Remote Work and Employment Dynamics under COVID-19: Evidence from Canada

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Les auteurs constatent que 41 pour cent des emplois au Canada peuvent être exercés à distance, la situation variant toutefois beaucoup selon les provinces, les villes et les secteurs d'activité. Ils étayent ce constat à l'aide de microdonnées relatives au travail et documentent les faits sur la relation entre la praticabilité du travail à distance et l'inégalité des revenus, le sexe, l'âge et d'autres caractéristiques des travailleurs. Les auteurs montrent ensuite que, pour certaines de leurs spécifications, chez les travailleurs occupant des fonctions pour lesquelles la possibilité de travailler à distance est moindre, les pertes d'emploi sont plus importantes entre mars et avril. Cette relation ne semble toutefois pas s'avérer pour les pertes d'emploi des travailleurs occupant des postes pour lesquels les possibilités de travail à distance varient, que ce soit en fonction des secteurs d'activité ou des provinces ou des villes.

Mots clés : Canada, COVID-19, marchés du travail, suppression d'emplois, travail à distance

In this study, we find that 41 percent of jobs in Canada can be performed remotely, with significant variation across provinces, cities, and industries. We complement this finding with labour microdata and document facts on the relationship between the feasibility of remote work and income inequality, gender, age, and other worker characteristics. We then show that, under some of our specifications, workers in occupations for which the possibility of remote work is less likely experienced larger employment losses between March and April. This relationship however does not seem to hold for a different measure of the possibility of remote work or for employment losses across industries with different possibilities of remote work nor across provinces or cities with different possibilities of remote work.

Keywords: Canada, COVID-19, job destruction, labour markets, remote work

Introduction

Social distancing is costly because some jobs cannot be performed at home. A key estimate to assess the economic impact of the coronavirus 2019 (COVID-19) pandemic is the percentage of jobs that can be done remotely. With this motivation, in this article we focus on Canada and estimate the feasibility of working from home, as well as the heterogeneity of this variable along several dimensions. We then measure employment changes during March and April 2020 and compare these changes with the computed feasibility of working remotely.

First, we provide a literature review and describe our contribution. We then compute the percentage of jobs that can be performed at home. We find that 41 percent of jobs in Canada can be performed remotely, with significant variation across provinces, cities, and industries. Next, we use labour microdata and document that poorer workers, male workers, workers without a college degree, private sector workers, single workers, small firm workers, seasonal or contractual workers, part-time workers, younger workers, and non-immigrant workers tend to be employed in jobs for which remote work is less possible. We then show that workers in occupations for which the possibility of remote work is less likely experienced larger employment losses between March and April. This relationship however does not seem to hold for a different measure of the possibility of remote work or for employment losses across industries with different possibilities of remote work nor across provinces or cities with different possibilities of remote work.

Literature Review

We follow the methodology in Dingel and Neiman (2020) to measure the percentage of jobs that can be done at home. This methodology has since been applied to other countries. For instance, Saltiel (2020) focuses on a sample of

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developing countries. We complement this methodology with worker characteristics. The worker characteristics and distributional aspect have been studied by, among others, Mongey, Pilossoph, and Weinberg (2020) and Yasenov (2020) in the United States, Lekfuangfu et al. (forthcoming) in Thailand, and Foschiatti and Gasparini (2020) in Argentina. We contribute to this literature by adding Canadian estimates. Our results are in line with all these findings.[1]

In terms of employment dynamics, our article is closest to Mongey et al. (2020), who report a link between remote work feasibility and changes in employment in March (in the United States). Other articles study job vacancies. Lange and Warman (2020) report that in Canada very rapid declines in vacancy postings occurred as the COVID-19 crisis brought the economy to a halt in mid-March. Postings declined by up to 50 percent until mid-April. Kahn, Lange, and Wiczer (2020) study the changes in job vacancies and unemployment insurance claims for different occupations and industries during the pandemic in the United States.

Remote Work Estimation

We apply the methodology of Dingel and Neiman (2020) to Canadian data. The main idea in Dingel and Neiman is to classify the feasibility of working at home for all occupations and merge this classification with occupational employment counts. The feasibility measure is based on responses to two Occupational Information Network (O*NET) surveys.[2] Dingel and Neiman estimate that as much as 37 percent of jobs can plausibly be done from home in the United States, and they provide estimates for a large sample of countries (but not Canada).

We use Statistics Canada's Employment Income Statistics (EIS), a tabulation from the 2016 Census that contains four-digit occupation classification employment counts at the provincial, city, and territorial levels (51 geographic areas in total). Classification codes correspond to the National Occupational Classification (NOC). The EIS also contains average income, which we use to compute percentage of wages (in addition to percentage of jobs).

