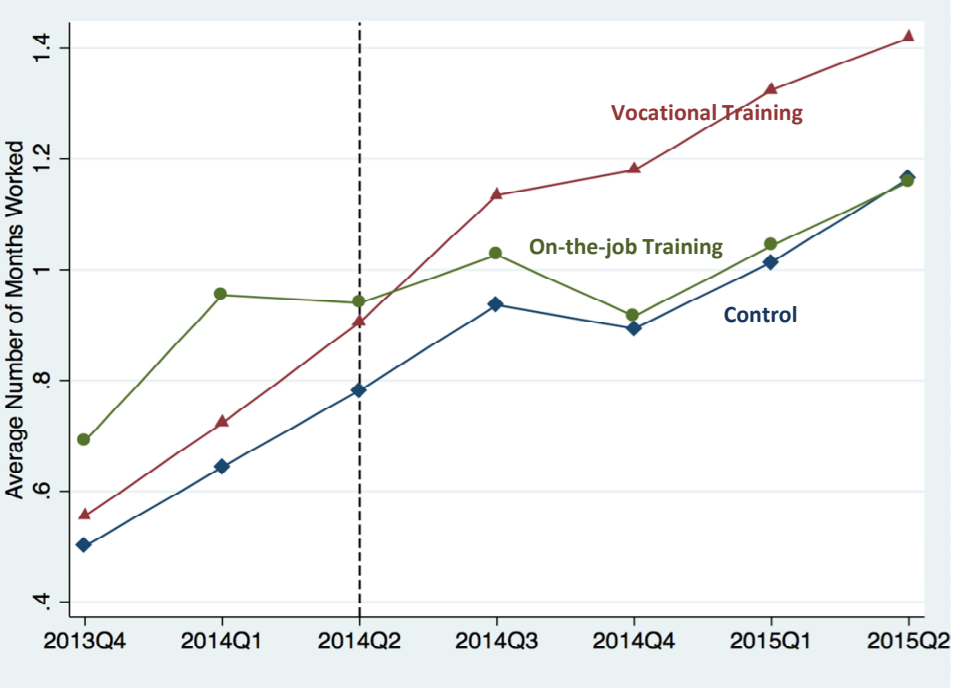
- recall Mincerian returns to VT: (+52%) [Table 1]
- RF earnings impacts: VT (33%), OTJ-T (24%) [Table 5]
  - ability/selection bias
- confirmed using Raven's matrices IQ measure:
  - worker sample: mean (sd) 4.8 (2.3)
  - another sample of workers that self-financed VT: 5.1 (2.1)
- SF-SS earnings impacts: VT (37%), OTJ-T (11%) [Table 7]
  - why do impacts to OTJ-T vary so much across methods?
- [Figure 4: Dynamics]

Figure 4: Average Quarterly Earnings and Months Worked, by Treatment

Panel A: Average Quarterly Earnings



Panel B: Number of Months Worked in Quarter



Notes: Panel A shows for each quarter, the average earnings in the quarter for workers in the control or match group (T1 or T5), those assigned to on-the-job training (T2), and those assigned to receive vocational training (T3 and T4). For those assigned to on-the-job training, this includes the value of the wage subsidy given to them. Panel B shows for each quarter, the average number of months in the quarter that workers in each of these groups is in employment for. For workers assigned to on-the-job training, this includes employment at the firm they are originally matched to. All monetary variables are deflated and expressed in terms of August 2012 prices, using the monthly consumer price index published by the Uganda Bureau of Statistics. Deflated monetary amounts are then converted into August 2012 USD.

Worker Expectations

- can compare worker expectations of returns to training with estimated SS $G(.)$ function (distribution of accepted wages)
- at baseline, workers expect returns to VT to be over 100%
- *overestimate* relative to steady state $G(.)$ for those assigned to VT
  - those assigned to VT converge to $G(.)$
  - those assigned to OTJ-T continue to *underestimate* true returns
- [Table 8: Expectations]

Table 8: Expectations

Columns 1 and 2: Means, standard deviations in parentheses
Column 3: OLS regression coefficients, robust standard errors in parentheses, Lee [2009] Bounds in brackets
All amounts in 2012 USD

	Measured at Baseline		Updated Expectations (Follow-up)	Steady State
	Expected earnings with current skill set (triangular distribution)	Expected earnings if receives VTI Training (triangular distribution)	Expected earnings (triangular distribution) [USD]	Earnings for those assigned to VT (G(.))
	(1)	(2)	(3)	(3)
All Workers (Baseline Interview)	60.2	129.8		
	(53.2)	(184.8)		
T2: On-the-job Training			2.20	95.6
			(4.33)	
			[-9.59 ; 10.8]	
T3 + T4: Vocational Training			33.0***	100.2
			(4.02)	
			[4.08 ; 52.0]	
Mean Outcome in Control Group			62.8	
Control for Baseline Value			Yes	
P-values on tests of equality:				
OTJ Training = Vocational Training			.000***	
N. of observations	1714	1714	1691	

