Labor Markets and Youth Unemployment:

Evidence from a Two-Sided Market Intervention in Uganda

Livia Alfonsi [BRAC], Oriana Bandiera [LSE]

Vittorio Bassi [UCL], Robin Burgess [LSE]

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

March 2017

Institute for Fiscal Studies

UCL

Motivation

- transition into the labor market marks a key stage in the life cycle

- transition dynamics have persistent impacts
    - e.g. youth unemployment spells have long lasting impacts

- transition process is shaped by three factors:
    - supply side: worker skills
    - demand side: employment in firms
    - labor market: efficiency of worker-firm matches

This Paper: Two-Sided Market RCT Design

- context: Uganda

  - skewed age distn, youth unemployment key policy issue

- workers: young entrants into the labor market

- firms: SMEs in eight sectors [manufacturing, services]

- two sided experimental design: T and C workers; T and C firms

- the RCT measures causal impacts **on workers and firms** of experimentally varying:

  - worker skills

  - matching between firms and workers

- sheds light on L^S, matching and L^D sides of the labor market

Treatments

- worker skills intervention:

  - provision of sector-specific vocational training

  - on-the-job-training [apprenticeships]

- worker-firm match interventions:

  - matching firms to skilled workers (have received vocational training)

  - matching firms to untrained workers that have some labor market attachment

Research Questions 1

- how do the impacts on workers of vocational training versus apprenticeships differ?

- **outcomes:** verified skills, employment, wages, hours, productivity

- are there informational frictions in these labor markets?
  - finding workers willing to work, finding skilled workers

Research Questions 2

- tracked workers for four 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

- **key outcomes:** job offer arrival rates (UJ, JJ), reservation wages and wage offer distribution

- feed into IRR calculations of alternative routes into the LM

Research Questions 3

- what are the labor demand side responses?

- two sided experimental design: T and C workers; T and C firms

- firm side experiment allows us to measure impacts of training/matching routes on:

  - displacement of other workers

  - rent-sharing between workers and firms

- supplement IRR calculations to account for social surplus generated by alternative routes

Related Literature: ALMPs

- wide range of active labor market programs: skills, training, apprenticeships, matching etc.

- WB invested $9bn in 93 skills programs 2002-12, $100mn per project [Blattman and Ralston 2015]

- meta-analyses: Card et al. [2015], Blattman and Ralston [2015], McKenzie [2017]

Innovations

- separate returns to vocational (classroom) and on-the-job training (appren-ticeships)

  - theoretically different mechanisms: signalling versus screening, learning

- **methodological** innovation:

  - market experiment: T and C workers; T and C firms

  - joint analysis of both sides of labor market: workers, firms and matching

- **long run** experimental study:

  - steady state impacts

  - feed into IRR

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]

- **panel data:** 1714 workers tracked from baseline and three follow-ups

- [Table 1: C-group Worker Characteristics and Labor Market Outcomes]

Table 1: Baseline Balance on Worker Labor Market Outcomes

Means, robust standard errors from OLS regressions in parentheses

	Number of workers	Currently working	Has worked in the last month	Has done any wage employment in the last month	Any self employment in the last month	Has done any casual work in the last month	Total earnings in the last month [USD]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T1: Control	451	**.381**	**.401**	.192	.047	.225	**5.11**
		(.049)	**(.048)**	(.029)	(.020)	(.046)	**(1.27)**

Context: Firms

- urban labor markets throughout Uganda

- matched to nationally representative sample of 1500 SMEs
  - $L \in [1, 15]$, $\bar{L} = 3$, operating in eight sectors:
  - welding, motor mechanics, construction,..,hairdressing

- [Table 2: The Demand for Skills, Mincerian Returns to Skills]

Table 2: The Mincerian Returns to Vocational Training, by Sector

			Worker 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]
	(1)	(2)	(3)	(4)
All Sectors		**31.0%**	**26.2*****	**.515*****
			(3.15)	**(.045)**
Manufacturing				
Welding	14.57%	24.9%	34.5***	.381***
			(6.40)	(.084)
Motor-mechanics	9.80%	23.5%	16.1*	.294*
			(9.41)	(.153)
Electrical wiring	6.37%	41.9%	27.3***	.486**
			(7.60)	(.189)
Construction	4.38%	28.8%	11.5	.289*
			(9.39)	(.170)
Plumbing	3.08%	49.1%	60.9***	.719**
			(19.0)	(.281)
Services				
Hairdressing	39.64%	29.2%	22.9***	.444***
			(5.97)	(.069)
Tailoring	14.96%	41.6%	15.9	.898***
			(9.76)	(.182)
Catering	7.20%	40.2%	26.8**	.330***
			(11.6)	(.109)

Context: Labor Markets

- OTJ training/apprenticeships common

- opportunity cost of time to firm owners from training

- majority of workers unpaid

- for those receiving wages during training: anchor our treatment design

- [Table 3: On-the-Job Training in this Labor Market Context]

Table 3: Characteristics of On-the-Job Training

A. Availability

Worker received on-the-job training at the current firm	.499
Duration of on-the-job training [months]	10

B. Payments
In the first month of training, the worker:

Was paid	.197
Was unpaid	.513
Was paying the firm owner	.291
Earnings (conditional on > 0) [US$] (median)	39.2 (40.1)
Amount worker was paying to owner (conditional on > 0) [US$] (median)	51.3 (33.3)

C. Trainers
Who was mainly involved in training the worker:

Firm owner only	.459
Other employees only	.091
Firm owner as well as other employees	.451

D. Skills Transferability
Were the skills learnt by the worker during OTJ at this firm:

Useful only in this firm and not useful at all in other firms	.116
Mostly useful in this firm, but also somehow useful in other firms	.231
Useful both in this firm as well as in other firms	.653

2.Design

[Figure 1: Summary of Experimental Design]

