

The Impact of COVID-19 on Behavior and Perception Changes: Role of Socio-Demographic Disparities

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ABSTRACT

The massive societal-level shock due to the COVID-19 leads people to change both behavior and perception and raises the concern about ensuring both the overall healthy life and economy. However, this is challenged by the worsening socio-demographic inequality, which in turn exacerbates not only the spread of the coronavirus, but also people's normal life amidst and post the crisis. This paper examines how people's behavior and perception change and the disparate role of their socio-demographic characteristics. A large-scale survey is used to take questions regarding different aspects of impact of COVID-19 on people from six representative countries. The regression analysis is applied to discover how different socio-demographic backgrounds affect behaviors and perceptions changes. This research also explored how people's agreement attitude toward government policy relate with their behavior and perception changes, by delving into the interplay between them using structural modeling approach. Our findings may shed light on how government should devise the more targeted emergency response plans by focusing on reducing the socio-demographic inequality.

Keywords: COVID-19, Behavior and perception changes, Inequality, Survey

1. INTRODUCTION

The global pandemic of coronavirus disease (COVID-19) poses serious health threat and great societal challenges that may fundamentally shadow the world economic outlook. According to the World Health Organization (WHO), as of August 2020, more than 25 million confirmed cases of COVID-19 have been reported in more than 216 countries, territories and areas, resulting in nearly 850,000 deaths. [1] International and regional organizations, governments respond to protect public health through different preventative measures [2-4]. Under the safety guidelines to avoid the physical contact, people start to experience the "new norm" that has created record level disruptions to almost every aspect of their lives: how they work [5], travel [6], socialize with others [7], to name just a few. For example, a Pew Research Center survey conducted in March 2020 reveals profound impacts of COVID-19 on the personal lives of American people, as over 90% of them agree that their life has changed as a result of the COVID-19 outbreak, and half of them experience the life changes in a major way [8].

Such disruptions leading to the behavior changes have strong economic implications. Firstly, the so-called "working-from-home economy" prevails amidst the pandemic to allow people to maintain social distancing and work remotely. Within just a few weeks, 42% of U.S. workers are now working from home full time, accounting for more than two-thirds of economic activity [9]. This is a great leap compared to pre-COVID era, as another survey from the Bureau of Labor Statistics shows only 15% of employees ever had worked from home full [10]. Moreover, behavior changes like remote working are expected to have long lasting social and economic effects even after the pandemic. As such, the trend of people flocking into large cities for high-skilled jobs is likely to reverse due to the pandemic [9]. Secondly, the shock of COVID-19 causes unprecedented job losses. Coibion et al. [11] estimated that 20 million lost jobs by April in the U.S., far more than jobs lost over the entire Great Recession. Similar scenarios are also reported in Canada and Germany [12, 13]. Workers who suffer from income fall due to the massive unemployment, either being laid off or furloughed, would potentially lead to the poverty [14]. Thirdly, people may also experience perception changes due to the behavior changes during the COVID-19 era [15]. On one hand, health risks and

preventive measures lead people to have negative psychological feelings, such as distress, loneliness, boredom, etc., [16-18]. On the other hand, people also reflect positive feelings such as having more free time with family, living with less air and noise pollution, among others [19, 20].

Moreover, as many scholars note, the COVID-19 crisis may worsen the inequality issues, widening socio-economic divisions that also make the virus riskier. Admittedly, there is a large body of public health research on the severity and mortality rates of COVID-19 between different demographic groups. It is relatively well understood that people in senior age group (age > 60), male, pre-existing health conditions, such as obesity, diabetes, hypertension are among the most vulnerable group [21-25]. However, the indirect role of socio-economic status is underexplored with less empirical evidence. For example, New York Times published a news article in March 2020 and reported that people with pre-existing social vulnerabilities are under greater risk of becoming infected and dying from the coronavirus, because they are prone to 1) develop chronic health problems at a younger age; 2) be uninsured to receive sufficient preventive care and health education and 3) get exposed under poor workplace protection [26].

This paper aims to examine the factors influencing people's behavior and perception changes after the outbreak of COVID-19. Drawing the findings from a comprehensive large-scale cross-national survey [27], this paper particularly explores the disparate impact of socio-demographic characteristics on survey participants' both financial and non-financial behavior and perception and perform comparative studies across countries that implement different stringency level of government policy response. Two research questions are proposed and addressed using statistical analysis based on the data collected from the survey:

How do people's behavior and perception changes vary based on their socio-demographic background (i.e., country, gender, age group, income level, residence and employment status)?

