Minimum Wage vs. Labour Productivity

for Tree Planters in Canada

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Why Labour Productivity?

- Previous studies regarding minimum wage focused on employment effect, as well as non-employment outcomes such as:
  - labour-labour substitution, changes in hiring practices, output prices...
- Rigorous empirical investigation on the productivity effect has been lacking in the literature (Ku, 2020)
- Direct measure of welfare effects

Previous Studies

- Studies investigated the effects on firm-level productivity:
  - restaurant industry in the US (Kim & Jang, 2019)
  - manufacuring firms in Vietnam (Nguyen, 2019)
  - registered companies in UK (Riley & Bondibene, 2017)
  - manufacturing firms in Chile (Alvarez & Fuentes, 2018)
- Studies examined labour productivity effect on:
  - (-) strawberry pickers in Northern California (Hill, 2018)
  - (+) bottom 40th percentile tomato pickers in Florida (Ku, 2020)
  - (+) employees in a large retailer in the U.S. (Coviello, Deserranno & Persico, 2018)
- Papers studied Canadian tree planters focused on:
  - piece rates and contract designs (Paarsch & Shearer, 1999; 2000)

Our Paper

- Estimates the productivity effect of minimum wage on Canadian tree planters
- Uses unique payroll dataset, which includes daily earnings and output (trees planted), hours worked and contract (location)
- Fixed effects on individual workers and contracts, while controlling experience, piece rate, weather
- Primary finding suggests minimum wage increases labour productivity, less productive workers are exerting more effort

The Tree Planter

Source: Ben Hemmings, BEN HEMMINGS MEDIA

Schedule and Compensation

- Season starts in late April or early May, ends in late June or early July
- Planters generally live in camps near the planting sites, work at "3+1" or "4+1" schedule
- Crews pick up the seedlings from camps and drive to the sites
- Paid by piece rate, ranging between 10-25c per tree (by difficulty)
- Daily pay can range from \$200 to \$500, contracts last 1-2 months

Why Tree Planters?

- Produce homogeneous goods, subject to quality standards
- Paid by piece rate, worker-level data is reliably recorded
- Planters are topped up to the minimum wage level, if earning below it
- Highly labour intensive
- Spread out across Canada, thus variation in minimum wage standards

