Occupational factors affecting the safe reopening of the economy

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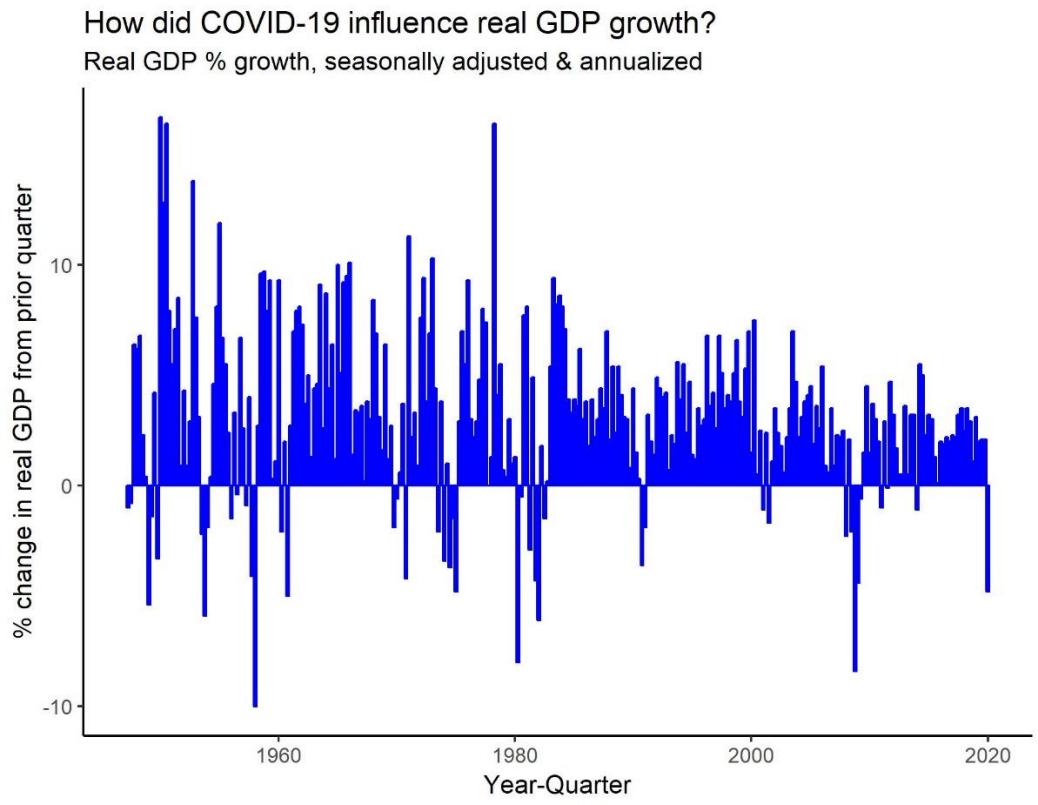
1 Introduction

COVID-19's impact on the economy is easy to understate. According to the U.S. Bureau of Economic Analysis, U.S. GDP contracted at an annual rate of ~5% in 2020 Q1 (Figure 1). Yet, this estimate does not capture the country's full economic woes, as COVID-19's impact on day-to-day lives did not begin in earnest until March, the very end of the quarter. Nor do available numbers on unemployment and consumer sentiment, which are mostly based on early-March surveys. And even if these numbers were available at hand, they would soon prove outdated by the speed of change in COVID-19's impact on the economy.

Figure 1: Annualized percent changes in real GDP, quarterly



Notes: Data are from the U.S. Bureau of Labor Statistics.

As the caseload and number of daily deaths decrease from an early-April high, the U.S. has drifted into unchartered waters. Over the next few months, the federal government and the nation's state governors will collaborate in a novel policy

experiment: how best to reopen the economy while protecting public health. This tradeoff is unavoidable. When the economy reopens, face-to-face discussions *sans* Zoom and virtual-less physical contact may lead to local hotspots of COVID-19 transmission. At the same time, the longer people are out of work and businesses out of revenue, the harder it will be for the state economy to reach its pre-COVID-19 state.