How do people agree and comply with the government policy in response to the pandemic, by exploring the interplay between behavior and perception changes? i.e. the effect of behavior changes that lead to perception change and vice versa.

This paper adds to the emerging yet proliferated literature on the economic perspective of COVID-19 pandemic with three major contributions: i) characterizing the disparate impact of individuals' socio-demographic background on their behavior and perception changes in response to the COVID-19 pandemic; ii) understanding the individual acceptance attitudes toward government policy by exploring the interplay between the behavior and perception changes;

and iii) more broadly, addressing the socio-economic inequality in the public health context.

The paper is organized as follows. Section 2 reviews the existing literature on the inequality of socio-economic factors related to the spread of COVID-19 and the interplay between behavior and perception changes. Section 3 introduces the public released survey by Belot et al. [27] and preliminary evidence of statistically different responses from participants of their sociodemographic background using the Analysis of Variance (ANOVA) technique. Section 4 shows the results derived from both reduced-form regressions and structural equation models known as the partial least squares path modeling (PLS-PM). Section 5 discusses the results and its economic and policy implications.

2. RELATED WORKS

Generally, the massive exogenous shock caused by the COVID-19 enables the researchers to examine its impact on every aspect of economic issues as a societal-level natural experiment. Given the scope of this paper, two stream of recent non-pharmaceutical research is reviewed as below: 1) how socio-demographic inequality worsen the infection and spread of COVID-19 and 2) how behavior and perception changes according to the dynamic norms, especially in the context of pandemic.

2.1. Socio-demographic Inequality during the COVID-19

The growing inequality issue that essentially reshaped the society has raised much attention in the past decades by many prominent economists [28-30]. Thus it is just unsurprising that socio-demographic inequality would play an important role in driving the economic outcomes in the context of public health. For example, Drago and Miller [31] found that people with disadvantageous socio-economic conditions may have severely elongated the H1N1 epidemic in the United States, accounting for a staggering 27 percent of all infections. Likewise, such disparate impact of COVID-19 is documented on different socio-demographic groups, such as age, gender, income level, residential area. Levin et al. [32] estimated infection fatality rate (IFR) across age groups and found that IFR is close to zero for children and younger adults but rises exponentially with age. Adams [33] found that women comprise a smaller share of deaths from Covid-19 mainly due to their low participation in the workforce under the high risk of exposure.

Ashraf [34] studied the impact of socioeconomic conditions on the health outcomes by COVID-19 using a panel dataset from 80 countries and showed strong negative association with COVID-19 confirmed cases and

death rates. In other words, socioeconomic conditions may signal the severity of overall well-beings at country level. Although most countries mandated a wide range of preventative measures at various stringency levels to stem the pandemic, the effectiveness of these measures are unevenly distributed across socio-demographic groups in ways that affect behavior and thus potentially the spread of illness⁴. Brown and Ravallion [35] showed that income poverty and inequality tend to increase the infection rate, after controlling for standard epidemiological factors. Papageorge et al. [36] similarly showed that people with lower income, less flexible work arrangements and lack of outside space at home are less likely to engage in preventive measures that are supposed to limit the spread of COVID-19.

Meanwhile, individuals with different socio-demographic status may suffer from disparate financial losses, especially for low-wage disadvantaged workers due to the business closure and employee layoff [37]. Alon et al. [38] found that women have experienced sharp employment losses both because their employment is concentrated in heavily affected sectors such as restaurants. Acknowledging the gap in unemployment outcome across sociodemographic groups such as races [39], gender [40], Montenovio et al. [41] argued that there remain substantial unexplained differences implied by the disparities in labor market losses.

2.2. Behavior and perception changes

It is well known from social psychology studies that people conform to normative information that lead to their behavior changes [42] and perception has a direct and pervasive impact on social behavior [43]. In the context of public health, Link [44] proposed the Social Shaping theory that used a wide range of sociological concepts to explain how people utilize their perception, and their behaviors that shape the consequences of biomedical accomplishments. For example, spread of the disease is influenced by people's willingness to comply with preventative public health behaviors, which are often associated with public risk perception. Dryhurst et al. [45] found that there was substantial variability of risk perceptions across people's background including cultures, individualistic worldviews, personal experience, prosocial values.