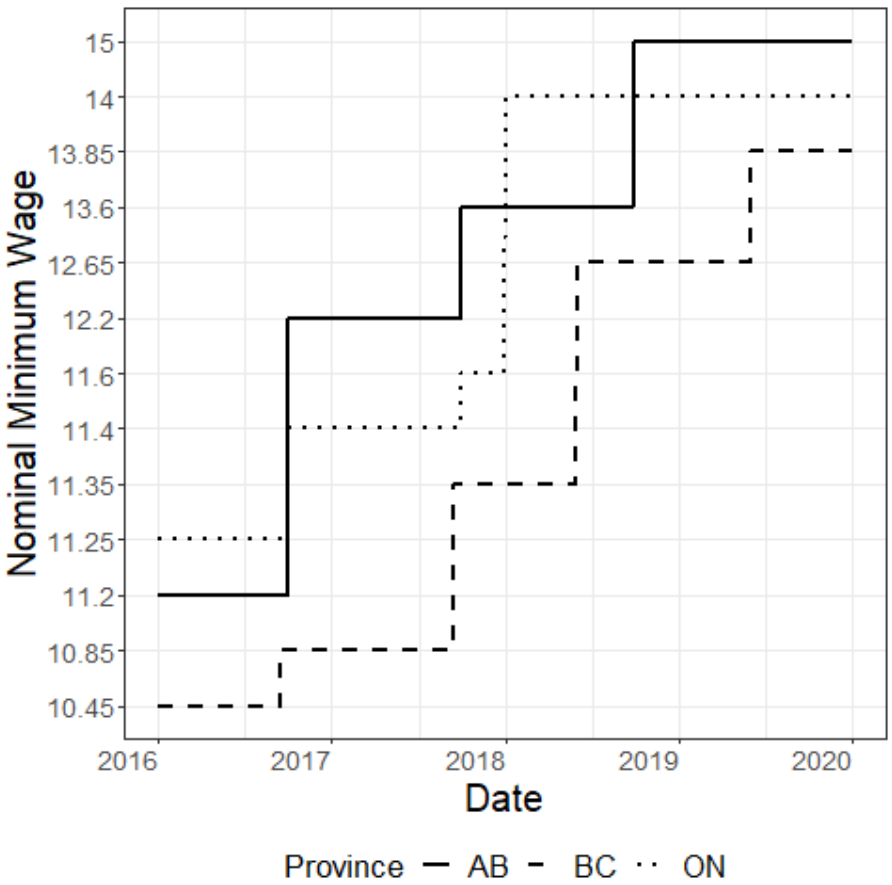
The Payroll Data

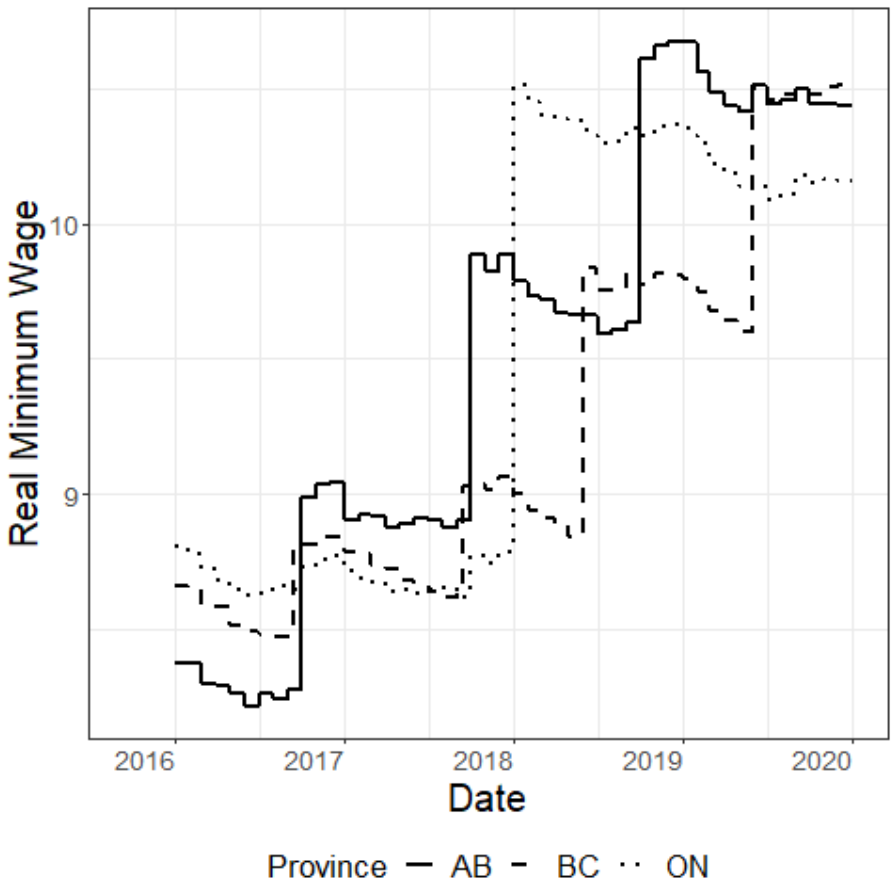
- Confidential payroll data from one of the largest and longest-running reforestation companies in Canada
- 116,742 daily observations on 2,241 planters, working for 176 contracts in Alberta, British Columbia and Ontario between 2016-2019
- Including variables, such as:
  - planter and contract name
  - trees planted
  - hours worked
  - daily pay