We use the Brookfield Institute for Innovation + Entrepreneurship (BII+E) cross-walk of O*NET with NOC. We then merge the occupations in NOC with O*NET's binary remote work index computed by Dingel and Neiman (2020). We call this the benchmark remote work index.[3]

As a robustness check, we then manually assign values for the NOC occupation categories, using introspection (as in the robustness check in Dingel and Neiman 2020) and call this the alternative remote work index.[4] Appendix A, Table A.1 reports the four-digit occupation codes for which the two measures differ the most. On the one hand, according to our benchmark classification, engineers and journalists cannot work from home, whereas in our alternative classification they can. On the other hand, in our benchmark classification, photographers, painters, air traffic controllers, administrative assistants, land survey technologists, technicians and forestry professionals can work from home, whereas in the alternative classification they cannot.

Results

According to our estimates, 41 percent of jobs in Canada can be done from home. When weighted by wages, this percentage increases to 51 percent. The robustness check estimates for our alternative specification are in line with these percentages but are somewhat lower—37 percent and 48 percent, respectively (all robustness checks are available in the replication package, available at https://github.com/guillgall/remotework_dynamics). The higher estimate when weighting by wages indicates that higher-wage jobs tend to be associated with jobs that can be more easily performed remotely. We return to this point later with the microdata. Dingel and Neiman (2020) estimate the percentage of jobs that can be done at home in the United States at 37 percent. Even though Dingel and Neiman do not report Canadian estimates, our results are consistent with their international evidence.[5]

As can be seen in Table 1, considerable heterogeneity exists among Canadian provinces. Ontario has a high share of jobs that can be done at home (44 percent), and Newfoundland and Labrador has the least amount of jobs can be done at home (32 percent).

We also observe heterogeneity at the city level. In Table 2, we report the estimates for the 10 largest cities. Ottawa, Toronto, and Montreal lead this remote work ranking (with roughly half of jobs being able to be done from home). We also include in the last row the aggregated smaller cities estimate.

The full sample of cities can be seen in Table A.2. Figure 1 shows the relationship between the estimated share of jobs that can be performed remotely and city size. As can be observed, the relationship is positive and non-linear.

Last, Table A.3 reports the territorial distribution. The Northwest Territories, Yukon, and Nunavut do not show

Table 1: Share of Jobs that Can Be Done at Home, by Province

Province	Unweighted	Weighted by Wages
Ontario	0.44	0.55
Quebec	0.42	0.51
British Columbia	0.41	0.48
Alberta	0.39	0.47
Manitoba	0.38	0.45
Nova Scotia	0.38	0.45
New Brunswick	0.37	0.43
Saskatchewan	0.35	0.41
Prince Edward Island	0.35	0.43
Newfoundland and Labrador	0.32	0.38

Source: Authors' calculations.

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Table 2: Share of Jobs that Can Be Done at Home, Ten Largest Cities and (Aggregated) Smaller Cities

City	Unweighted	Weighted by Wages	National Employment Share
Ottawa–Gatineau	0.52	0.63	0.04
Toronto	0.49	0.63	0.17
Montreal	0.46	0.56	0.12
Calgary	0.46	0.59	0.04
Quebec City	0.45	0.54	0.02
Vancouver	0.45	0.55	0.07
Hamilton	0.42	0.52	0.02
Winnipeg	0.42	0.50	0.02
Kitchener, Cambridge, Waterloo	0.42	0.52	0.02
Edmonton	0.40	0.45	0.04
Rest of smaller cities	0.40	0.46	0.16

Source: Authors' calculations.

much difference, at roughly 42 percent. We also provide an estimate for rural areas, which have a remote work index of 32 percent and contain 27 percent of Canada's employment.[6]

Worker Characteristics and Employment Dynamics

Next, we explore the Labour Force Survey (LFS), which contains Canadian labour microdata at the two-digit occupation level. We assign remote index values by taking a weighted average across the four-digit subcategories.

In Tables A.4 and A.5, we document that the provincial and city estimates using the LFS are consistent with those reported earlier. In addition, in Table A.6 we report the estimation by industry: as can be observed, sectors such as finance and insurance report the largest percentage of ability to perform remote work, whereas agriculture reports the lowest percentage.