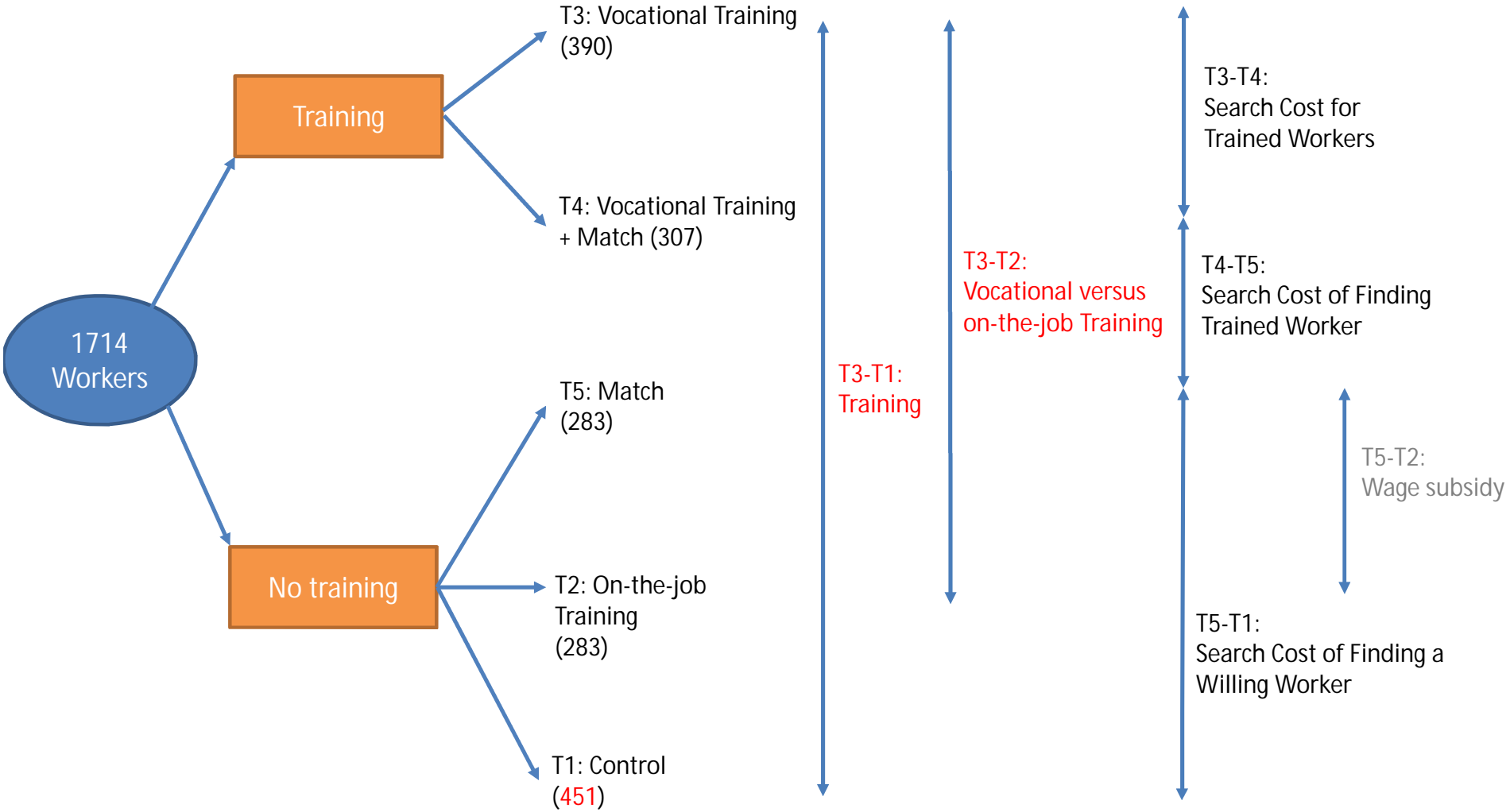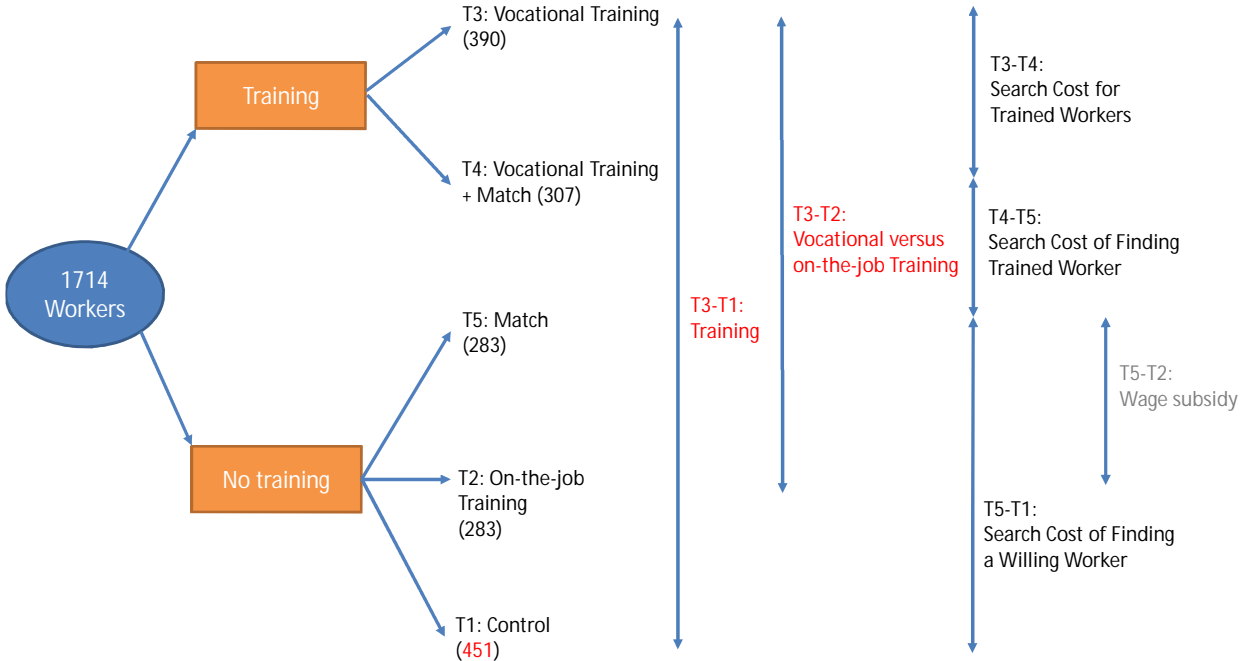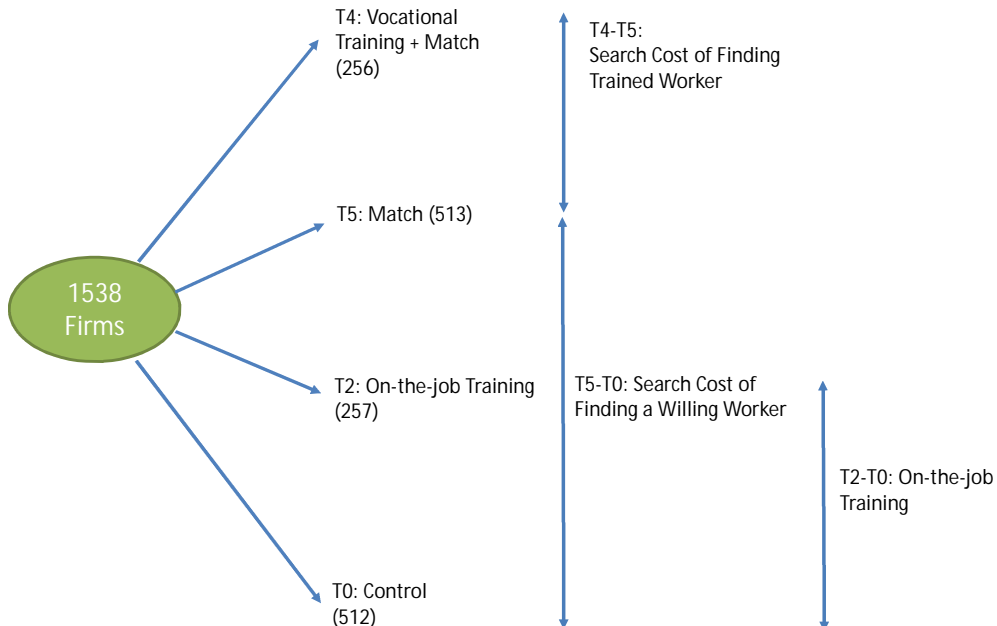# Figure 1: Experimental Design

A. Worker Side Design

Figure 1: Experimental Design

A. Worker Side Design

1714 Workers

Training
- T3: Vocational Training (390)
- T4: Vocational Training + Match (307)

No training
- T5: Match (283)
- T2: On-the-job Training (283)
- T1: Control (451)

T3-T1: Training

T3-T2: Vocational versus on-the-job Training

T3-T4: Search Cost for Trained Workers

T4-T5: Search Cost of Finding Trained Worker

T5-T2: Wage subsidy

T5-T1: Search Cost of Finding a Willing Worker

B. Firm Side Design

1538 Firms

- T4: Vocational Training + Match (256)
- T5: Match (513)
- T2: On-the-job Training (257)
- T0: Control (512)

T4-T5: Search Cost of Finding Trained Worker

T5-T0: Search Cost of Finding a Willing Worker

T2-T0: On-the-job Training

Training in VTIs [T3, T4]

- 6 months sector-specific training

- in T3 and T4, BRAC covered total cost $470 per trainee:

  - 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 months) to hire an untrained worker

- inflexible wage subsidy with designated split: $12.5 to owner, $38 to worker

- two anchors for this split:

- for those reporting to be an apprentice with a wage, mean wage is $39

- wages of unskilled workers

  – 63% of unskilled workers have wages at or below $38

  – subsidy rate for unskilled workers (subsidy/average wage): 63% [de Mel *et al.* 2010, SR=50%]

Wage Subsidy Component of OJT

- wage subsidy lasted 6 months, conditional on the trainee remaining employed in the firm

- monitored use of wage subsidies: BRAC staff conducted checks to ensure:

  - workers hired for at least 6 months [median =6 mnths, average = 6.2 mnths]

  - designated split closely adhered to in T2

Matching Treatments

- workers are those randomized out in oversubscription design

- firms presented lists of workers that are:

  - willing to work and trained [T4]

  - willing to work but untrained [T2, T5] [McKenzie *et al.* 2014, McCasland *et al.* 2015]

- maximum of two workers on a list

- firms knew nature of VT for trained workers, but not told that training had been paid for by BRAC

Vocational versus On-the-Job Training: Worker's Perspective

- screening/employer learning:

  - OTJ training as subsidizing firm's ability to screen worker

  - employer learning [Farber and Gibbons 1996, Altonji and Pierret 2001]

  - apprenticeships as screening technologies [Autor 2001, Hardy and McCasland 2015]

- signaling/certification:

  - VTI trained workers can signal their skills to employers

  - JJ, UJ transitions

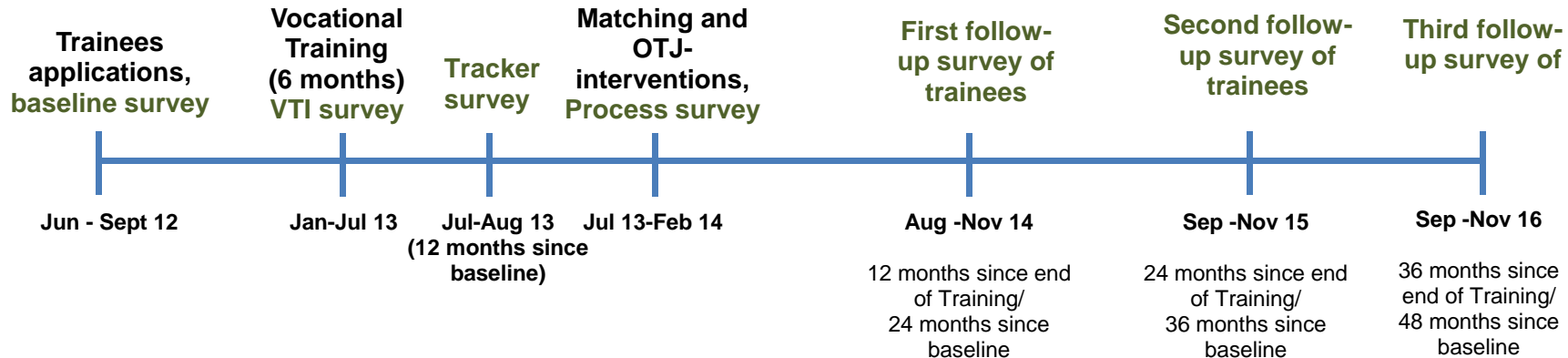 - value of certification [Pallais 2014, MacLeod *et al.* 2016, Bassi and Nansamba 2017]

Vocational versus On-the-Job Training: Firm's Perspective

- incentives for firms to train workers depends on labor market imperfections [Acemoglu and Pischke 1998, 1999]

  – search frictions, signaling

- VT workers more likely to be poached than OTJ $\rightarrow$ tilts to balance towards latter having relatively more firm specific skills

- firms can appropriate more of the returns to worker skills due to labor market imperfections from OTJ trainees

  – monopsony power of firms over worker: wages below MPL

  – further increased if OTJ have relatively more firm specific skills

- RF evidence: skills test, wages, productivity, firm profits

- SM evidence: UJ and JJ transitions

Timeline

- baseline sample: 1714 individuals eligible for training

- follow-up surveys cover period **after** subsidy has expired

  – 24, 36 and 48 (12, 24 and 36) months after baseline (training ends/OTJ placement)

- [Figure 2: Timeline]

Figure 2: Timeline

Trainees applications, baseline survey	Vocational Training (6 months) VTI survey	Tracker survey	Matching and OTJ-interventions, Process survey	First follow-up survey of trainees	Second follow-up survey of trainees	Third follow-up survey of
Jun - Sept 12	Jan-Jul 13	Jul-Aug 13 (12 months since baseline)	Jul 13-Feb 14	Aug -Nov 14	Sep -Nov 15	Sep -Nov 16
				12 months since end of Training/ 24 months since baseline	24 months since end of Training/ 36 months since baseline	36 months since end of Training/ 48 months since baseline

Timing of Treatments 1

- 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

Balance and Attrition

- **randomize individuals** to treatment within strata [region (C, N, E, W), gender, education]

- balance on characteristics and labor market outcomes

- 13% attrition rate by 36-month follow-up

- bias cannot be signed *a priori*

- 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 $t = 0, 1, 2, 3$

- estimate the following ANCOVA specification in survey waves $t = 1, 2, 3$:

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

- worker i's assigned treatment T_i (j treatments)

- λ_s, ϑ_t: strata and survey wave fixed effects (20 strata)

- 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
  - 5% of total workers
  - 7% of new hires (past 3 months: intertemporal substitutes)

- workers are geographically and sectorally mobile

Spillovers: Size of Labor Markets

- **implications:**

  - do not expect C-group to be contaminated by treated workers in the same labor market $\rightarrow$ SUTVA holds

  - but might be spillover effects onto workers *not* in our evaluation sample [GE effects]

- **firm side experiment:** *displacement effects* within firms that hire a treated worker

4. Results: RF Impacts on Skills, 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 and third follow-up

- innovative design to measure firm specific skills (third follow up)

- [Table 4]

- [Figure 3: Tasks]

- [Tables 5 and 6: Employment (Extensive and Total Margins)]

Table A5: General Skills Test for Motor Mechanics

	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?	<table><tr><td>1</td><td>Battery over charging</td><td>A</td><td>Leaking fuel tank</td></tr><tr><td>2</td><td>Engine over heating</td><td>B</td><td>Renew regulator</td></tr><tr><td>3</td><td>Lubricant leakage</td><td>C</td><td>Reduce oil to the correct level</td></tr><tr><td>4</td><td>Smoke in exhaust</td><td>D</td><td>Renew piston rings</td></tr><tr><td>5</td><td>Engine fails to start</td><td>E</td><td>Charge the battery</td></tr></table>	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 4: Skills

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

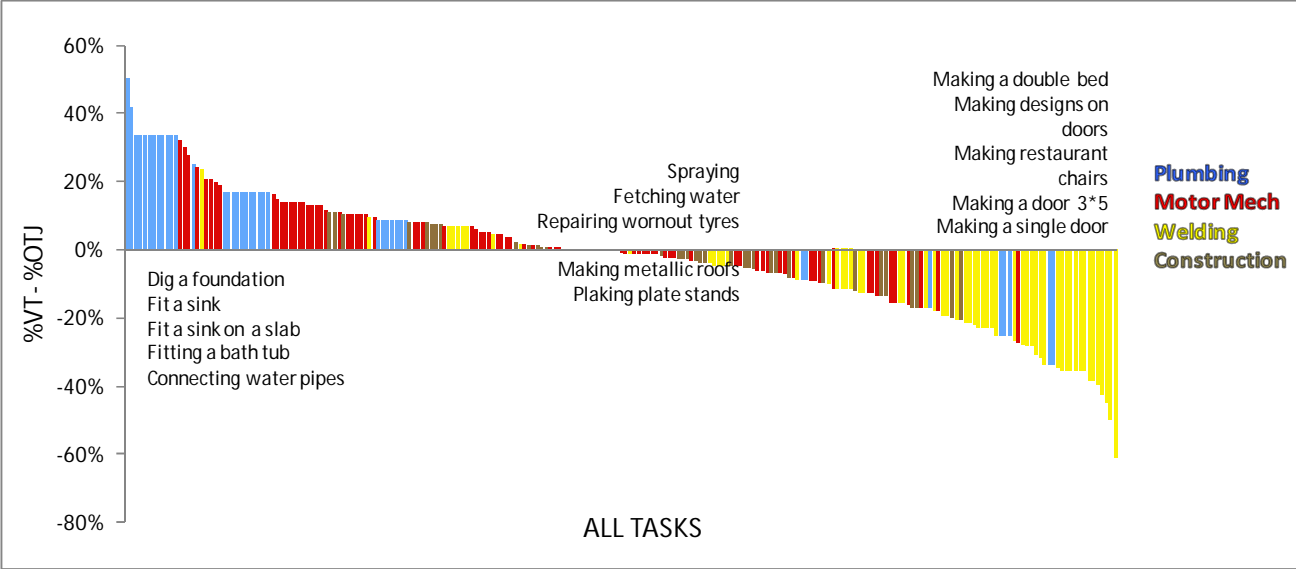|	**General Skills Test**		
	Report No Skills	**ITT**	**ATE: Offered Worker-Firm Match**
	(1)	**(2)**	**(3)**
T2: On-the-job Training	-.105***	1.93	4.05
	(.032)	(1.53)	(3.03)
T3: Vocational Training	-.278***	7.00***	-
	(.026)	(1.34)	-
T4: Vocational Training + Match	-.256***	7.14***	60.5***
	(.029)	(1.57)	(16.1)
T5: Match	-.017	.999	6.93
	(.032)	(1.52)	(9.87)
Mean (SD) Outcome in Control Group	.404	30.1	30.1
Control for Baseline Value	No	No	No
P-values on tests of equality:			
OTJ Training = Vocational Training	.000***	.001***	
OTJ Training = Vocational Training + Match	.000***	.003***	.000***
Vocational Training = Vocational Training + Match	.411	.929	
N. of observations	2,178	2,178	1,663