see table

Minimum Wage

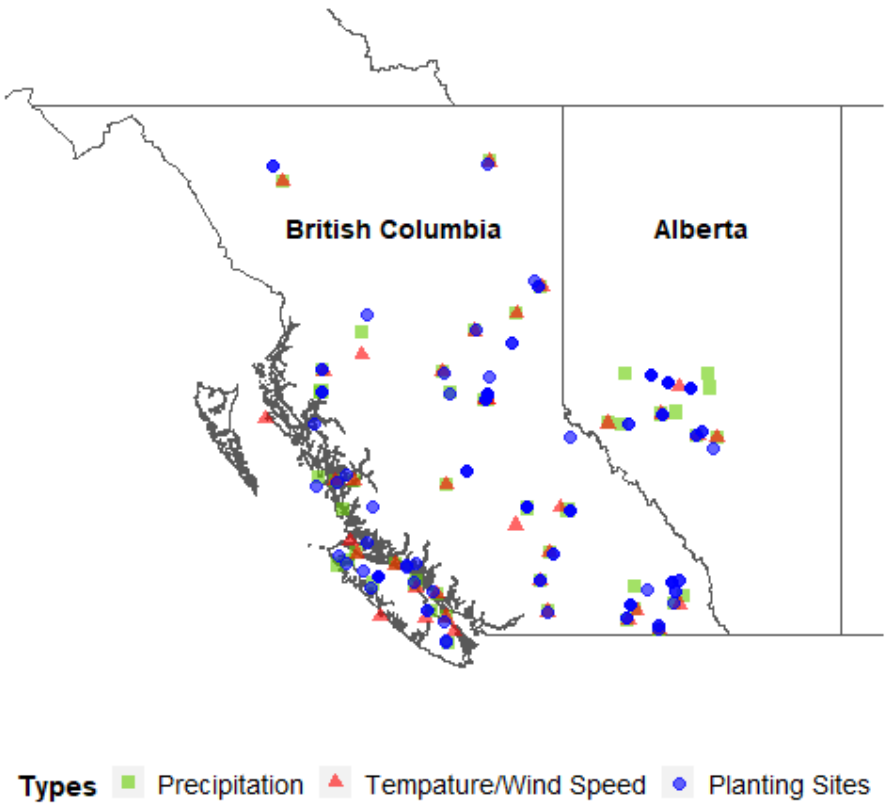
- Monthly minimum wage levels of AB, BC and ON between 2016-2019

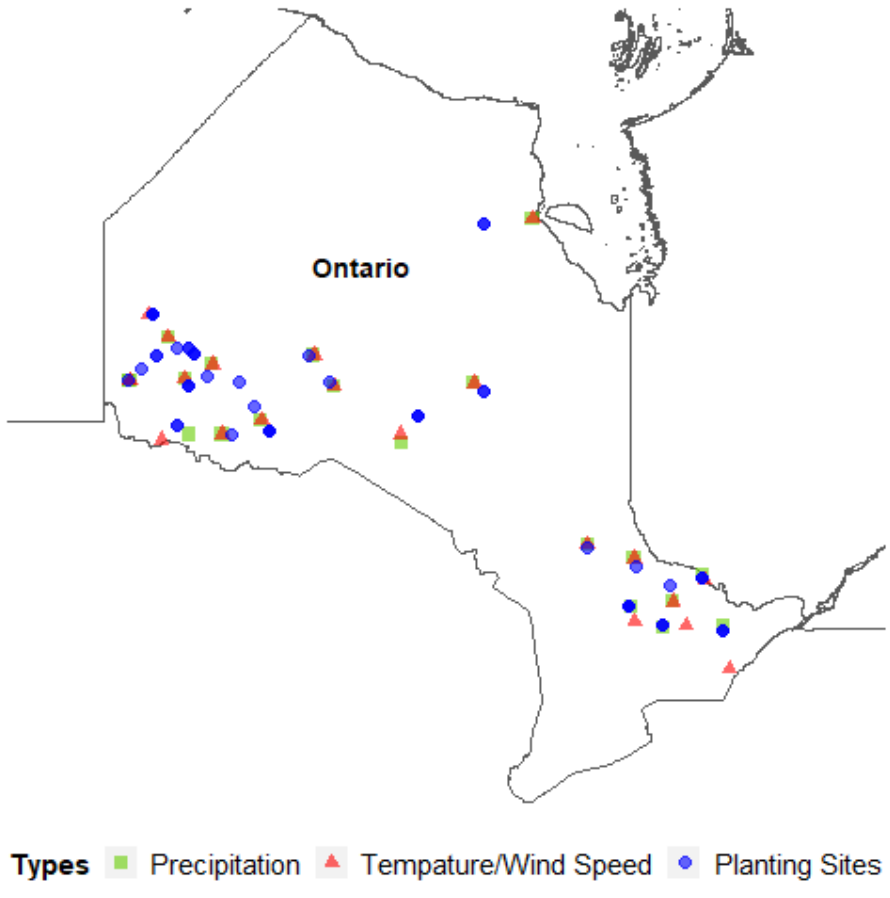




Meteorological Data

- Weather data from Environment and Climate Change Canada (ECCC): temperature, precipitation, wind speed see table