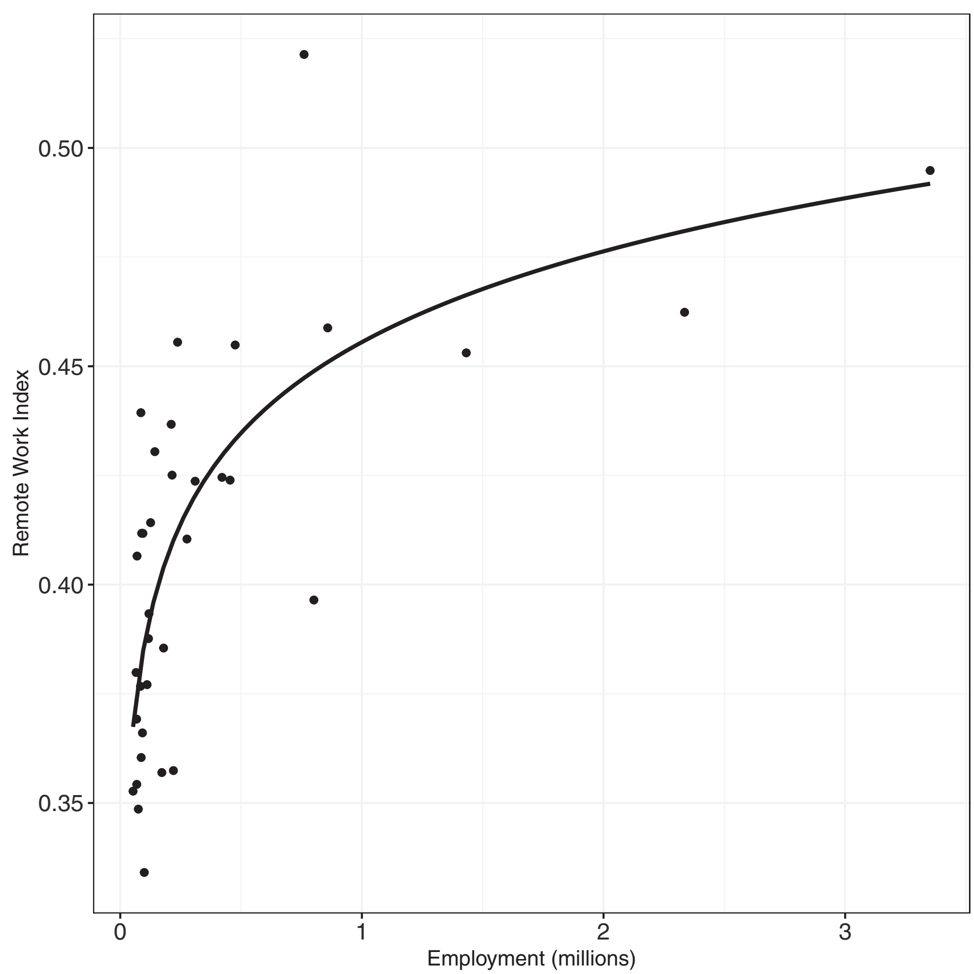

Figure 1: Remote Work Index and City Size by Employment

Source: Authors' calculations.

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Worker Characteristics

What type of workers are more vulnerable to this labour market shock? We use LFS 2019 data to document correlations between worker characteristics and the possibility of working from home. We first explore the distributional dimension. In Figure 2, we report the remote work index by percentile of the income distribution.

This figure shows that higher-income workers are on average more likely to be able to work from home. This would suggest that social distancing is regressive, in the sense that poorer workers tend to work in jobs that are more difficult to perform remotely. Note that this is consistent with the findings in the previous section on the higher share of jobs that can be done at home when weighting by wages.[7]

We then explore other worker characteristics. Here we follow the methodology in Mongey et al. (2020), who focused on the United States. We run a simple regression as in Mongey et al. Let y_{ij} be a characteristic of a worker i who reports working in occupation j in 2019. We construct binary variables based on the worker characteristics of LFS 2019; for example, we construct a variable y_{ij} if the continuous variable wage is above the median. We then estimate the following regression for each of our observables, where S_j is the two-digit occupation remote work score:

$$y_{ij} = \alpha_y + \beta_y S_j + \varepsilon_{ij}. \quad (1)$$

We then plot the values for $\hat{\beta}_y$ in Figure 3. As an example to understand the interpretation of $\hat{\beta}_y$, let us take the case of below-median income: because $\hat{\beta}_y < 1$, then workers with below-median income tend to be in occupations that are less likely to be performed remotely. This

