

***Linkages between Workplace Skill Training and  
Firm Productivity: Analysis Using WES***

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Ottawa Partners Meeting of the Network  
“Productivity, Firms and Incomes”

September 26th

# Background

- Canada-US productivity gap has widened, from 27% in 2016 (GDP per hour) from just 10% 35 years ago (BDC 2016)
- Two contributors have been identified: lack of ICT investment by Canadian firms and lack of workplace training, especially for SMEs
- There is some evidence that tech change and training and their combined interaction foster productivity at the firm level (Fang & Gunderson, 2009, 2010)

# Background

- Despite importance of training, few empirical studies have examined the impact of training on the productivity and competitiveness of firms
- Most studies focus on the determinants of training, not outcomes from training, in part because of severe methodological problems in establishing a causal link
- The Workplace and Employee Survey (WES) provides an unique opportunity to examine the training-productivity relationship (employer-employee linked data, longitudinal)

# Background

- The literature on evaluating government-supported training programs (focusing on disadvantaged workers who take such programs) tends to find minimal positive outcomes and, when positive, the benefits are unlikely to exceed the cost.
- The literature on the impact of private sector training programs (focusing on executives and managers) tends to find that the parties self-report positive *perceptions* of training, but seldom link these perceptions to ultimate performance measures and they do not indicate if the benefits exceed the costs

# Data

- Our empirical analysis is based on both the *workplace* and the *individual* files of the Workplace and Employee Survey (WES) for the years 1999-2004
- The WES data is ideally suited for this type of analysis for a number of specific reasons
- *Both workplace and individual level data files* can be linked to enabling information on individuals to be combined with a wide range of characteristics of the workplace – the level of aggregation where productivity issues are spawned

# Data

- There is a rich set of *productivity related outcomes* (objective and subjective) in both workplace and individual files;
- Information is available on both *formal classroom* and *informal on-the-job training* (OJT) including expenditures and the percent of employees received either type of training;
- Detailed information also exists on *types* of classroom training and OJT enabling a linking of type of training to productivity;
- There is detailed information on *funding* of training

# Data

- There is a wide range of *control variables* related to managerial practices and workplace characteristics in the workplace file, and individual demographic and employment environmental characteristics from the employee file;
- WES has information on the *nature of instruction* for OJT and classroom training (e.g., self-learning, supervisor, fellow-workers, in-house trainer, outside trainer etc.) to determine the potential importance of such factors for the *effective training of older workers*
- Individual data file also has information of the most recent *promotion* including the importance of training in career development in securing the promotion

# Data

- The analysis of the workplace file was restricted to for-profit organizations (e.g. competition)
- Only odd-year WES data (e.g. 2003) contains information on organizational factors that can affect training decisions including *the nature of competition*
- The analysis was also restricted to individuals age 15+ given the focus on employment outcomes
- This yielded a substantial sample size of 17,213 employees within 5,763 workplaces, 12.2% age 15-24, 56.6% age 25-45 and 31.4% over 45.



# Empirical Framework and Estimation Procedures

- Our empirical analysis essentially involves regressing various training outcomes as dependent variables on a wide range of training inputs as key independent variables as well as control variables that can also influence the outcomes.
- When the dependent variables are continuous, conventional ordinary-least-squares regression is employed. When the dependent variables are binary-coded, probit regressions are employed and marginal effects are reported to portray that impact

# Workplace Level Analysis

- Our analysis is performed at two separate levels of aggregation: the workplace level and the individual employee level
- The workplace-level analysis uses two categories of training outcomes as dependent variables: 3 objective outcomes: **labour productivity** defined as revenue per employee; **profits** per employee defined as revenue minus expenditures of the organization divided by the number of employees at location and **% change in revenues** between 2002 and 2003.

# Workplace Level Analysis

- The second category of workplace-level training outcomes involves subjective assessments by employers of their perception as to whether there were increases over the past year in five outcomes:
  - Productivity
  - Profits
  - Sales
  - Product quality
  - Customer satisfaction.