Empirical Model

$$\text{Productivity}_{i,t,r,c} = \beta_1 \text{MW}_{t,r} + \beta_2 \text{TopUp}_{i,t,r,c} + \beta_3 \text{MW}_{t,r} \times \text{TopUp}_{i,t,r,c}$$
$$+\beta_4 \text{Piece}_{i,t,r,c} + \beta_5 \text{Piece}_{i,t,r,c} \times \text{TopUp}_{i,t,r,c} + X' \times \Gamma_{i,t,r,c}$$
$$+\alpha_i + \alpha_{y,r,c} + \epsilon_{i,t,r,c}$$

- Indices: i individual, t day, y year, r region, c contract
- Productivity: hourly productivity in dollar value (in log)
- MW: real value of minimum wage (in log)
- TopUp: top-up dummy generated based on the nominal earnings
- Piece: real piece rate (in log)
- X: experience and its squared term, weather vector
- Fixed effects: individual and contract

Primary Results

Dependent Variable:	Productivity
Variables	
Min Wage	0.56528***
	(0.12781)
Top-up	-3.25933***
	(0.49679)
Min Wage × Top-up	0.81425***
	(0.22148)
...	...
Fixed-effects	
id	Yes
contract	Yes
Fit statistics	
Observations	106,567
R^2	0.75404
Within R^2	0.42443

Clustered (contract) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Conclusion

- An increase in minimum wage raises the labour productivity of tree planters: every 1% increase in minimum wage leads to 0.57% increase in labour productivity
- Higher minimum wage helps mitigate the earning gap among the planers: topped-up planters receive an extra 0.81% productivity boost
- The coefficients are robust to estimating using the nominal values of minimum wage and piece rate see table

Thank you! Questions?

Appendix: The Payroll Data

	AB	BC (inland)	BC (coast)	ON	Total
Total Trees Planted	1,943.50 (708.54)	1,547.63 (626.28)	1,234.62 (453.76)	1,767.47 (869.37)	1,666.35 (750.54)
Daily Earnings	177.25 (66.08)	197.37 (81.09)	204.87 (67.60)	132.34 (65.39)	170.89 (78.78)
Productivity	243.62 (87.70)	194.17 (77.04)	155.18 (55.83)	222.66 (107.78)	209.39 (92.89)
Productivity in Dollar Value	22.22 (8.19)	24.76 (9.95)	25.75 (8.32)	16.68 (8.12)	21.46 (9.73)
Piece Rate	0.09 (0.01)	0.13 (0.02)	0.17 (0.04)	0.08 (0.01)	0.11 (0.04)
Total Hours Worked	7.96 (0.41)	7.96 (0.54)	7.94 (0.51)	7.93 (0.63)	7.95 (0.56)
Contracts	24	68	31	53	176
Observations	16,783	49,488	7,281	43,190	116,742

return

Appendix: Meteorological Data

	AB	BC (inland)	BC (coast)	ON	Total
Temp/Wind Stations' Distance (km)	32.65 (21.63)	27.55 (19.81)	43.58 (15.85)	36.21 (16.29)	32.49 (19.25)
Precip Stations' Distance (km)	39.30 (26.15)	16.48 (17.26)	22.34 (13.94)	37.02 (18.09)	27.72 (21.55)
Temperature (°C)	16.86 (4.42)	17.46 (4.83)	9.97 (2.51)	16.22 (5.55)	16.46 (5.25)
Wind Speed (km/h)	11.94 (6.03)	9.91 (5.00)	16.53 (9.06)	12.17 (5.26)	11.45 (5.83)
Precipitation (mm)	3.38 (7.26)	1.72 (3.88)	8.02 (11.13)	2.94 (6.48)	2.77 (6.23)