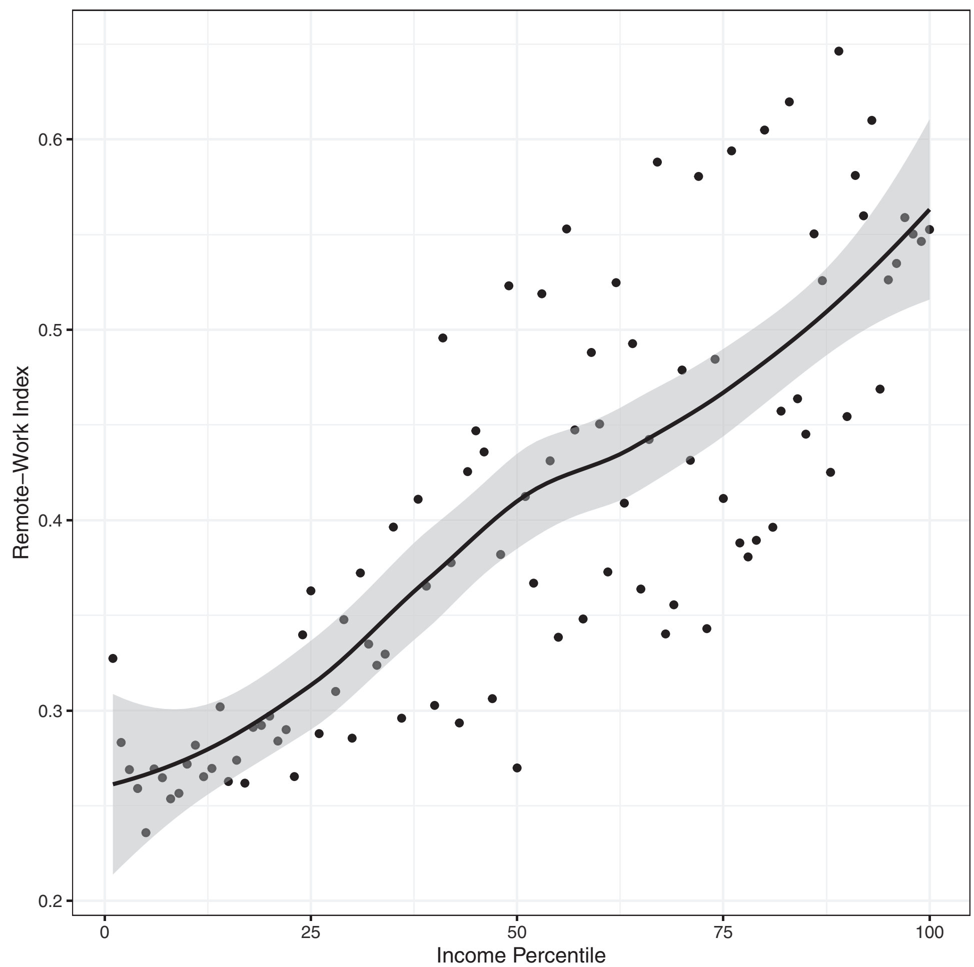

Figure 2: Remote Work Index and the Distribution of Income

Note: Each dot represents the average of the corresponding percentile, and the line represents the conditional mean with corresponding standard errors.

Source: Authors' calculations.

is consistent with the findings reported earlier (share of wages is higher than share of jobs) as well as with the discussion of Figure 2.

Our results suggest that poorer workers, male workers, workers without a college degree, private sector workers, single workers, small firm workers, seasonal or contractual workers, part-time workers, younger workers, and non-immigrant workers tend to be employed in jobs for which remote work is less possible. These results are overall consistent with the findings of Mongey et al. (2020) for the United States.

Employment Dynamics

We then obtain the March and April 2020 LFS data and compare them with the February 2020 data (before the social distancing measures in Canada). In Figure 4, we can see the correlations between the monthly percentage change in employment and the remote work index at the two-digit occupation level. Between March and April 2020 (Figure 4b), the relationship was positive: the two-digit occupations that had higher remote work scores experienced smaller (less negative) employment declines. However, no such relationship exists for February–March 2020 (Figure 4a). Here we are using the alternative remote work index.

We then control for jobs deemed essential by public policy. For example, front-line medical workers have a low remote work index (0), but because they have been declared essential, they can continue to work. We construct an essential service dummy variable to take this important caveat into account.[8] We also construct a continuous essential service variable: we use the four-digit essential service binary classification done by the Labour Market Information Council (LMIC) and aggregate it into two digits by taking employment weighted averages, thus making the index no longer binary.[9]

We formally test this relationship. For an occupation j, let employment be q_j and denote $\Delta q_{j,t,\tau}$ as the percentage of change in employment between period t and τ. We then