# Workplace Level Analysis

- The key independent variables for our workplace-level analysis involve a wide range of training inputs. These include the type of training paid for or provided: *Classroom training; On-the-job training; Both classroom and on-the-job training*
- Measures of the intensity of training:
  - Expenditures on class room training per employee
  - % of employees receiving any classroom training
  - % of employees receiving subsidized classroom training
  - % of employees receiving only on-the-job training

**Table 1 – Mean Values of Organizational Outcomes by  
Various Training Inputs, WES 2003 Workplace File,  
N=5,763**

Training Inputs and Control Variables	Objective Outcomes (continuous)			Employer Perceived Outcomes (categorical, coded 1 if perceived to increase over past year, 0 else)				
	Labour Product. (\$1,000)	Profits/ Employee (\$1,000)	% Change in Revenue	Product- ivity ↑	Profits ↑	Sales ↑	Product Quality ↑	Customer Satisfaction ↑
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Training Type	<b>Panel 1 -- Estimated on the full sample, n =5,763</b>							
Mean Value of Outcome	<b>176.5</b>	<b>36.4</b>	<b>20.9</b>	<b>0.370</b>	<b>0.356</b>	<b>0.467</b>	<b>0.284</b>	<b>0.332</b>
[None paid or provided]	165.9	35.3	17.6	0.286	0.324	0.410	0.242	0.295
Classroom only	188.3	38.7	8.6	0.425	0.403	0.531	0.270	0.340
On-the-job (OJT) only	163.2	31.7	17.7	0.399	0.344	0.473	0.282	0.361
Both classroom & OJT	205.7	42.4	34.6	0.483	0.415	0.549	0.371	0.371

# Workplace Level Analysis

- In addition to this array of training inputs, we include control variables for a wide array of other factors that can affect the outcomes. These include (details shown in Appendix):
- Workplace traits
  - Competitive pressures
  - Managerial strategies with respect to workplace practices
  - Managerial strategies with respect to incentive schemes

Table 2 -- Illustrate Full Regressions with Control Variables; Mean Dependent Dummy Variable (Productivity Increased=1)= 0.370, N=5,763

Explanatory Variables	OLS Regression		Probit Marginal Effects	
	Coefficient	P-value	Marg. Effect	P-value
	(1)	(2)	(3)	(4)
<b>Type of Training Provided</b>				
[None paid or provided]				
Classroom only	0.103*	0.088	0.113*	0.072
On-the-job (OJT) only	0.089**	0.022	0.097**	0.022
Both classroom & OJT	0.116***	0.003	0.125***	0.002

# Longitudinal Analysis: Workplace Level

- We regress *changes* in training outcomes on *changes* in various training inputs in both the short run (2003 to 2004) as well as the long run (1999 to 2003) along with the previously discussed control variables.
- In order to assess the long-run impact of the *continuity* of training inputs we also regress the changes in the training outcomes over the period 1999-2003 on indicators of whether training was never provided over that period and whether it was provided in one, two, three, four or all five of the five years over that period.



# Longitudinal Analysis: Workplace Level

- The *longitudinal* analysis based on workplace data finds (Table 3):
- **In the short-run**, there is generally no statistically significant relationship between *changes* in training inputs and *changes* the various objective measures of productivity, profitability and revenue
- The notable exception is that workplaces that changed from providing no classroom and OJT in 2003 to providing both classroom and OJT in 2004 were associated with positive and quantitatively large increases in the probability of the employer perceiving improvements in all of the outcome measures.

**Table 3 – Short-Run (2003-2004) Longitudinal Impact of Changes in Various Training Inputs on Changes in Organizational Outcomes, WES 2003-04 Workplace Files (N=1228)**

Training Inputs and Control Variables	Objective Outcomes (continuous)			Employer Perceived Outcomes (categorical, coded 1 if perceived to increase over past year, 0 else)				
	ΔLabour Product. (\$1,000)	ΔProfits/ Employee (\$1,000)	% Change in Revenue	ΔProduct- ivity ↑	ΔProfits ↑	ΔSales ↑	ΔProduct Quality ↑	ΔCustome Satisfactor
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Mean Value of Outcome</b>	6.31	-0.680	0.458	0.265	0.287	0.327	0.194	0.241
<b>Training Type</b>								
[None paid or provided]								
Classroom only	-9.04	0.138	-0.328	0.182*	0.095	0.013	-0.032	0.026
On-the-job (OJT) only	-2.05	-1.13	-0.304	0.045	0.050	0.033	0.044	0.099
Both classroom & OJT	-9.38	3.57	-0.272	0.227**	0.186*	0.229**	0.121	0.146
<b>Training Magnitudes</b>								
Classrm exp/employee (\$100)	0.099	1.66**	0.004	-0.014**	0.001	0.025	-0.005	0.011***
% receiving any classroom	-6.39	-6.35	0.064	0.325***	0.143	0.051	0.064	0.014
% receiving class subsidized	-1.01	2.76	-0.289	0.088	0.023	0.005	0.076*	0.094
% receiving any OJT	-57.7*	0.271	-0.327	0.116	0.108	0.158	-0.009	-0.022

# Longitudinal Analysis: Workplace Level

- The **long-run** workplace results suggest that firms that provided training over different combinations of years over the period 1999-2003, including those that continuously provided training over that period, had *worse* outcomes than did firms that did not provide any training over the period (**Table 4**).
- We have no straightforward explanation for this surprising result, which is an outlier in our analysis. It could be that firms that provided more continuous training were doing so in response to negative outcomes they were experiencing – that is, causality was in the direction of poor outcomes fostering training.
- It is also possible that workplaces in the reference categories (those that didn't provide training in any of the five years) might be more mature and less in need of training.