Table 4: Skills

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

	Firm Specific Skills		On-the-job Training	
	Skills Transferability Across Firms	Interactions with Downstream Suppliers	Received OTJ-T at First Employer	Position in First Job is "Trainee"
	(4)	(5)	(6)	(7)
T2: On-the-job Training	.104	.227*	.142***	.220***
	(.080)	(.127)	(.052)	(.041)
T3: Vocational Training	.170**	-.023	-.009	-.015
	(.069)	(.093)	(.048)	(.029)
T4: Vocational Training + Match	.136*	.189	-.058	-.027
	(.082)	(.123)	(.047)	(.028)
T5: Match	.001	.233**	-.046	-.030
	(.111)	(.118)	(.051)	(.029)
Mean (SD) Outcome in Control Group	0	0	.400	.092
Control for Baseline Value	No	No	No	No
P-values on tests of equality:				
OTJ Training = Vocational Training	.176	.054*	.004***	.000***
OTJ Training = Vocational Training + Match	.581	.807	.000***	.000***
Vocational Training = Vocational Training + Match	.478	.092*	.303	.662
N. of observations	669	669	938	940

Figure 3: Most Common Tasks Performed

Panel B: Manufacturing

%VT - %OTJ (y-axis)

ALL TASKS

Legend:
- **Plumbing**
- **Motor Mech**
- **Welding**
- **Construction**

Labels (left, top values):
Dig a foundation
Fit a sink
Fit a sink on a slab
Fitting a bath tub
Connecting water pipes

Labels (middle, above zero):
Spraying
Fetching water
Repairing wornout tyres

Labels (middle, below zero):
Making metallic roofs
Plaking plate stands

Labels (right, top values):
Making a double bed
Making designs on doors
Making restaurant chairs
Making a door 3*5
Making a single door

Panel C: Services

%VT - %OTJ (y-axis)

ALL TASKS

Legend:
- **Tailoring**
- **Catering**
- **Hairdressing**

Labels (left, top values):
Make a party dress
Make simple dresses
Take measurements
Making peas
Making posho

Labels (middle, above zero):
Pedicure
Hair toning

Labels (middle, below zero):
Make vegetable soup
Make trousers for men

Labels (right, top values):
Repair cuscion cloth
Make a t-shirt
Sewing damaged garment
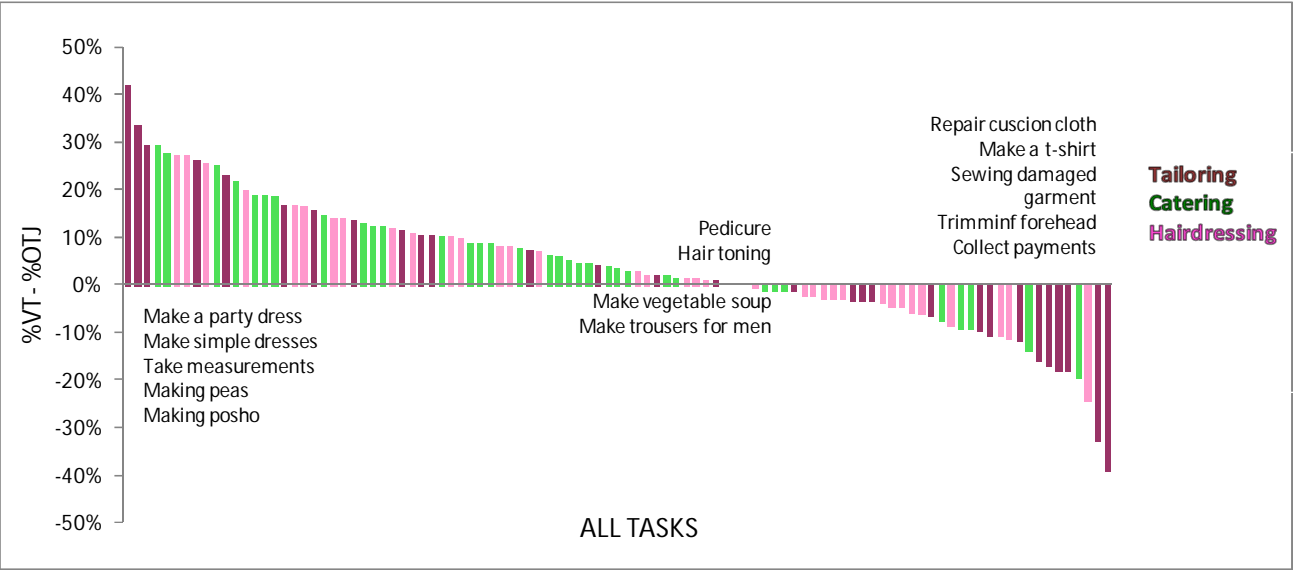Trimminf forehead
Collect payments

Table 5: Extensive Margin Impacts on Employment

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

	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	.065***	.073***	.115***
	(.025)	(.023)	(.012)
T3: Vocational Training	.105***	.071***	N/A
	(.022)	(.021)	
T4: Vocational Training + Match	.071***	.046**	.010**
	(.025)	(.023)	(.004)
T5: Match	.062**	.049**	.007**
	(.025)	(.023)	(.003)
Mean Outcome in Control Group	**.438**	**.271**	.000
Control for Baseline Value	Yes	Yes	No
P-values on tests of equality:			
OTJ Training = Vocational Training	.111	.910	N/A
Vocational Training = Vocational Training + Match	.170	.303	N/A
N. of observations	3,915	3,915	3,126

Table 6: Total Effect Impacts on Employment

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

	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	2.508	.534**	.075***	8.375**
	(1.590)	(.259)	(.025)	(3.500)
T3: Vocational Training	3.241**	1.107***	.065***	15.833***
	(1.493)	(.233)	(.018)	(3.159)
T4: Vocational Training + Match	2.402	.599**	.046***	10.682***
	(1.623)	(.259)	(.018)	(3.314)
T5: Match	2.602	.709***	.014	7.595**
	(1.660)	(.257)	(.017)	(3.386)
Mean Outcome in Control Group	17.6	4.49	.123	39.161
Control for Baseline Value	Yes	No	Yes	Yes
P-values on tests of equality:				
OTJ Training = Vocational Training	.661	.031**	.699	.049**
Vocational Training = Vocational Training + Match	.622	.057*	.342	.184
N. of observations	3,769	3,915	3,726	3,747