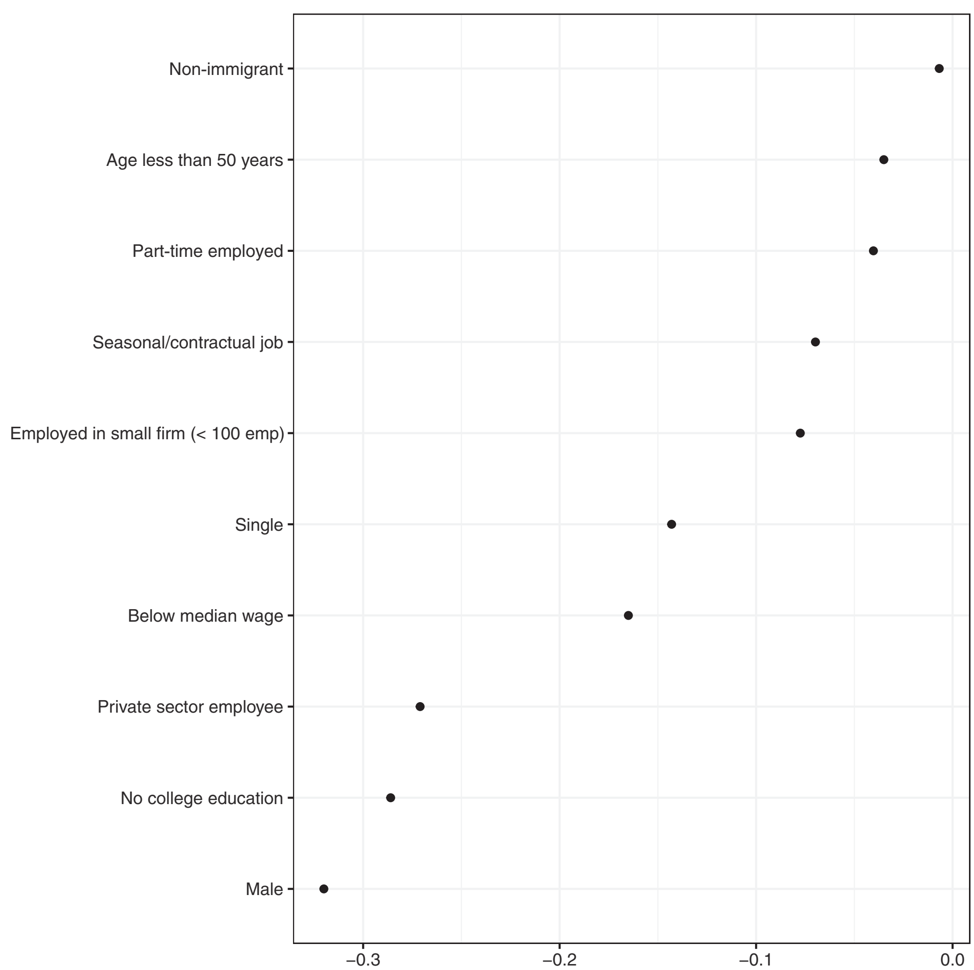

Figure 3: Worker Characteristics and Likelihood of Having a Job that Can Be Done at Home
Source: Authors' calculations.

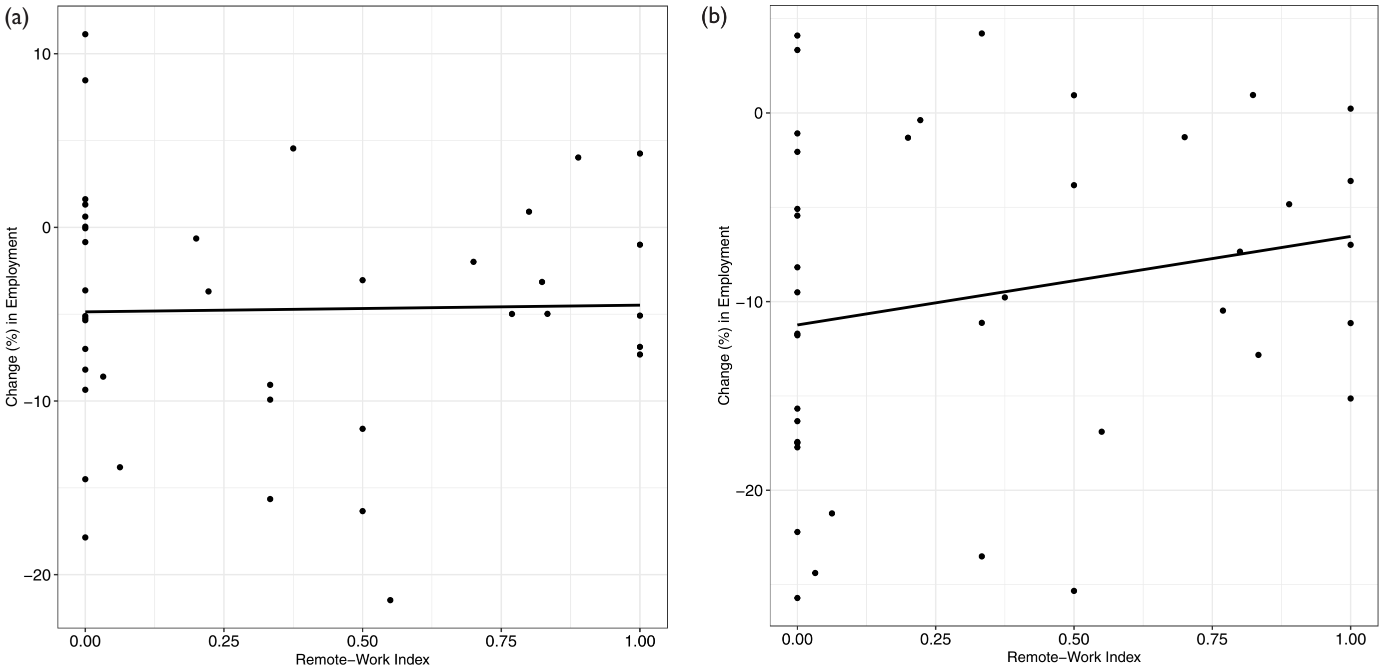

Figure 4: Employment Dynamics and Remote Work Index (Two-Digit Occupation): (a) February–March 2020 and (b) March–April 2020
Source: Authors' calculations.