**Table 4 – Long-Run (1999-2003) Longitudinal Impact of  
Continuity in Training Inputs on Changes in  
Organizational Outcomes, WES 99-03 Workplace Files,  
N=4,057**

Change in Training Inputs	Objective Outcomes (continuous)			Employer Perceived Outcomes (categorical, coded 1 if perceived to increase over past year, 0 else)				
	ΔLabour Product. (\$1,000)	ΔProfits/ Employee (\$1,000)	% Change in Revenue	ΔProduct- ivity ↑	ΔProfits ↑	ΔSales ↑	ΔProduct Quality ↑	ΔCustomer Satisfaction ↑
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Mean Value of Outcome</b> →	28.07	-11.91	0.709	-0.061	-0.030	-0.009	-0.087	-0.089
<b>Training Continuity</b>								
[None paid, provided 99-03]								
1 of 5 years	-33.2	10.9	-0.141	-0.152*	-0.204**	-0.235**	-0.092	-0.144
2 of 5 years	-66.1**	-30.6	-0.178	-0.226**	-0.089	-0.209**	-0.135	-0.142
3 of 5 years	-34.90	-9.0	0.188	-0.198**	-0.182*	-0.277**	-0.048	-0.165
4 of 5 years	-49.3*	-33.4*	-0.145	-0.084	-0.118	-0.218**	-0.139	-0.202**
Continuous 1999-2003	-56.0**	-23.3	-0.001	-0.125	-0.181**	-0.290***	-0.124	-0.281***
	<b>p-values</b>							
[None paid or provided]								
1 of 5 years	0.110	0.415	0.751	0.090	0.029	0.012	0.372	0.113
2 of 5 years	0.050	0.275	0.689	0.015	0.382	0.019	0.208	0.199
3 of 5 years	0.173	0.617	0.648	0.046	0.083	0.007	0.674	0.121
4 of 5 years	0.069	0.098	0.697	0.319	0.197	0.016	0.148	0.018
Continuous 1999-2003	0.029	0.207	0.998	0.143	0.036	0.001	0.197	0.001

# Individual Level Analysis

- At the individual level we utilize 3 indicators of training outcome: *hourly wages; whether a productivity bonus was received; and an index of job satisfaction* that ranges from 1 (very dissatisfied) to 5 (very satisfied).
- The training inputs are the key explanatory variables and include: *received classroom training only; received on-the-job training only; received both*
- We also include 3 age categories: age 15-24; age 25-45; and age 46 and over. Importantly, these are also interacted with types of training. This enables testing for whether the effects of the different types of training on the various outputs differed for *older workers, middle age workers and younger workers*.

**Table 5 – Mean Values of Individual Training Outcomes by Various Training Inputs, WES 2003 Employee File with Link to Workplace File (N=17,213)**

<b>Training Inputs</b>	<b>Hourly Wage (\$/hr)</b>	<b>Productivity Bonus Received</b>	<b>Job Satisfaction Scale (1 low-5high)</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>Panel 1 – Estimated on full sample who received only classroom, only OJT or both, n=17,213</b>			
<b>Mean Value of Outcome →</b>	19.89	0.255	4.10
<b>Type of Training Received</b>			
Received no training	17.86	0.200	4.01
Received classroom only	21.92	0.296	4.19
Received OJT training only	18.81	0.278	4.10
Received both classroom and OJT	25.48	0.357	4.25

# Individual Level Analysis

- All of the regressions included a wide range of control variables that could affect the outcomes. These included:
  - Personal characteristics
  - Employment characteristics
  - Workplace characteristics
  - Competitive pressures: local, regional, international
  - Managerial practices with respect to human resource incentives  
Managerial practices with respect to workplace practices, and
  - Controls for industry, occupation and region.

# The *individual-level* regression results

- The *individual-level* regression results that control for the impact of other factors that can affect the outcomes are broadly consistent with a profile analysis that does not control for those factors (**Table 5, Panel 1**). This suggests the following generalizations.
- Compared to workers who received no training, all 3 outcomes (wages, productivity bonuses and job satisfaction) were higher for those who received training, especially for classroom training and even more so for both classroom and OJT.
- The exceptions were that wages were not significantly higher for those who receive OJT only, and the positive relationship between productivity bonuses and the training inputs were not statistically significant at conventional levels.