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

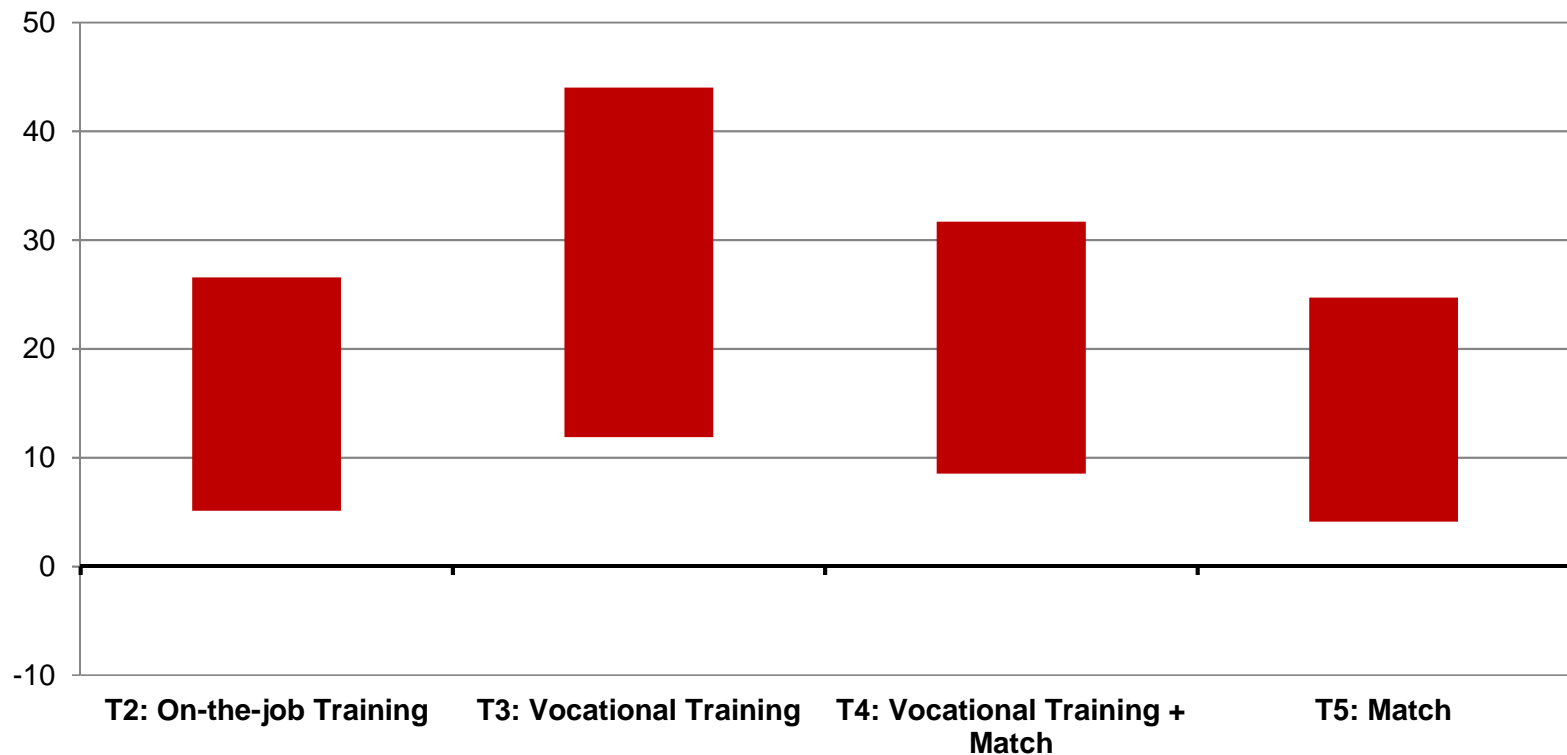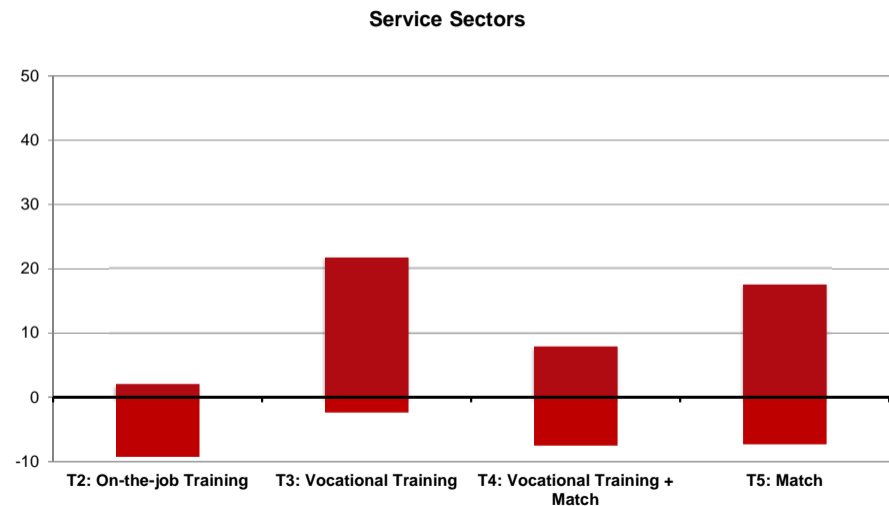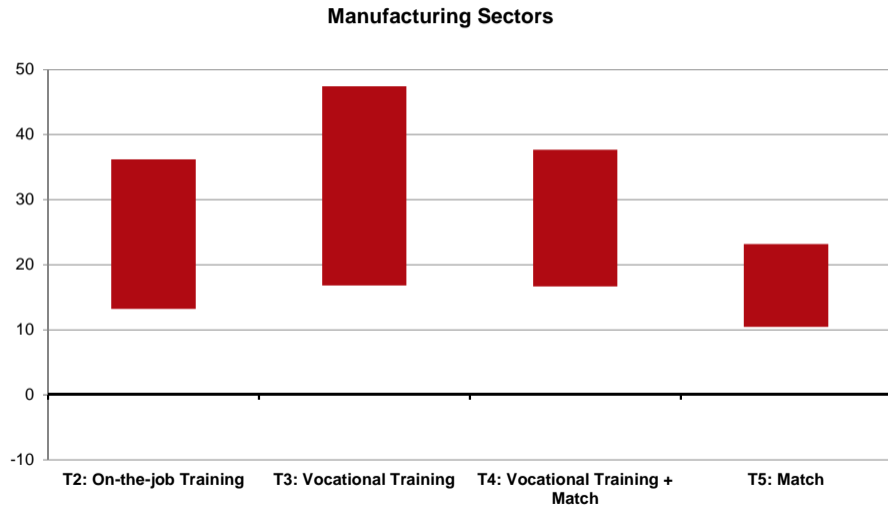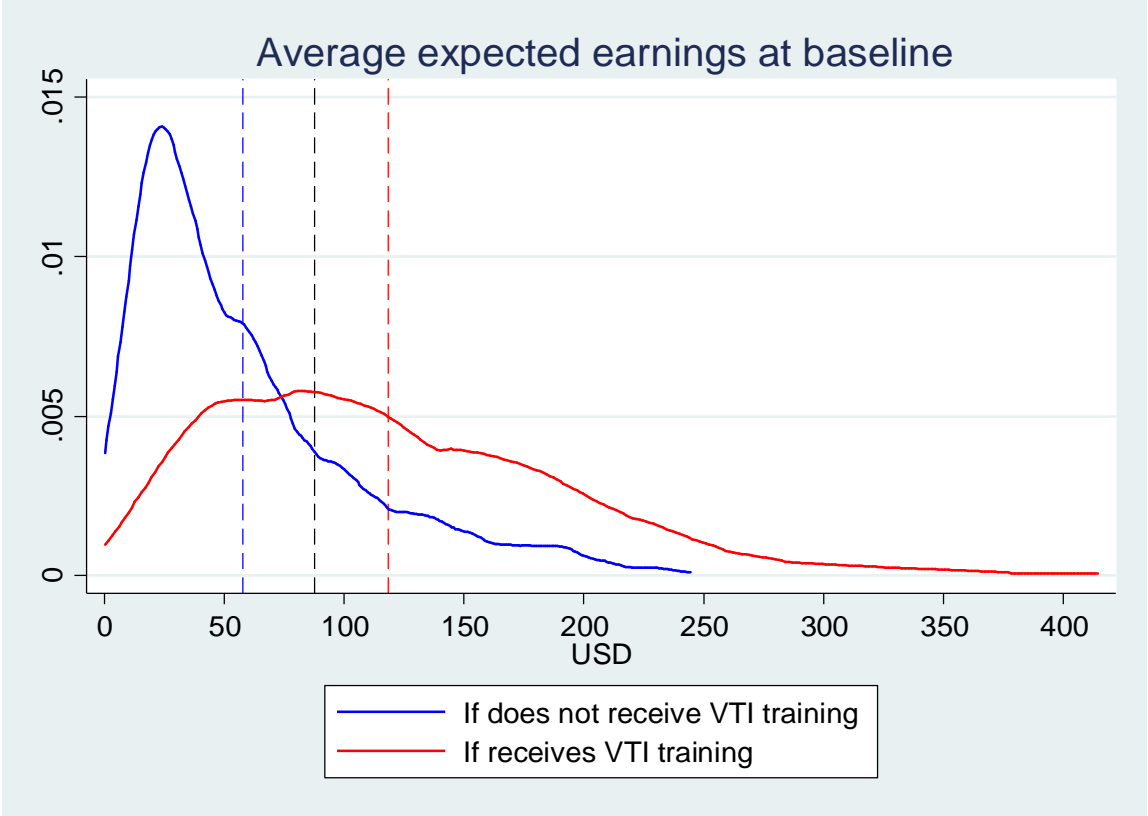- [Figure 4: Productivity Bounds]

Figure 4: Productivity Bounds

Figure 4: Productivity Bounds

Manufacturing Sectors

Service Sectors

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

- asymmetric information:

  - friction: firms meeting workers attached to the LM

- worker beliefs:

  - imperfect information about returns to skills in low-income labor markets [Jensen 2009, Kaufmann 2014]

- [Table A8: Expectations]

Figure A4: Expected Returns to Vocational Training at Baseline

Average expected earnings at baseline

Legend:
- If does not receive VTI training
- If receives VTI training

**Means, standard deviations in parentheses**

|	Average expected monthly earnings with current skill set (triangular distribution)	Average expected monthly earnings if receives VTI Training (triangular distribution)
All Workers (Baseline Interview)	57.979	129.799
	(47.254)	(184.777)
N. of observations	1,263	1,428