Government officials across the U.S. have publicly discussed the need for a measured economic reopening strategy that balances economic revitalization without sacrificing public health. As data scientists at the Rochester Data Science Consortium, we believe that a **measured** approach to the state's reopening requires a reliance on data.

In this white paper, we outline a general approach to economic reopening for New York and the country at large that mitigates COVID-19 transmission risk through two primary mechanisms:

(1) Encourage employers to continue work-from-home policies for **employees in occupations that can perform their work tasks from home**
(2) Provide employers with mitigation strategies for **employees in occupations that are most at risk of COVID-19 transmission**

Rather than use intuition to identify the groups of occupations in bold, we outline a data-driven approach built on a novel database of standard workplace activities and contexts by occupation and industry. This database is from the U.S. Bureau of Labor Statistics' (BLS) Occupational Information Network (O*NET) surveys. Our approach uses these surveys to rank occupations and, subsequently, industries on the degree to which their work environment is (1) conducive to teleworking, and (2) presents large risks of COVID-19 transmission. This approach builds on research from the University of Chicago and elsewhere (Dingel and Neiman, 2020; Jin and McGill, 2020), though we extend this earlier work to encompass a wider set of factors that make a job more-or-less teleworkable and risky.

2 Background

The U.S. BLS O*NET database contains information on workplace activities, contexts, and tasks for nearly 1,000 of the most common occupations in the U.S. These data are one of the primary sources of occupational information. These surveys contain details on education and experience typical of occupations, as well as the day-to-day workplace environment and common activities associated with the occupation. Recently, these data have been used by multiple research groups to identify the relative feasibility of remote working by industry, most prominently Dingel and Neiman (2020).

3 Our Framework

Our objectives in this paper are to bring data to bear on the occupation-level (1) feasibility of continued remote work and (2) COVID-19 transmission risk profile. We also want to build on (2) by providing occupation-level information of the specific work activities and contexts that lead to enhanced risk of COVID-19 transmission. This information is relevant to risk mitigation strategies.

3.1. Remote-Feasibility Index

We first describe our approach in defining the degree to which an occupation can be worked from home. We generally follow Dingel and Neiman (2020), though we expand the list of work activities and contexts that cannot be worked from home. At a high-level, for each occupation in the database, we calculate the percentage of workers that have some type of work activity or context that precludes them from working at home as part of their day-to-day life. This is generally measured by identifying whether the particular work activity or context is either:

- Performed at least once a week in the occupation
- Very or extremely important or relevant to the occupation
- Takes at least half of the time spent in the occupation

A full list of these work activities and contexts are listed in the Tables A1 and A2, respectively.

We do two things to measure feasibility of working from home. We first create a continuous scale from 0-100 with higher values indicating greater feasibility of working from home. This scale gives one a *relative* sense of an occupation's remote-feasibility and is especially useful for visualization purposes. However, it is not ideal for decision-making because it's not operational. In our second measure, we define the occupation as remote-workable if its continuous index from 0-100 is greater than 50. Although this threshold is arbitrary, it matches well with the classification performed by Dingel and Neiman (2020).[1] Hypothetically, this binary variable can be used in decision support to determine which occupations should be encouraged to stay home and work remotely versus those that should be allowed to resume normal operations, all else being equal.

3.2. The COVID-19 Scale

Additionally, we build on Dingel and Neiman (2020) and use the O*NET data to produce a scale of risk of transmission of COVID-19 by occupation. Specifically, we argue that not all industries and occupations have the same inherent risk of COVID-19 transmission, and this risk manifests in different ways. We call this scale, quite simply, the **COVID-19 Scale**.

[11] Using this scale, our classifications of teleworkable vs. non-teleworkable match over 87% of the time.