**Table 6 – Impact of Various Training Inputs on Individual Outcomes WES 2003 Employee File with Link to Workplace File (N=17,213)**

Training Inputs	Log of Hourly Wage (\$/hr) Mean=2.842		Productivity Bonus Received Mean=0.255		Job Satisfaction Scale (1 low-5high) Mean=4.10	
	(1)	(2)	(3)	(4)	(5)	(6)
	Coef.	P-value	Marg.Ef	P-value	Coef.	P-value
<b>Panel 1 – Estimated on full sample who received only classroom, only OJT or both, n=17,213</b>						
<b>Type of Training Received</b>						
[Received no training]						
Received classroom only	0.035**	0.024	0.019	0.279	0.142***	0.001
Received OJT training only	-0.022	0.174	0.033	0.126	0.086*	0.080
Received both classroom and OJT	0.089***	0.000	0.033	0.134	0.200***	0.000

# The *individual-level* regression results

- Older workers who receive OJT only have significantly higher wages than do middle age and younger workers who receive OJT only, suggesting the possible effectiveness of informal OJT for older workers enabling them to utilize their considerable experience and receive training in a more self-paced fashion (**Table 7**).
- In general, there is no significant difference between the type of training and the different outcomes suggesting that older workers who undertake the different types of training are not likely to experience inferior outcomes, and in the case of OJT they are likely to experience superior wage outcomes.
- There is not a consistent difference between older and middle-age workers relationship in how outcomes vary according to the *nature of classroom instruction*.

Table 7 – Age Effects from Interacting Age with Type of Training and Nature of Instruction WES 2003 Employee File with Link to Workplace File

Training Inputs	Log of Hourly Wage (\$/hr) Mean=2.842		Productivity Bonus Received Mean=0.255		Job Satisfaction Scale (1 low-5 high) Mean=4.10	
	(1)	(2)	(3)	(4)	(5)	(6)
	Coef.	P-value	Marg.Ef	P-value	Coef.	P-value
<b>Panel 1 – Estimated on full sample who received only classroom, only OJT or both, n=17,213</b>						
<b>Age Interact with Type of Training</b>						
Received classroom only x Age 45+	-0.009	0.767	-0.046	0.141	0.000	0.998
Received OJT only x Age 45+	0.090**	0.012	0.056	0.225	-0.144	0.169
Received both class&OJT x Age 45+	-0.032	0.514	-0.108***	0.005	0.142	0.185
Received classroom only x Age15-24	0.012	0.809	-0.068	0.359	0.304*	0.067
Received OJT only x Age 15-24	-0.021	0.655	-0.129**	0.032	0.353**	0.041
Received both class&OJTxAge15-24	-0.097**	0.032	-0.103	0.154	0.303	0.125

# The *individual-level* regression results

- With respect to the nature of informal OJT instruction, higher wages and productivity for older workers compared to middle age workers are associated with receiving OJT from an outside trainer, and positive productivity effects exist for three of the sources of instruction for OJT (self-learning, an in-house trainer, and an outside trainer).
- This suggests the cautious conclusion that additional productivity effects are often associated with different sources of instruction for OJT for older workers, and outside trainers seem particularly effective.

# Longitudinal Analysis: Individual Level

- We regress *changes* in 3 individual outcomes on *changes* in training inputs, along with the levels of the control variables in the initial year.
- This is done by pooling the three two-year panels: 1999-2000; 2001-2002; and 2003-2004 (longer panels are not available in the individual files).
- To capture the changes in training inputs we restrict the analysis to individuals who received no training in the base year (the first year of each panel) and then record four possible changes in the training input in the subsequent year of the panel: continued to receive no training; received classroom training only; received OJT only; and received both classroom training and OJT.

# *Longitudinal Analysis: Individual Level*

- *Individual level Longitudinal* analysis (**Table 8**) suggests:
- Strong and uniform positive and large effects of training on each of the outcomes (wages, productivity bonus, job satisfaction) emerge with the effects being largest for individuals who received both classroom and OJT, and they are generally larger for those who received classroom training only compared to OJT only.
- They are generally in line with (albeit stronger than) the previous cross-section estimates which compared outcomes across individuals who received different types of training with those who received no training, including the similar finding of strongest effects for those who received both classroom and OJT, followed by those who received classroom training only.