run the following Ordinary Least Squares regression, where S_j is the remote work score of occupation j and ES_j is the "essential-service" continuous variable (or the "essential service" dummy variable as described in the previous paragraph):

$$\Delta q_{j,t,\tau} = \alpha_j + \beta_1 S_j + \beta_2 ES_j + \varepsilon_j. \quad (2)$$

When we run this regression with the benchmark remote work index, this index is not significant for any of the month-to-month changes. We report those results in our online Appendix B. In Table 3, we report the results using our alternative remote work index and the essential service variable. As can be observed, the remote work index score variable is positive and statistically significant only for the March–April change. The lack of statistical significance for the January–February change (the before-social-distancing observation) is expected but is more surprising in the case of February–March. As we report in the online Appendix B, a significant relationship also holds at the ten NOC broad occupation level for the March–April variation, under both the benchmark and alternative remote work index.

The relationship is however no longer statistically significant under other specifications for the two-digit occupation level: in online Appendix B, we provide all other specifications (benchmark remote work index, essential service dummy variable, both benchmark remote work index and essential service dummy variable), as well as the regression tables at the industry, province and city level.

Conclusion

The magnitude of the COVID-19 shock on labour markets is historic. Policy-makers around the world are responding as fast as possible to mitigate this shock. Understanding and designing policy during the crisis and after it (ease of lockdown and relaxing of social distancing) is crucial.

This article has three main results:

1. We find that 41 percent of jobs in Canada can be performed remotely, with significant variation across provinces, cities, and industries.
2. We complement this finding with labour microdata and document facts on the relationship between remote work and worker characteristics; our results suggest that poorer workers, male workers, workers without a college degree, private sector workers, single workers, small firm workers, seasonal or contractual workers, part-time workers, younger workers, and non-immigrant workers tend to be employed in jobs for which remote work is less possible.
3. We show that, under some of our empirical specifications, workers in occupations with less possibility for remote work experienced larger employment losses between March and April. This relationship however does not seem to hold for a different measure of

Table 3: Employment Change and Remote Work Index: Two-Digit Level

	Monthly Percentage Change in Employment							
	$\Delta q_{j,Jan,Feb}$		$\Delta q_{j,Feb,Mar}$		$\Delta q_{j,Mar,Apr}$		$\Delta q_{j,Feb,Apr}$	
Covariate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S_j *(Alternative)*	−0.393	−0.439	1.452	1.586	6.020	6.659*	6.977	7.693
	(2.483)	(2.524)	(3.377)	(3.426)	(4.045)	(3.935)	(5.515)	(5.447)
ES_j		−0.605		1.749		8.355*		9.351
		(2.880)		(3.908)		(4.489)		(6.213)
Constant	0.838	1.008	−5.211***	−5.702***	− 11.605***	−13.951***	−16.020***	−18.645***
	(1.166)	(1.431)	(1.586)	(1.942)	(1.900)	(2.231)	(2.590)	(3.088)
No. of observations	40	40	40	40	40	40	40	40
R^2	0.001	0.002	0.005	0.010	0.055	0.136	0.040	0.096
Adjusted R^2	−0.026	−0.052	−0.021	−0.043	0.030	0.089	0.015	0.047

Notes: $\Delta q_{j,t,\tau}$ is the percentage of change in employment between month *t* and τ in occupation *j*, *Sj* (*Alternative*) is the remote work index, and ES_j is the essential service variable.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: Authors' calculations.

the possibility of remote work or for employment losses across industries with different possibilities of remote work nor across provinces or cities with different possibilities of remote work.

Future work with updated data could extend and improve on the empirical findings. For instance, measuring the share of productivity or output (potentially produced remotely) instead of jobs seems important. It will also be relevant to study the impact of policy, such as the Canada Emergency Response Benefit financial support.

Acknowledgements

The replication package for this project is available at https://github.com/guillgall/remotework_dynamics. We thank Umut Oğuzoğlu, Janelle Mann, Ian Hudson, an anonymous guest editor, and participants at the University of Manitoba online brownbag for comments. Mahesh Acharya and Shantanu Debbarman provided excellent research assistance. We also thank Mary Lui (University of Toronto Press) for feedback and suggestions. Any errors are our own.

Notes

1 Our overall remote-work estimate for Canada (41 percent) seems to also be in line with the estimations by Chen and Mehdi (2019), who calculate that 41.5 percent of workers in Canada can choose their start and end time at work. Chen and Mehdi (2019) provide other important stylized facts on the labour market. The estimates by Statistics Canada (which were published after our paper was accepted) for remote work at the aggregate and provincial level are in line with our estimates, although their estimates at the industrial level show more dispersion than ours. They also study heterogeneity along income, education, gender and age. See Deng, Morissette, and Messacar (2020).

2 These are the Work Context and Generalized Work Activities surveys, which provide data on whether an occupation requires daily work outdoors, operation of vehicles, mechanized devices, equipment, physical activities, and other characteristics relevant for the possibility of remote work.