We identify those work activities and contexts most likely to enhance the risk of COVID-19 transmission upon return to normal work operations. These include the following:

- Physical proximity with others within at least arm's length during workday
- A high degree of importance of assisting and caring for others
- Exposure to disease or infections

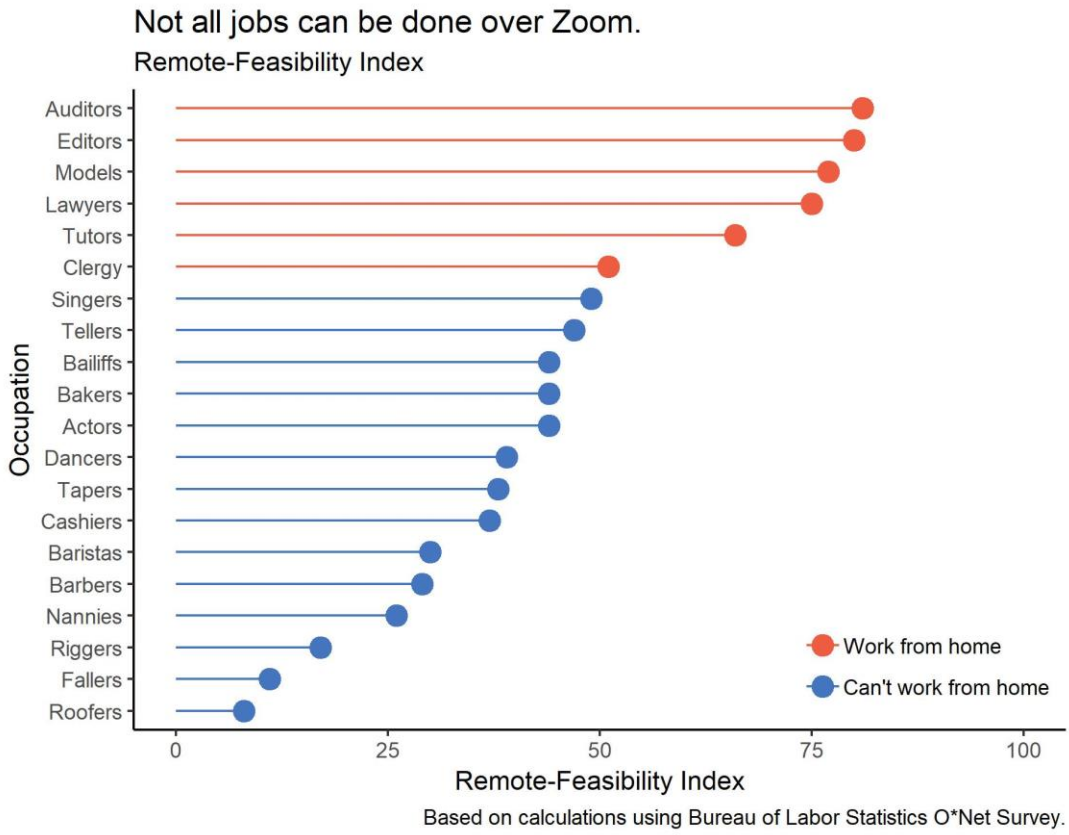
We again create a 0-100 score that measures the growing risk of COVID-19 transmission to/from others. For decision support we create an indicator of whether the occupation has a high degree of risk of transmission of COVID-19. We base our assignment of risk transmission by whether the occupation's continuous COVID-19 risk scale is greater than or equal to 50. We do not have an analogous study to benchmark this threshold, though it is consistent with our approach for Remote-Feasibility Index.

4 Results

4.1. Remote-Feasibility Index

In Figure 2, we provide a sample of our occupation-level estimates of the feasibility that the occupation can be worked from home. Increases in the Remote-Feasibility Index correspond to increased ability of the occupation to be worked from home. We also show that auditors, lawyers, and tutors are more teleworkable than roofers, barbers, and nannies. The latter group of occupations are more physical or demand more interaction between the employees and a customer. Holding all else equal, we argue that the former group should be encouraged to work from home. For the latter group, our recommendation would be dependent on some combination of the risk profile of the occupation, which we discuss below, and the essentialness of the occupation, which we leave for policymakers to determine.