External Validity

- we have documented large impacts of training relative to studies in middle- and high-income countries: **why?**

- our effect sizes are large relative to literature

- ranking of treatments similar to earlier studies (VT > match)
  - low-income setting + sectoral focus [Card et al. 2015, McKenzie 2017]
  - worker selection into evaluation sample
  - treatment intensity
  - VTI quality (interacting with imperfect information of workers)

- [Figure 5: McKenzie 2017 Meta-analysis]

Figure 5: Comparison of Treatment Impacts to Meta-analysis by McKenzie [2017]
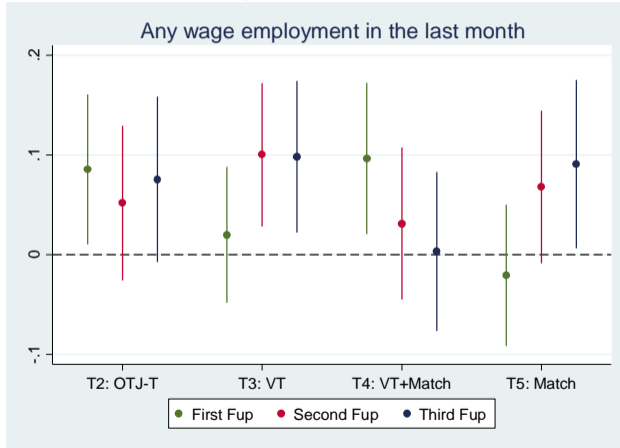
Panel A: Employment impacts
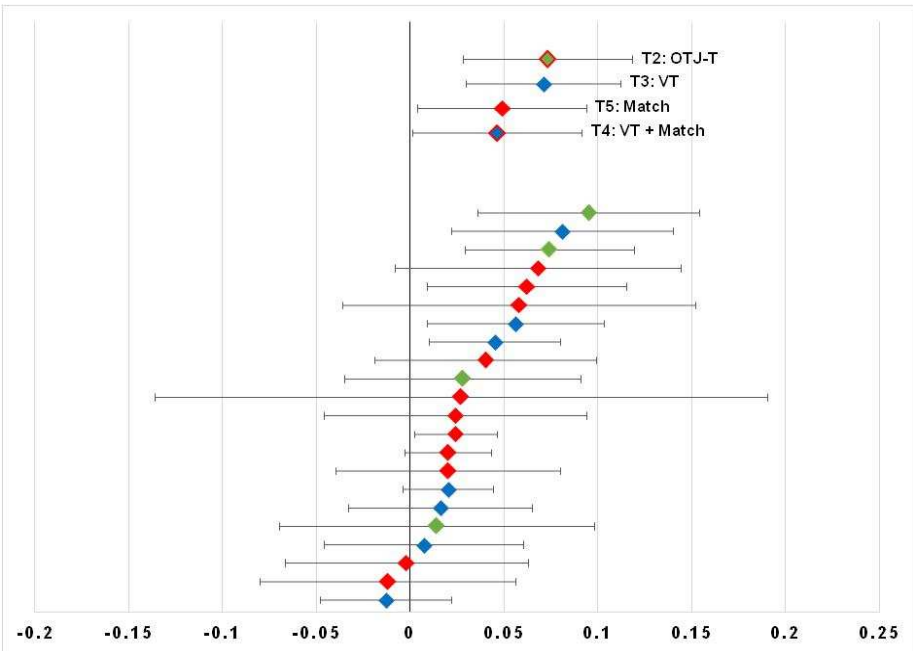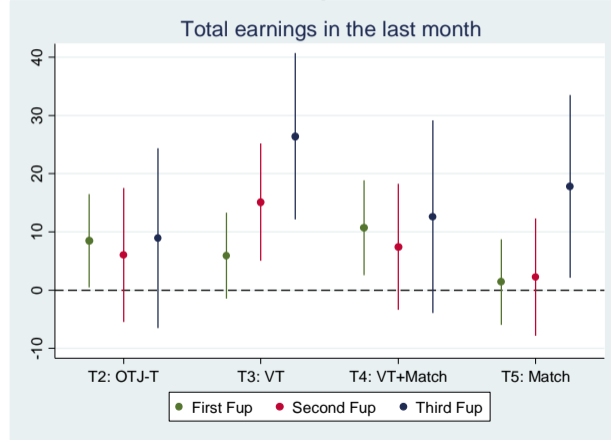
Panel B: Earnings impacts
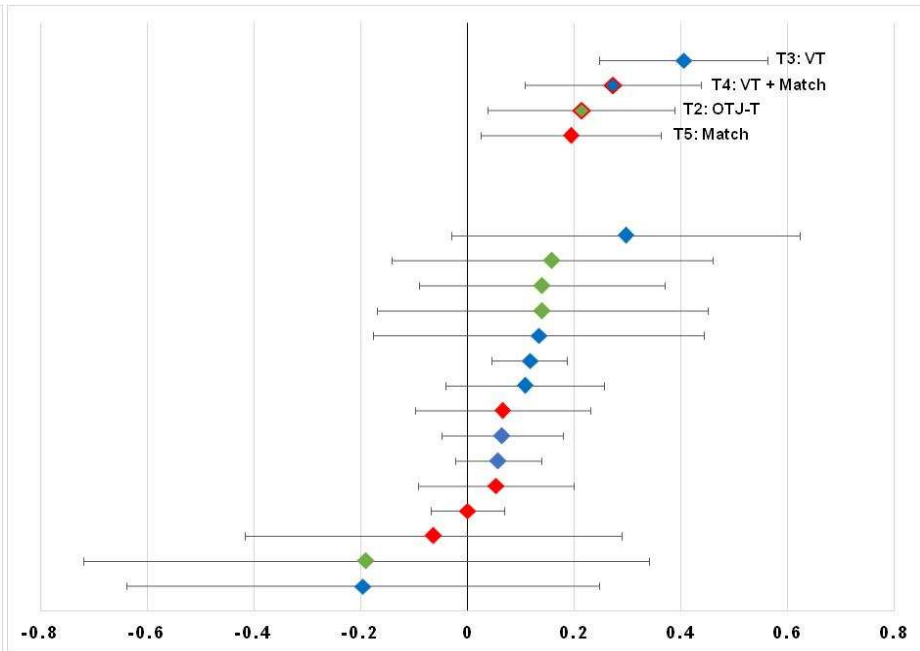
5.Structural Model of Job Search

Figure 6: Treatment Effects on Key Outcomes, by Survey Wave
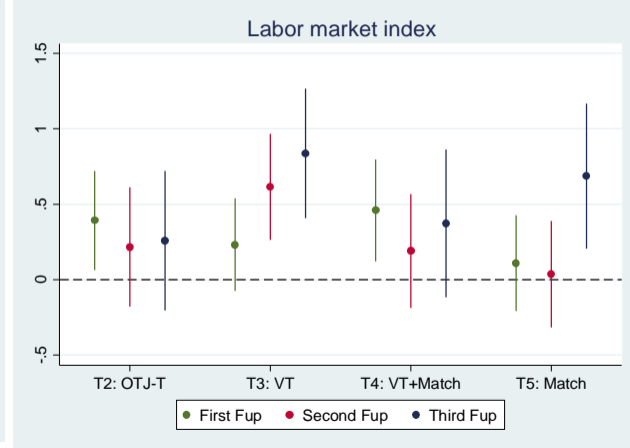
Panel A: Any Wage Employment in the Last Month   Panel B: Total Earnings in the Last Month   Panel C: Labor Market Index

Value Added of a Structural Model

- **dynamic impacts** of training routes differ

- SM helps pinpoint mechanisms driving steady state impacts:

  - transition rates: UJ, JJ

  - signaling/certification: transitions should be higher for vocational trainees

  - distribution of offered and accepted wages

- input estimated SS impacts into IRR calculations

- [Figure 6: Dynamics]

Auxiliary Assumptions

- standard job ladder model of worker search

- risk neutral workers

- homogenous workers apart from training $(t = 0, 1)$ and employment status (u, e)

- workers are in steady state by November 2015 (two years since end of VT)

- firms post wage w and make take-it-or-leave-it offers

- firms do not make wage offers to u workers that would be refused

Value Functions

- value function for an unemployed worker is:

$$V^n(t) = -\varphi(c) + \beta \left[\begin{array}{c} \lambda_0(c,t) \max\left\{\int V(w,t)dF(w|t), V^n(t)\right\} \\ +(1 - \lambda_0(c,t))V^n(t) \end{array} \right]$$