Table 8 – Short-Run Longitudinal Impact of Changes in Various Training Inputs on Changes in Individual Outcomes, WES Individual Files (N=13,480)

	$\Delta$ Log of Hourly Wage (\$/hr)	$\Delta$ Productivity Bonus	$\Delta$ Job Satisfaction Scale (1 low-
	<b>1999-2004</b>		
<b>Mean Change</b>	0.034	0.001	-0.011
<b>Training Type</b>			
[None continued]			
Class only in t+1	0.050***	0.047**	0.262***
OJT only in t+1	0.025**	0.053**	0.127***
Both in t+1	0.064**	0.113**	0.320***
	<b>P-values</b>		
[None continued]			
Class only in t+1	0.000	0.036	0.000
OJT only in t+1	0.024	0.037	0.007
Both in t+1	0.013	0.020	0.004

# *Longitudinal Analysis: Individual Level*

- Since the individual longitudinal estimates provide stronger evidence of causality, they suggest that the causality goes in the direction of training leading to the positive outcomes.
- These strong positive effects of training based on the longitudinal analysis for *individuals* do not bode well with negative effects from the *long-run* pooled analysis that examined the continuity of training for *workplaces*.
- The explanation for this seemingly contradictory results is not straightforward and we have no easy answer.



# *Longitudinal Analysis: Individual Level*

- It could be that for the pooled workplace level data, causality is going in the other direction. That is, firms that have poor performance indicators are instituting training to try to reverse that situation so that causality is going in the direction of poor performance to training.
- As well, it is possible that workplaces in the reference categories (those that didn't provide training in any of the 5 years) might be more mature and less in need of training.

# *A Summary of the Summaries*

- Training is generally associated with positive productivity related outcomes at both the workplace and individual level.
- This is especially the case for combinations of both classroom and OJT, but also for classroom training and to a lesser extent for OJT.
- The strong positive effects based on longitudinal analysis that follow the same individual over time suggest that the relationship is causal – that is, training leads to positive outcomes.
- However, there are qualifications.

# *A Summary of the Summaries*

- The longitudinal analysis based on workplace data found no effect of training in the **short-run** and *negative* effects in the **long run**.
- This is a puzzle, perhaps suggesting reverse causality in that firms that were experiencing problems responded with training. Another qualification is that the positive effects of training were not always uniformly and consistently found.
- There are generally no strong consistent relationships between training outcomes and the source of the subsidy for classroom training or the nature of classroom or on-the-job training.
- Older workers seem to benefit as much from the training as do non-older workers and there is some evidence that they benefit more when the training is geared to their specific needs.

# Policy Implications

- Implications for Canadian policy related to training are discussed.
- The evidence suggested that there was no obvious case for concluding that the private parties were engaging in too much or too little training or that there should be a shift away from the emphasis on an active labour market adjustment strategy with training as a component
- As well, it suggested that there is no obvious reallocation that should be made across the types of training or the nature of the training or the source of the subsidy.

# Policy Implications

- The current emphasis on training for purposes of skill development (e.g., to fill labour shortages and enhance productivity) rather than using training as an equity oriented policy to assist the disadvantaged seems appropriate since training is unlikely to be a panacea for the disadvantaged.
- Other policies appear more appropriate for assisting the disadvantaged, including an emphasis on basic education given the high returns it yields and the fact that it provides a foundation for subsequent training.

Thank you!

Questions?

# Future Research

- A number of alternative methodological procedures were recommended, although their potential problems were also discussed. The procedures included:
  - Random assignment; random assignment at the margin;
  - Regression discontinuity procedures;
  - Use of limited treatment groups;
  - Comparisons of those who received different *amounts or types* of training without trying to make comparisons with those who received no training;

# Future Research

- Establishing the link between employee/employer subjective *perceptions* of the usefulness of training and the objective *actual* effectiveness of training so as to rely on survey evidence of the perceptions of the parties, with that link to actual outcomes that can be externally verified;
- Estimating the effect on intermediate outcomes like returning to school and using external evidence to link the intermediate outcome to ultimate outcomes like earnings;
- Using natural experiments to obtain exogenous variation in the extent of training; and building-in the evaluation design at the time that new programs are being established.



# Future Research

- Identifying the barriers that may inhibit the private parties themselves from engaging in training;
- Determining the extent to which wage constraints such as those imposed by minimum wage laws inhibit workers from accepting a lower wage in return for training;
- Analysing whether immigration may serve as a substitute for training;

# Future Research

- Determining the extent to which training and education are complements or substitutes;
- Analysing the extent to which the success of training depends upon it being “bundled” or interacted with other workplace and human resource practices; and
- Obtaining information on the costs of training so as to facilitate determining whether benefits exceed the costs.