Figure 2: Remote-Feasibility Index for a sample of occupations common in the U.S.



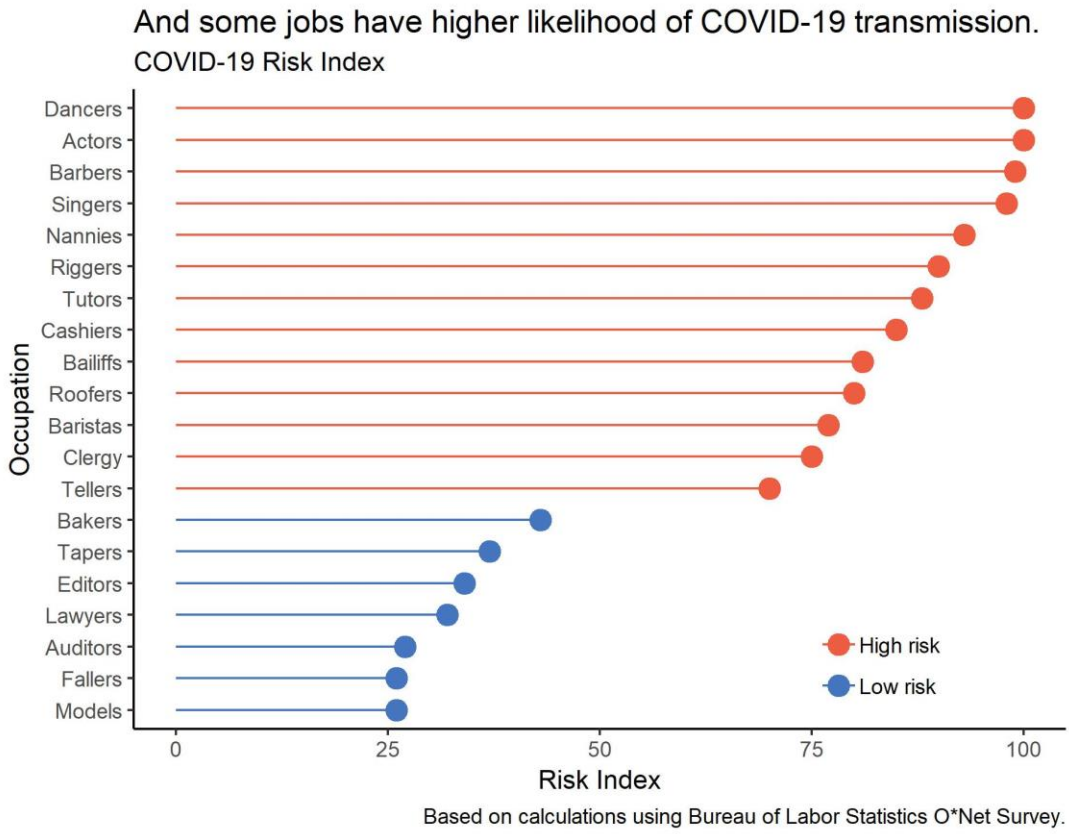
Notes: In this figure, we display our Remote-Feasibility Index for a selection of 20 occupations surveyed in the Bureau of Labor Statistics O*Net Survey. According to our estimated Remote-Feasibility Index, occupations shown in red can be performed at home. Those in blue cannot be performed at home.

4.2. COVID-19 Risk Index

We now provide a snapshot of our estimates of occupation-level risks of COVID-19 transmission upon return to work in Figure 3. As was the case for the Remote-Feasibility Index, increases in the COVID-19 Risk Index correspond to increases in risk of COVID-19 transmission. Our estimates suggest that dancers, barbers, nannies, and roofers have a higher risk of COVID-19 transmission than auditors, editors, and lawyers. These estimates should make sense, as the former group require much more physical contact than the latter group. However, we do note that some of the occupations on the higher-end of COVID-19 transmission risk likely present different and, in some cases, easier mitigation strategies. For example, mitigation for a roofer may not only look completely different than for a barber, but it may also be much

easier. We do not speculate what these mitigation strategies would look like, but they certainly suggest occupation-varying, targeted approaches to mitigation.