- value function for an employed worker with wage w is:

$$V(w,t) = w - \varphi(c) + \beta \left[\begin{array}{c} \delta V^n(t) + \lambda_1(c,t) \max\left\{\int V(w,t)dF(w|t), V(w,t)\right\} \\ +(1 - \delta - \lambda_1(c,t)V(w,t) \end{array} \right]$$

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 7: Worker Beliefs and Search]

Table 7: Worker Beliefs and Job Search

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

	Job Offer Probability	Offered Wages			Search Intensity and Method	
	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	Main channel through which looked for a job is formal [yes=1]
	(1)	(2)	(3)	(4)	(5)	(6)
T2: On-the-job Training	.645***	.458	.270	.598	-.001	.013
	(.137)	(2.898)	(5.600)	(4.405)	(.025)	(.008)
T3: Vocational Training	1.859***	18.514***	30.342***	26.757***	.102***	.019**
	(.124)	(2.727)	(5.051)	(4.076)	(.023)	(.008)
T4: Vocational Training + Match	1.867***	18.522***	30.544***	25.338***	.079***	.013
	(.134)	(2.938)	(5.510)	(4.409)	(.025)	(.008)
T5: Match	-.091	3.971	2.870	-.139	.001	.002
	(.133)	(3.108)	(5.482)	(4.406)	(.025)	(.007)
Mean Outcome in Control Group	2.783	65.49	123.758	95.523	.509	.017
Control for Baseline Value	Yes	Yes	Yes	Yes	No	No
P-values on tests of equality:						
OTJ Training = Vocational Training	.000***	.000***	.000***	.000***	.000***	.442
Vocational Training = Vocational Training + Match	.958	.998	.969	.742	.346	.435
N. of observations	3,770	2,627	2,622	2,233	3,914	3,913

Steady State

- given u in SS, we can derive SS relationship between $F(w)$ and $G(w)$:

$$F(w) = \frac{(\delta + \lambda_1)\, G(w)}{\delta + \lambda_1 G(w)} \tag{1}$$

$$\frac{F(w) - G(w)}{(1 - F(w))G(w)} = \boxed{\frac{\lambda_1}{\delta} = \kappa_1} \tag{2}$$

- 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 (labor market tightness)

    – no. outside offers received before being laid off

Estimation

- follow two-step procedure in Bontemps *et al.* [2000]

  – $\lambda_0, \lambda_1, \delta$ are estimated, asymptotic se's calculated

- to increase precision:

  – combine T3 and T4: VT

  – V2: OTJ

  – C: control

  – T5: match

Table 9: Structural Estimates of the Job Ladder Model

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

Panel A: Parameter Estimates		Steady State: November 2015 (Data from Third and Second FUP)			
		Control	On-the-job Training	Vocational Training	Match
		(1)	(2)	(3)	(4)
Job destruction rate (monthly):	δ	.0271	.0259	.0241	.0192
		(.0030)	(.0037)	(.0021)	(.0028)
Arrival rate of job offers if UNEMPLOYED (monthly):	λ_0	.0189	.0191	.0237	.0181
		(.0019)	(.0024)	(.0019)	(.0025)
Arrival rate of job offers if EMPLOYED (monthly):	λ_1	.0407	.0386	.0471	.0456
		(.0103)	(.0121)	(.0090)	(.0151)

Table 9: Structural Estimates of the Job Ladder Model

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

Panel A: Parameter Estimates		Steady State: November 2015 (Data from Third and Second FUP)			
		Control	On-the-job Training	Vocational Training	Match
		(1)	(2)	(3)	(4)
Unemployment Rate	u	.5890	.5756	.5036	.5139
Interfirm competition for workers	κ_1	1.502	1.490	1.954	2.375

Table 9: Structural Estimates of the Job Ladder Model

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

		Steady State: November 2015 (Data from Third and Second FUP)			
Panel B: Function and Income Estimates					
Average (sd) monthly OFFERED wage [USD]	*F(.)*	62.3	65.9	63.9	56.7
		(52.1)	(61.9)	(59.0)	(60.9)
Average (sd) monthly ACCEPTED wage [USD]	*G(.)*	89.7	97.8	100.4	99.6
		(63.6)	(77.6)	(78.0)	(84.8)
Treatment Effect Impact on Annual Income [USD]			55.7	155.7	138.6
% Impact:			12.6%	35.2%	31.3%

Mincerian, Experimental and Structural Returns

- recall Mincerian returns to VT: (+52%) [Table 2]

- RF earnings impacts: VT (40%), OTJ-T (21%) [Table 6]

  – 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 (35%), OTJ-T (13%) [Table 9]

7.Labor Demand

Firms

- large difference in SS returns to vocationally trained workers: $156 versus $56

- 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:

  - *ex ante* cannot predict which firms workers will match to

- caveat: some of this might not be productivity effect, but monopsony power of employer over OTJ trainees

- [Table 9, Panel C: Estimates of the Job Ladder Model]

Table 9: Structural Estimates of the Job Ladder Model

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

		Steady State: November 2015 (Data from Third and Second FUP)			
Panel C: Firm Productivity Distribution					
Average (sd) firm productivity	*P(.)*	161.5	118.9	253.9	106.5
		(564.8)	(436.9)	(1067.4)	(341.0)
% Impact:			**-26%**	**57%**	**-10%**

Labor Demand

- large reductions in unemployment rates:

  – OTJ: 1.34pp (2.3%)

  – VT: 8.54pp (14.5%)

  – match: 7.51pp (12.8%)

- *if* no displacement $\Rightarrow$ more effective job creation than easing L^d constraints on firm

- now use firm side experiment to shed light on displacement effects

- [Figure 1: Experimental Design]

- [Table 10: Firms and Labor Demand]

Figure 1: Experimental Design
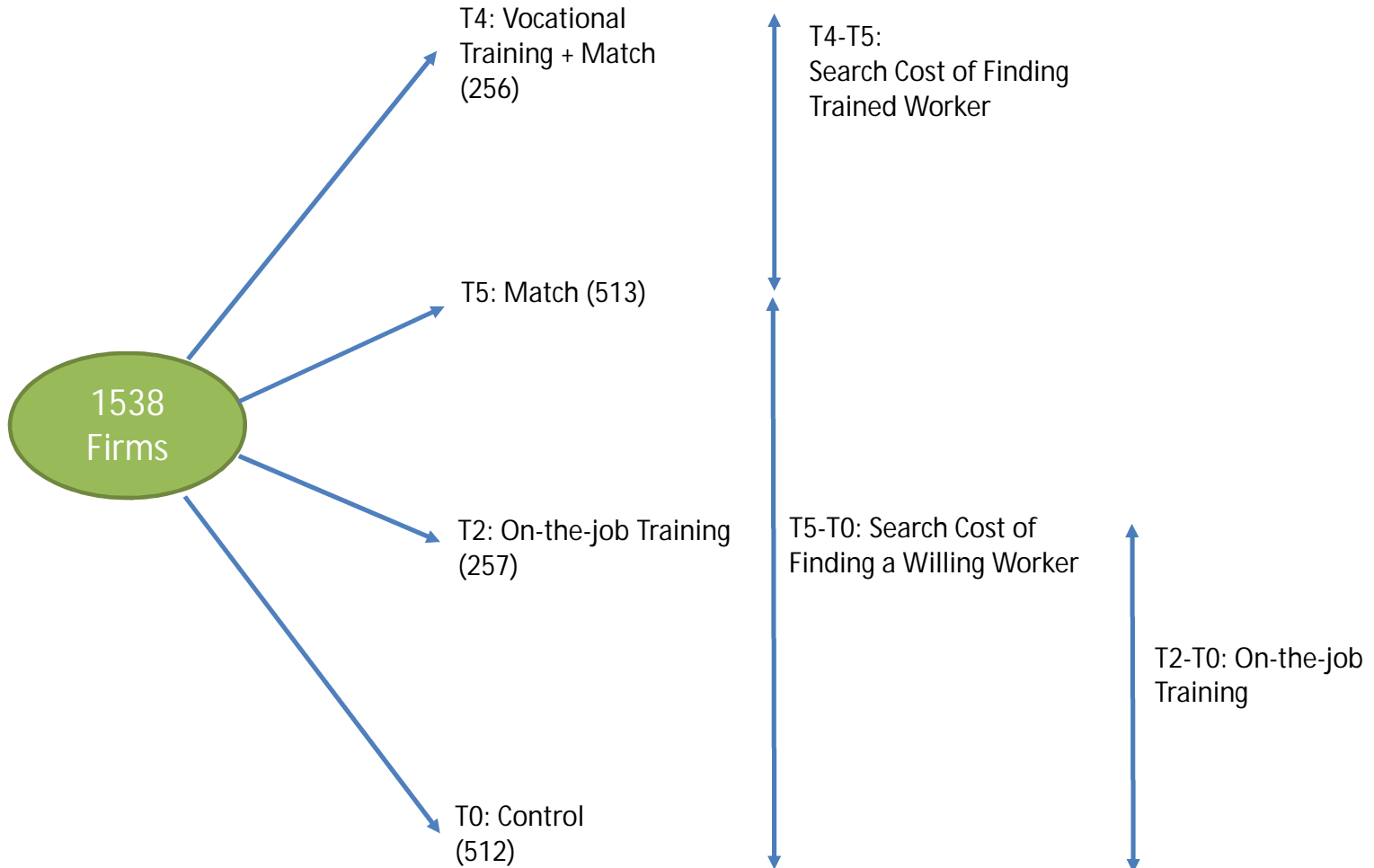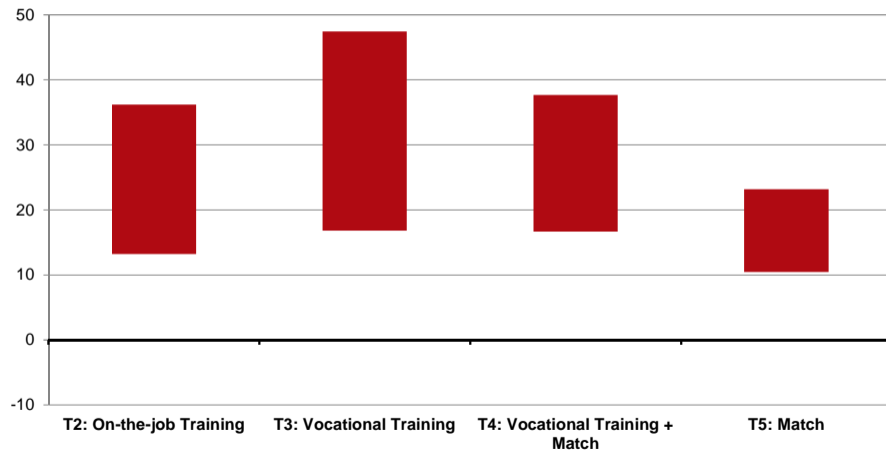
B. Firm Side Design