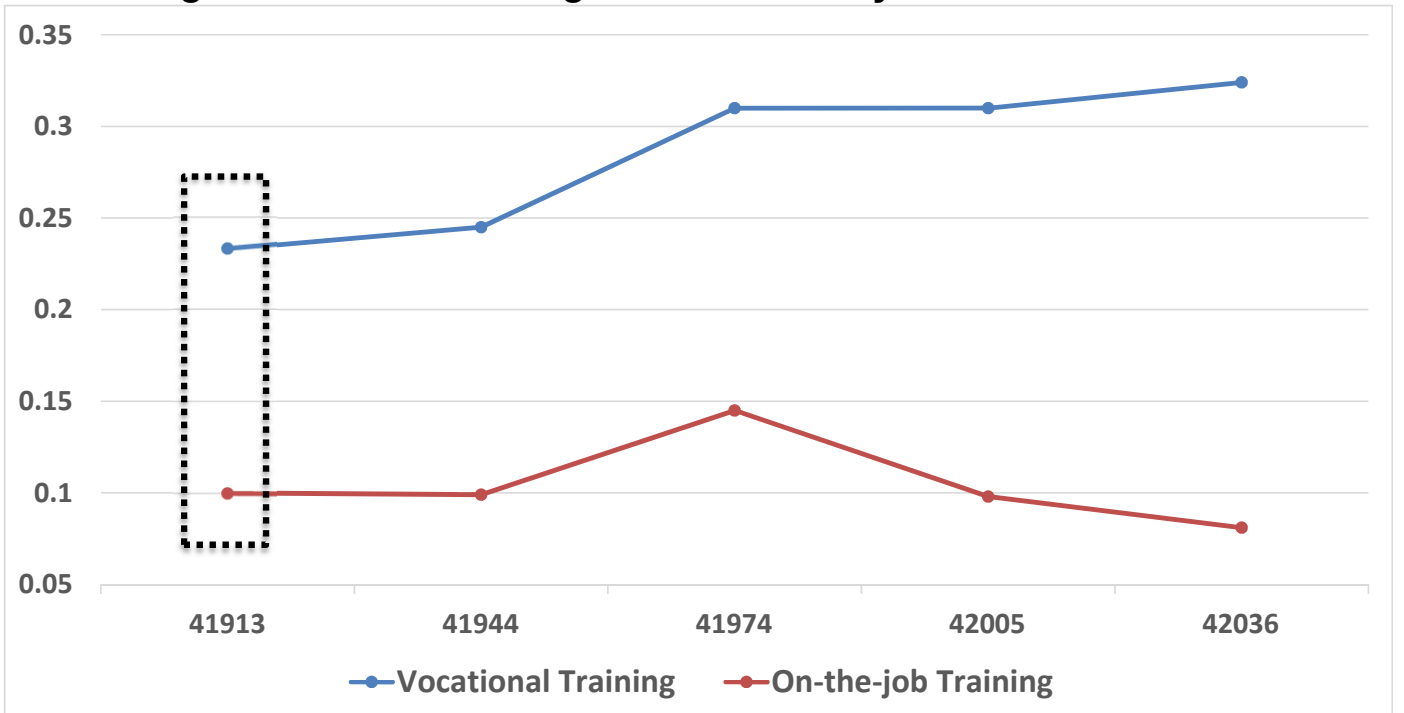
IRR

- IRR challenge versus capital/cash transfers in low-income settings [Blattman and Ralston 2015]
- vocational training cost: \$470 per trainee split as VTI (\$400) + out-of-pocket costs (\$70)
- OTJ training cost: \$50.3 x 6 months = \$302 per trainee
- SS earnings impact 3 times larger for vocational training: \$122 versus \$37
- opportunity costs: foregone earnings while being trained
- [Table 9: IRR]
- [Figure 5: IRR Robustness]

Table 9: Internal Rate of Return to Training

	On-the-job Training	Vocational Training
Panel A. External parameters		
Total cost per individual at year 0 [USD]:	**357**	**525**
(i) Training costs (for 6 months)	302	470
(ii) Program overheads costs	19	19
(iii) Foregone earnings (for 6 months)	36	36
Social discount rate = 5%		
Remaining expected productive life of beneficiaries	38 years	38 years
Panel B. Estimated total earnings benefits		
1 NPV change in total earnings year 1 and beyond-forever (from structural model)	621	2063
2 Benefits/cost ratio	**1.74**	**3.93**
Sensitivity to different discount rates/time horizons		
Social discount rate = 10%	1.00	2.27
3 Internal Rate of Return (IRR)	**0.100**	**0.233**
Panel C. Women		
4 Internal Rate of Return (IRR)	**0.136**	**0.216**
Sensitivity to different expected remaining productive life of beneficiaries		
Remaining expected productive life = 20 years	**0.124**	**0.212**
Remaining expected productive life = 10 years	**0.063**	**0.172**
Panel D. Programme Costs for IRR to equate social discount rate		
5 Total cost per individual at year 0 [USD]	**615**	**1900**
Sensitivity to different discount rates/time horizons		
Social discount rate = 10%	357	1185

Figure 5: IRR Assuming Different Steady State Start Dates



Conclusions

Contributions 1

- extension of training evaluations into low-income country setting
- separating returns to vocational and on-the-job training
  - **why** such large impacts?: setting, workers, treatment intensity
- no evidence of **some** forms of worker-firm match frictions
- long term follow-ups allow us to study steady state impacts

Contributions 2

- use experimental variation to identify a structural model of worker search to pinpoint mechanisms:
- $\lambda_0(OTJ)$ and $\lambda_1(OTJ)$ are low: VT workers move up the job ladder; OTJ-T do not
- important role of firm side heterogeneity in driving impacts:
  - productivity of firms employed at: VT ($+13\%$), OTJ-T (-39%)
- IRR challenge met versus capital/cash transfers [Blattman and Ralston 2015]
- large reductions in unemployment rates: OTJ: 2.35pp (3.3%), VT: 8.01pp (11.4%)
- *if* no displacement $\Rightarrow$ more effective job creation than easing L^d constraints on firm