Figure 3: A snapshot of the COVID-19 Risk Scale for a sample of occupations in the O*NET Survey



Notes: In this figure, we display our COVID-19 Risk Index for a selection of 20 occupations surveyed in the Bureau of Labor Statistics O*Net Survey. According to our estimated Remote-Feasibility Index, occupations shown in red have higher risks of COVID-19 risk transmission than those shown in blue.

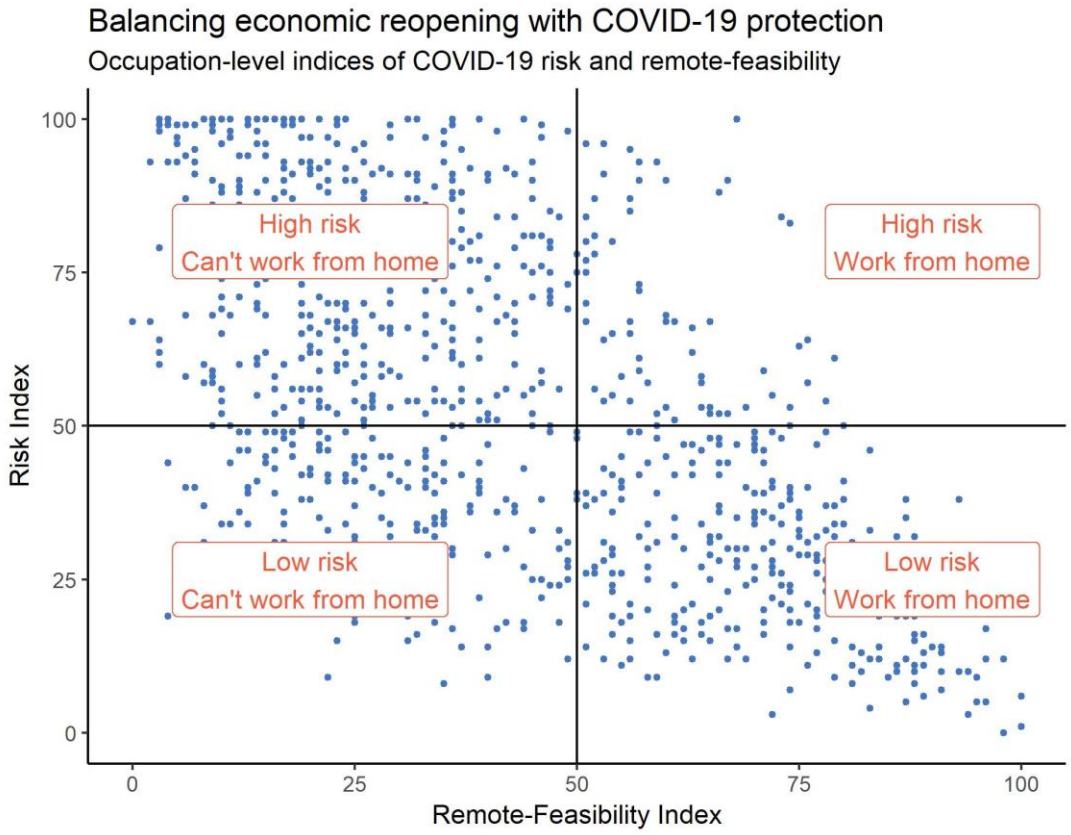
4.3. Interactive plot

We provide an occupation-by-occupation interactive plot of both the Remote-Feasibility Index and the COVID-19 Risk Index. This plot is available at this link. We show a static version of this plot in Figure 4.

We have separated the occupations into quadrants based on high-level recommendations for the reopening strategy. Occupations in the right-hand quadrants can reasonably be worked from home especially those in the high-risk category in the

top-right quadrant. Occupations on the left-hand side cannot easily be worked from home. Those in the bottom-left quadrant present lower risk of COVID-19 transmission, and thus a mitigation strategy will be more limited than those in the top-right quadrant.