return

Appendix: Robustness Check

Dependent Variable:	Productivity in Dollar Value			
Model:	(1)	(2)	(3)	(4)
Variables				
Nominal Min Wage	0.49641***	0.81676***	0.62582***	0.57720***
	(0.10987)	(0.12525)	(0.13383)	(0.12220)
Top-up	-3.01717***	-3.11673***	-3.21277***	-3.26150***
	(0.51393)	(0.52215)	(0.52113)	(0.49665)
Min Wage × Top-up	0.71939***	0.77089***	0.79549***	0.81532***
	(0.22941)	(0.23075)	(0.23015)	(0.22137)
Piece Rate	0.14817***	0.12317***	0.19555***	0.08493*
	(0.04112)	(0.04086)	(0.04732)	(0.04631)
Piece Rate × Top-up	-0.19643***	-0.19439***	-0.21171***	-0.22910***
	(0.07339)	(0.07374)	(0.07409)	(0.06976)
Experience	0.00406***	0.00490***	0.00516***	0.00664***
	(0.00045)	(0.00049)	(0.00049)	(0.00048)
Experienc2	-0.00001***	-0.00002***	-0.00002***	-0.00002***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Temperature	0.00482***	0.00492***	0.00332***	0.00214**
	(0.00103)	(0.00103)	(0.00106)	(0.00095)
Precipitation	-0.00015	-0.00030	0.00016	0.00014
	(0.00052)	(0.00051)	(0.00045)	(0.00044)
Wind Speed	-0.00238***	-0.00226***	-0.00115*	-0.00107
	(0.00067)	(0.00067)	(0.00069)	(0.00066)
Fixed-effects				
id	Yes	Yes	Yes	Yes
year		Yes	Yes	
region			Yes	
contract				Yes
Fit statistics				
Observations	106,567	106,567	106,567	106,567
R^2	0.72663	0.73008	0.73290	0.75407
Within R^2	0.45527	0.43107	0.43130	0.42450

Clustered (contract) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

return

Primary Results (Full)

Dependent Variable:	Productivity in Dollar Value			
Model:	(1)	(2)	(3)	(4)
Variables				
Min Wage	0.50734***	0.71663***	0.64223***	0.56528***
	(0.13779)	(0.14505)	(0.13614)	(0.12781)
Top-up	-3.00379***	-3.12935***	-3.19926***	-3.25933***
	(0.52312)	(0.52788)	(0.52206)	(0.49679)
Min Wage × Top-up	0.71688***	0.77568***	0.78947***	0.81425***
	(0.23240)	(0.23298)	(0.23052)	(0.22148)
Piece Rate	0.13450***	0.09894**	0.19596***	0.08572*
	(0.04144)	(0.04000)	(0.04728)	(0.04637)
Piece Rate × Top-up	-0.19307***	-0.19444***	-0.21164***	-0.22915***
	(0.07364)	(0.07387)	(0.07407)	(0.06968)
Experience	0.00420***	0.00487***	0.00518***	0.00668***
	(0.00045)	(0.00050)	(0.00049)	(0.00048)
Experienc2	-0.00001***	-0.00002***	-0.00002***	-0.00002***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Temperature	0.00488***	0.00523***	0.00339***	0.00217**
	(0.00103)	(0.00104)	(0.00105)	(0.00095)
Precipitation	-0.00011	-0.00016	0.00017	0.00015
	(0.00052)	(0.00051)	(0.00045)	(0.00044)
Wind Speed	-0.00233***	-0.00213***	-0.00114	-0.00107
	(0.00068)	(0.00068)	(0.00069)	(0.00066)
Fixed-effects				
id	Yes	Yes	Yes	Yes
year		Yes	Yes	
region			Yes	
contract				Yes
Fit statistics				
Observations	106,567	106,567	106,567	106,567
R^2	0.72618	0.72930	0.73294	0.75404
Within R^2	0.45438	0.42943	0.43137	0.42443

Clustered (contract) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*