3 One issue that we faced was that the O*NET occupation classification in BII+E and Dingel and Neiman (2020) have some discrepancies. After merging with the NOC data, 17 occupations were dropped. Please refer to the replication package for details.

4 Two of our research team manually assigned values of 0, 0.5, and 1.0 to each four-digit NOC code, which we then averaged.

5 See Figure 2 in Dingel and Neiman (2020) and recall that Canada's gross domestic product per capita is around US$46,000.

6 The rural estimate was computed indirectly, because we only observe urban and aggregate employment: employment in Canada is the sum of rural and urban employment, $E_{CAN} = E_{Rural} + E_{Urban}$. Moreover, the remote work share for Canada, S_{CAN}, is a weighted average of the urban and rural shares, $S_{CAN} = \frac{E_{Urban}}{E_{CAN}} \times S_{Urban} + \frac{E_{Rural}}{E_{Can}} \times S_{Rural}$. Using the first equation in the second and rearranging yields $S_{Rural} = \frac{E_{Can} \times S_{Can} - E_{Urban} \times S_{Urban}}{E_{Can} - E_{Urban}}$.

7 However, one can argue whether health outcomes should be included in the trade-off. If so, social distancing might not be regressive (or at least not as much as this figure suggests). This is because vulnerability to COVID-19 might decrease with income. Future research and evidence might shed light on this issue.

8 We intuitively match the two-digit occupations to the essential service sectors as listed by Public Safety Canada: energy and utilities, information and communication technologies, finance, health, food, water, transportation, safety, government, and manufacturing. We are aware of the subjectivity involved in the construction of this dummy variable. We thus complement this with the alternative essential service variable as robustness check (as described next).

9 These two essential service measures turn out to have some differences. For instance, occupations linked with finance and manufacturing were labelled as essential by us but had a low LMIC score. We treated them as essential because Public Safety Canada linked both finance and manufacturing as essential service sectors.

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Appendix A: Plots and Tables

Table A.1: Comparison of the Benchmark Remote Work Index and the Alternative Remote Work Index

Occupation	Benchmark	Alternative
0621 Retail and wholesale trade managers	1	0
1222 Executive assistants	1	0
2254 Land survey technologists and technicians	1	0
1211 Supervisors, general office and administrative support workers	1	0
1214 Supervisors, mail and message distribution occupations	1	0
4422 Correctional service officers	1	0
5232 Other performers, n.e.c.	1	0
5221 Photographers	1	0
1215 Supervisors, supply chain, tracking and scheduling co-ordination occupations	1	0
0632 Accommodation service managers	1	0
6232 Real estate agents and salespersons	1	0
5252 Coaches	1	0
5241 Graphic designers and illustrators	1	0
5231 Announcers and other broadcasters	1	0
5136 Painters, sculptors, and other visual artists	1	0
1241 Administrative assistants	1	0
4423 By-law enforcement and other regulatory officers, n.e.c.	1	0
2174 Computer programmers and interactive media developers	1	0
1435 Collectors	1	0
2272 Air traffic controllers and related occupations	1	0
2115 Other professional occupations in physical sciences	1	0
9472 Camera, platemaking, and other prepress occupations	1	0
5132 Conductors, composers, and arrangers	1	0
2122 Forestry professionals	1	0
1314 Assessors, valuators, and appraisers	0	1
2132 Mechanical engineers	0	1
6222 Retail and wholesale buyers	0	1
2241 Electrical and electronics engineering technologists and technicians	0	1
2141 Industrial and manufacturing engineers	0	1
2232 Mechanical engineering technologists and technicians	0	1
5243 Theatre, fashion, exhibit, and other creative designers	0	1
5123 Journalists	0	1

Note: n.e.c. = not elsewhere classified.

Source: Authors' calculations.

Table A.2: Share of Jobs that Can Be Done at Home, by City

City	Unweighted	Weighted by Wages
Ottawa–Gatineau (Ontario part)	0.53	0.65
Ottawa–Gatineau	0.52	0.63
Toronto	0.49	0.63
Ottawa–Gatineau (Quebec part) City	0.49	0.58
Montreal	0.46	0.56
Calgary	0.46	0.59
Halifax	0.46	0.54
Quebec City	0.45	0.54
Vancouver	0.45	0.55
Moncton	0.44	0.52
Victoria	0.44	0.52
Regina	0.43	0.50
Oshawa	0.43	0.50
Hamilton	0.42	0.52
Winnipeg	0.42	0.50
Kitchener, Cambridge, Waterloo	0.42	0.52
St. John's	0.41	0.49
Kingston	0.41	0.49
Guelph	0.41	0.51
London	0.41	0.49
Saint John	0.41	0.46
Edmonton	0.40	0.45
Sherbrooke	0.39	0.46
Barrie	0.39	0.45
Saskatoon	0.39	0.45
Peterborough	0.38	0.45
Kelowna	0.38	0.43
Trois Rivieres	0.38	0.44
Thunder Bay	0.37	0.41
Greater Sudbury	0.37	0.40
Saguenay	0.36	0.40
St. Catharines, Niagara	0.36	0.43
Windsor	0.36	0.43
Lethbridge	0.35	0.40
Belleville	0.35	0.40
Brantford	0.35	0.42
Abbotsford–Mission	0.33	0.38

Source: Authors' calculations.