Figure 4: How do occupations vary on both the Remote-Feasibility and COVID-19 Risk Indices?



Notes: In this figure, we highlight occupation-level estimates of the Remote-Feasibility Index and COVID-19 Risk Index. An interactive version of this plot is available here.

4.4. Industry-level profiles

Occupation-level estimates of the Remote-Feasibility Index and the COVID-19 Risk Index are of only limited utility to state-level policymaking, where decisions are made on entire branches of industries and types of business. To make our results more relevant for state-level decision-making, we estimated our indices at the NAICS-industry level in Table 1, along with high-level findings below:

- Manual labor-focused industries have more limited COVID-19 transmission risk and lower feasibility of continued remote work.
    - Should be pushed forward in any reopening strategy, alongside the necessary risk mitigation strategies.
- Industries that have high COVID-19 transmission risks and limited remote feasibility include *Accommodations and Food Services* and *Healthcare and Social Services*, and *Retail Trade*.
    - These industries rely on physical contact and face-to-face conversations.
    - Mitigation of COVID-19 transmission should be at the forefront of any reopening strategy for these industries.
- Two industries with a high degree of teleworkable occupations are *Management of Companies and Enterprises* and *Professional, Scientific, and Technical Services*.
    - Employers in these industries should promote work-at-home policies.

Table 1: How do industries compare in their Remote-Feasibility & COVID-19 Risk Indices?

NAICS Sector	Risk Index	Remote-Feasibility Index
Accommodation and food services	77	35
Admin./support and waste management and remediation services	58	41
Agriculture, forestry, fishing and hunting	46	24
Arts, entertainment, and recreation	73	41
Construction	60	30
Education services	65	49
Finance and insurance	44	65
Health care and social assistance	79	31
Information	46	52
Management of Companies and Enterprises	44	37
Manufacturing	48	38
Mining	47	35
Other services, except public administration	64	40
Professional, Scientific and Technical Services	42	61
Public administration	50	55
Real estate and rental and leasing	60	39
Retail trade	67	40
Transportation and warehousing	56	28
Utilities	46	47
Wholesale trade	52	34

Notes: To calculate industry-specific means of the COVID-19 Risk and Remote-Feasibility Indices, we estimated the index mean for occupations in each industry, weighted by the number of employees in each occupation within the industry.

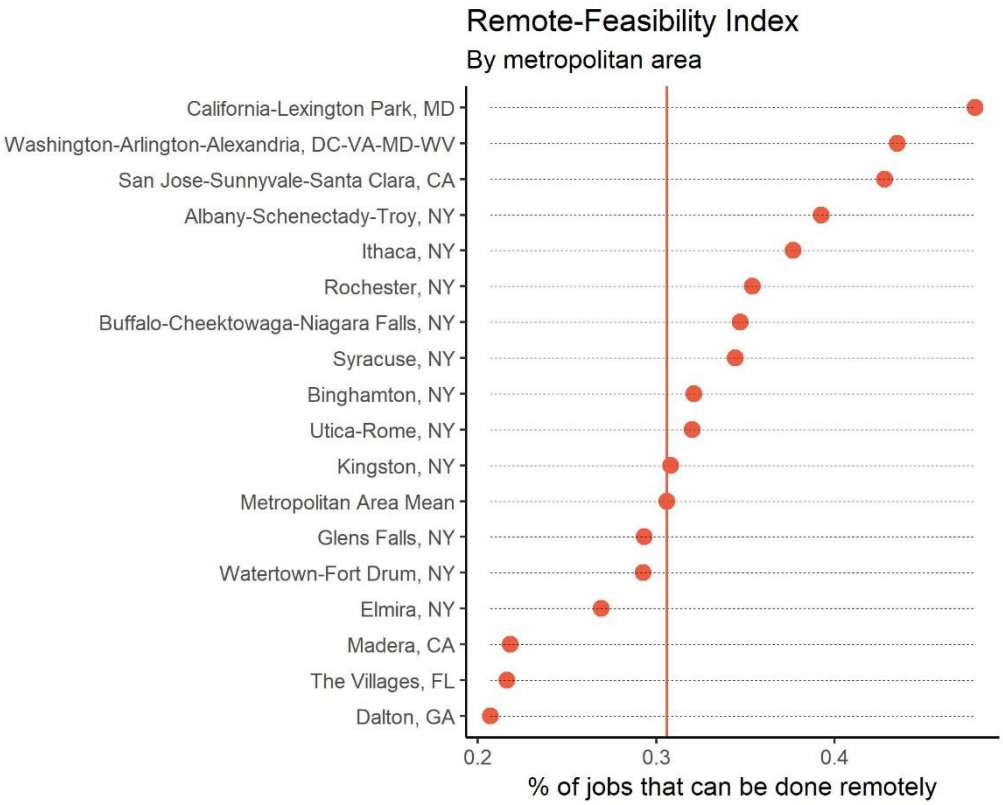
4.4. Metropolitan area-level Remote-Feasibility and COVID-19 Risk Indices