Table 10: Results Overview - Firm Side at First Follow Up

OLS IPW regression coefficients, standard errors clustered by sector-region in parentheses

All Sectors

|	Number of Employees	Number of skilled employees	Number of unskilled employees	Log (Average Monthly Profits)
	(1)	(2)	(3)	(4)
Vocational Training and Match	.075	.041	.132	-.028
	(.193)	(.142)	(.144)	(.086)
Match	.167	.241	-.012	-.002
	(.211)	(.147)	(.098)	(.078)
On-the-job Training	.426**	.166	.358***	.032
	(.205)	(.135)	(.130)	(.101)
Mean Outcome in Control Group	2.42	1.68	.653	201.3
Control for Baseline Value	Yes	Yes	Yes	Yes
Number of observations (firms)	1,854	1,707	1,676	1,428

Figure 4: Productivity Bounds
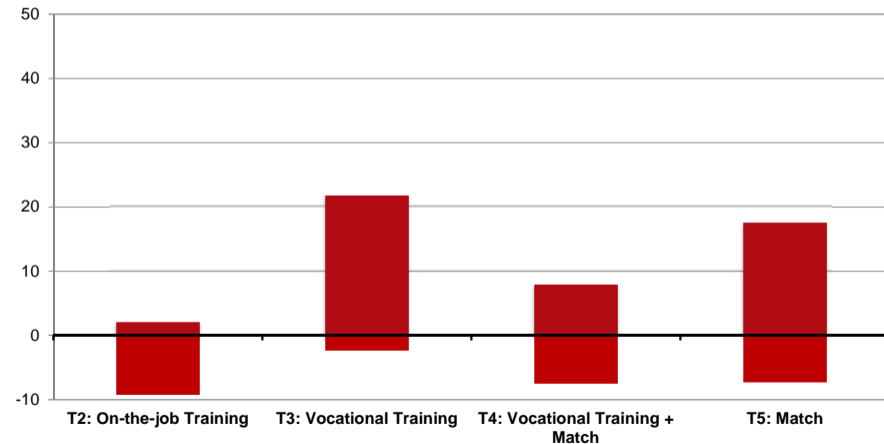
Table 10: Results Overview - Firm Side at First Follow Up

OLS IPW regression coefficients, standard errors clustered by sector-region in parentheses

	Manufacturing				Services			
	Number of Employees	Number of skilled employees	Number of unskilled employees	Log (Average Monthly Profits)	Number of Employees	Number of skilled employees	Number of unskilled employees	Log (Average Monthly Profits)
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Vocational Training and Match	.283	.138	.201	.119	-.054	-.042	.082	-.092
	(.358)	(.256)	(.322)	(.190)	(.196)	(.154)	(.105)	(.084)
Match	.054	.103	.153	.183	.190	.279	-.116	-.078
	(.296)	(.213)	(.211)	(.173)	(.287)	(.194)	(.094)	(.080)
On-the-job Training	.765**	.577**	.399*	.297*	.205	-.126	.336**	-.111
	(.348)	(.242)	(.222)	(.158)	(.237)	(.128)	(.157)	(.124)
Mean Outcome in Control Group	3	2.15	.789	279	2.07	1.40	.571	159
Control for Baseline Value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations (firms)	704	646	629	509	1,150	1,061	1,047	919

OTJ Training: Implications

- ITT profit impact in manufacturing (.297 x 279 = $82.8/month)

- ITT wage impacts: $8.38/month

- note: bounded productivity effects of OTJ in these sectors: [$13, $37]

- rent sharing: around **10%** of the social surplus generated by OTJ training goes to the worker

  – Conti [2005, Italy]: training boosts productivity, not wages

  – Card *et al.* [2016]: rent-sharing, elasticity of w wrt current profitability 3-7%

8.IRR

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: $156 versus $56

- opportunity costs: foregone earnings while being trained

- [Table 11: IRR]

Table 11: Internal Rate of Return to Training Types

	On-the-job Training	On-the-job Training (including firm effect)	Vocational Training	Vocational Training + Match
Panel A. External parameters				
Total cost per individual at year 0 [USD]:	**368**	**368**	**510**	**527**
(i) Training costs (for 6 months)	302	302	470	470
(ii) Program overheads costs	31	31	4	21
(iii) Foregone earnings (for 6 months) - average at baseline	36	36	36	36
Social discount rate = 5%				
Remaining expected productive life of beneficiaries	38 years	38 years	38 years	38 years
Panel B. Estimated total earnings benefits				
1 NPV change in total earnings year 1 and beyond-forever (from structural model)	939	1011	3159	2382
2 Benefits/cost ratio	**2.55**	**2.75**	**6.20**	**4.52**
3 Internal Rate of Return (IRR)	**0.150**	**0.183**	**0.368**	**0.268**
Panel E. Programme Costs for IRR to equate social discount rate				
5 Total cost per individual at year 0 [USD]	**939**	**1011**	**3157**	**2383**

9.Conclusions

Original Motivation

- transition into the labor market marks a key stage in the life cycle

- transition dynamics have persistent impacts
  - e.g. youth unemployment spells have long lasting impacts

- transition process is shaped by three factors:
  - labor supply: skills of workers

  - labor demand from firms

  - labor market: efficiency of worker-firm matches

Key Contributions 1

- extension of training evaluations into low-income country setting

- separate returns to vocational and on-the-job training

  - screening versus signaling

- evidence of **some** forms of worker-firm match frictions

- structural model of worker search to pinpoint **mechanisms**:

  - singnaling: VT make frequent JJ,, UJ transitions

  - OTJ-T less so

Key Contributions 2

- two sided experiment:

    – T and C workers, T and C firms

- VT and OTJ routes differ in terms of outcomes from firm's perspective:

    – less employment displacement with OTJ: youth unemployment impacts

    – monopsony power over OTJ: rent sharing within firms

- **external validity:**

    – setting/sectors, worker selection, treatment intensity, VTIs