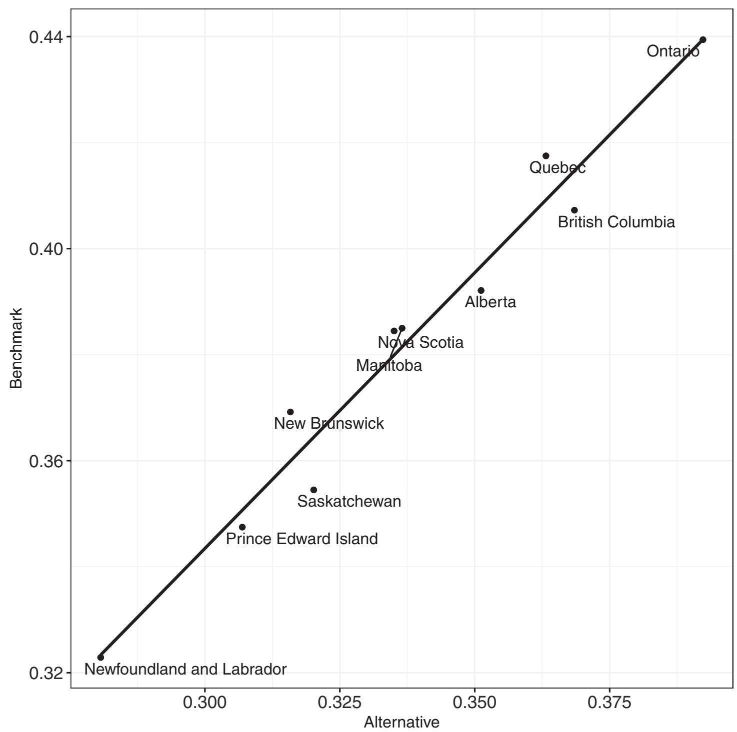

Figure A.1: Index Comparison
Source: Authors' calculations.

Table A.3: Share of Jobs that Can Be Done at Home, by Territory

Territory	Unweighted	Weighted by Wages
Northwest Territories	0.43	0.50
Yukon	0.42	0.48
Nunavut	0.42	0.53

Source: Authors' calculations.

Table A.4: Share of Jobs that Can Be Done at Home, by Province (Labour Force Survey Estimates)

Provinces	Benchmark	Alternative
Ontario	0.41	0.39
Alberta	0.39	0.38
British Columbia	0.39	0.37
Nova Scotia	0.39	0.37
Quebec	0.39	0.37
Canada	0.39	0.37
Manitoba	0.38	0.36
New Brunswick	0.38	0.36
Newfoundland and Labrador	0.38	0.36
Saskatchewan	0.38	0.36
Prince Edward Island	0.37	0.35

Source: Authors' calculations.

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Table A.5: Share of Jobs that Can Be Done at Home, by City (Labour Force Survey Estimates)

City	Benchmark	Alternative	National Employment Share
Ottawa	0.45	0.42	0.03
Hamilton	0.42	0.40	0.02
Montreal	0.42	0.40	0.11
Toronto	0.42	0.40	0.18
Calgary	0.41	0.39	0.04
Vancouver	0.41	0.38	0.07
Edmonton	0.39	0.37	0.04
Quebec	0.39	0.37	0.02
Winnipeg	0.39	0.37	0.02
Other CMA or non-CMA	0.38	0.36	0.46

Note: CMA = Census Metropolitan Area.

Source: Authors' calculations.

Table A.6: Share of Jobs that Can Be Done at Home, by Industry (Labour Force Survey Estimates)

Sector	Benchmark	Alternative
Finance and insurance	0.62	0.57
Real estate and rental and leasing	0.46	0.42
Wholesale trade	0.44	0.41
Professional, scientific, and technical services	0.43	0.41
Educational services	0.42	0.40
Health care and social assistance	0.41	0.38
Information, culture, and recreation	0.41	0.39
Utilities	0.39	0.38
Construction	0.39	0.38
Retail trade	0.39	0.36
Transportation and warehousing	0.39	0.38
Accommodation and food services	0.39	0.35
Total	0.39	0.37
Other services (except public administration)	0.38	0.36
Manufacturing—durable goods	0.37	0.36
Public administration	0.37	0.35
Manufacturing—non-durable goods	0.35	0.33
Business, building, and other support service	0.34	0.32
Mining, quarrying, and oil and gas extraction	0.32	0.32
Forestry and logging and support activities for forestry	0.25	0.27
Fishing, hunting, and trapping	0.18	0.19
Agriculture	0.17	0.22

Source: Authors' calculations.