In line with Dingel and Neiman (2020), we provide metropolitan area-level estimates of the share of jobs that can be worked remotely and the share of jobs that are at high-risk of COVID-19 transmission. We show these estimates in Figures 5 and 6 for all metropolitan areas in our home state of New York, as well as the top-3 and bottom-3 for the rest of the U.S. for reference. In NY, only Elmira, Watertown-Fort Drum, and Glen Falls are below the metropolitan area-level mean in terms of the share of workers that can work from home. The Albany-Schenectady-Troy, Ithaca, and Rochester metropolitan areas have the highest share of workers that can work remotely in NY; this finding makes sense given that all three areas are education and services hubs.[2]

We observe similar trends for the COVID-19 Risk Index by metropolitan area, though the pattern is reversed. Those metropolitan areas with a concentration of occupations that can be worked remotely also have a concentration of lower-risk occupations (e.g., more educational and professional services-oriented occupations).

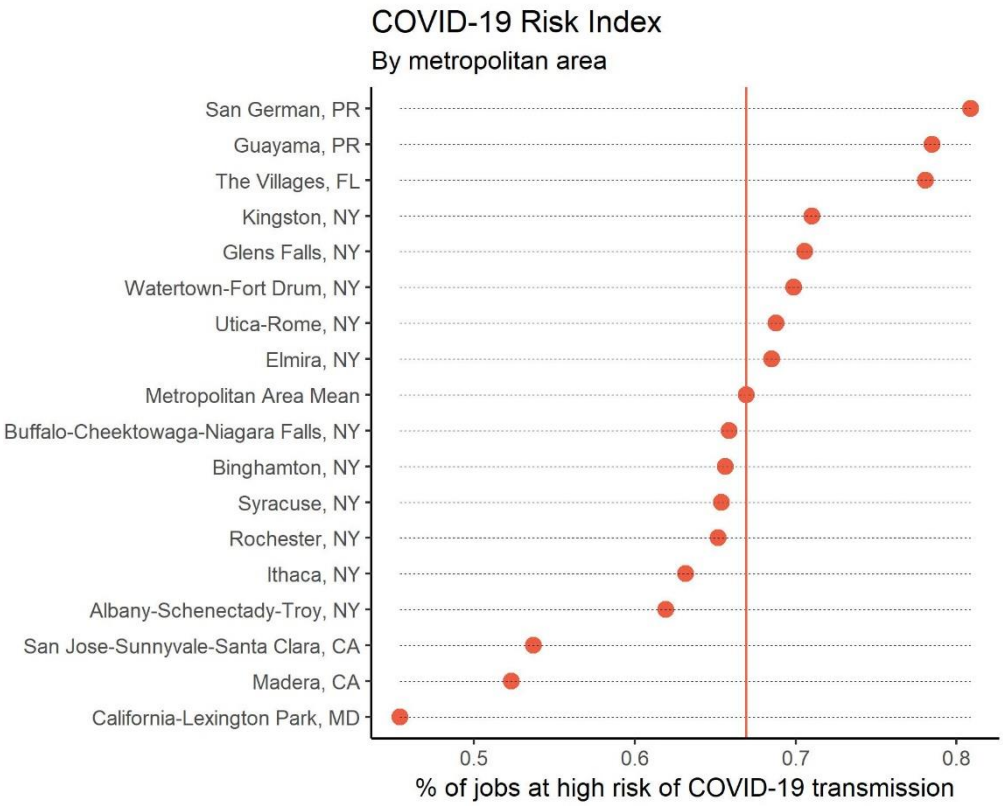
[2] As a note, our estimates are considerably lower than those found by Dingel and Neiman (2020), which is due to the fact that we use a wider set of work activities and contexts that cannot be done at home.

Figure 5: Proportion of jobs that can be performed at home, by metropolitan area



Notes: These data are from Dingel and Neiman (2020). We include data from all metropolitan areas in New York state and, for comparison's sake, the top-3 and bottom-3 for the rest of the U.S., as well as the metropolitan area-level mean. We add a vertical line that references the unweighted metropolitan area-level mean (~0.30).

Figure 6: Proportion of jobs that are high risk of COVID-19 transmission, by metropolitan area



Notes: We calculated proportions of jobs in occupations with high risk of COVID-19 transmission by metropolitan area. We include data from all metropolitan areas in New York and, for comparison's sake, the top-3 and bottom-3 for the rest of the U.S.,

Summary

To assess strategies for re-opening the economy, we used the U.S. BLS O*NET database to score occupations by 1) feasibility of working remotely and 2) risk of COVID-19 transmission owing to essential aspects of the job. We then aggregate these occupation-level estimates up to the industry-level using other BLS databases. These higher-level estimates are likely more relevant for state policymaking.

We believe these data-driven scores will enable decision-makers to assess mitigation and remote work strategies for most types of businesses throughout New York and beyond. However, we do not make any firm or specific recommendations as to what any state government should or should not incorporate into the reopening strategy. Data analytics should play a necessary, but not sufficient, role in policy

crafting. There are questions that go into policy formation we cannot easily address with data. With that said, the application of data can help define an economic reopening strategy that gets those occupations and industries back to the office or work-site that need to be there while reducing the risk of COVID-19 transmission to staff, customers, and the community at large. This balancing act will loom large in the coming months and, potentially, years.

Works Cited

Dingel, J., Neiman, B., 2020. With much of U.S. staying at home, how many jobs can be done remotely? Univ. Chic. Work. Pap.

Jin, B., McGill, A., 2020. Who is most at risk in the coronavirus crisis: 24 million of the lowest-income workers [WWW Document]. URL https://politico.com/interactives/2020/coronavirus-impact-on-low-income-jobs-by-occupation-chart/ (accessed 5.6.20).

Appendix

Table A1: Work activities that make up the Remote-Feasibility Scale

Work activities
Repairing and maintaining mechanical equipment
Repairing and maintaining electronic equipment
Performing general physical activities
Operating vehicles, mechanized devices, or equipment
Inspecting equipment, structures or material
Handling and moving objects
Controlling machines and processes
Assisting and caring for others

Table A2: Work contexts that make up the Remote-Feasibility Scale

Cramped work space, awkward positions
Outdoors, exposed to weather
Exposed to disease and infection
Exposed to hazardous conditions
In an enclosed vehicle or equipment
Spend time walking and running
In an open vehicle or equipment
Deal with physically aggressive people
Exposed to high places
Exposed to minor burns, cuts, bites, or stings
Outdoors, under cover
Physical proximity
Very hot or cold temperatures
Wear specialized protective or safety equipment such as breathing apparatus, safety harness, full protection suits, or radiation protection
Spend time climbing ladders, scaffolds, or poles
Spend time kneeling, crouching, stooping, or crawling
Wear common protective or safety equipment such as safety shoes, glasses, gloves, hearing protection, hard hats, or life jacket