The individual perception to the COVID-19 may serve as a major determinant that influence behavior. Seale et al. [46] further showed that the public risk perception determines the extent to which people adopt recommended hygiene-related behaviors in response to COVID-19, as their avoidance behaviors was associated with psychological factors such as trust in government/authorities, perceived rating of effectiveness of behaviors, perceived ability to adopt social distancing strategies, etc. Likewise, Martarelli and Wolff [47]

suggest that boredom during the COVID-19 challenges people's self-control to adhere to the containment measures such as social distancing. Zajenkowski et al. [48] explained people's different personality traits have dispositional tendencies in predicting behaviors. Geldsetzer [49] conducted the survey that identified several important misconceptions on how to prevent acquisition of COVID-19, and such information provision could influence the people's consideration to adopt recommended care-seeking behavior.

3. DATA DESCRIPTION

3.1. Global survey data

This survey was conducted by researchers from European University College, Seoul National University, University of Exeter, and University of Vermont in the third week of April 2020 (April 15-April 23) on six thousand people across six countries (China, Italy, Japan, South Korea, the United Kingdom, and the United States) [27].

Five types of variables were used in the survey: Socio-Economic Status (including age group, gender, race, labor status, and income group), Risk and Exposure (including number of infected interactions, close contact with different age people, number of people sharing facility, access to open air, traveling abroad, going to public space, and so on), Behavior (including change in daily behaviors, reason of behavior change, prevention, prevention behaviors at different times, job change, income changes, and so on), Economic Impacts (including work change, fall in household income, change weekly expenses, and so on), and Perceptions (including how bothered they are of restrictions, belief on policy effectiveness, belief effectiveness of washing hands, belief fraction infected, belief on how serious the symptoms may develop, positive and negative non-financial effects, happiness, agreement on government action and belief health consequence vs flu).

3.2. Explorative data analysis

We explore the differences across participants' age group and gender, and find that there is a statistically significant difference between participants in different age group and gender to changed daily behaviors, and the interactions are also statistically significant. We explore the differences across participants' countries and their current living area and find that there is a statistically significant difference between participants from different countries and current living area to choose to agree government actions or not, and the interactions are also statistically significant. We explore the differences across participants' income group and their labor status and find that there is a statistically significant difference between

participants from different income groups and labor status to choose to agree government actions or not, and the interactions are also statistically significant.

4. RESULTS

In this section, we aim to identify the effect of social-demographic characteristics on people's various behavior and perception changes during the COVID-19. We do so by performing regression analysis to examine how do people's behavior changes and perception changes (in terms of both financial and non-financial impact) vary conditional on gender, age, income level, employment status and residential area. We also include the region and country dummy to control for unobserved heterogeneity at region level. We adopt linear regression, ordinal regression and logit regression depending on the nature of the dependent variable. All reported robust standard errors are estimated using sandwich variance estimator [50].

4.1. Social-demographics effects on behavior

4.1.1. Changed behaviour

The dependent variable Change in Daily behavior is a dummy variable that takes the value of 1 if the respondent had changed their behavior during COVID-19 for any reason, or 0 otherwise. We fit the logit model to estimate the effect of socio-demographic characteristics on whether the respondent had changed behavior. Gender has a significant effect on the change of behavior overall ($\beta = 0.42$, $p < 0.01$), in Japan ($\beta = 0.58$, $p < 0.01$), Korea ($\beta = 0.79$, $p < 0.01$), UK ($\beta = 0.57$, $p < 0.05$), and USA ($\beta = 0.52$, $p < 0.05$), as the model shows that females are more likely than males to have changed their behavior during COVID-19. We also find that individuals from a higher quintile of income level are more likely to change their behavior across all countries. Compared with individuals from the first income quintile (having the least income level), individuals from second income quintile ($\beta = 0.346$, $p < 0.01$), the third income quintile ($\beta = 0.534$, $p < 0.01$), the fourth income quintile ($\beta = 0.917$, $p < 0.01$), and the fifth income quintile ($\beta = 1.026$, $p < 0.01$) are increasingly more likely to change their behavior. A possible explanation is that wealthier people may enjoy more options for behavior change, while less wealthy people may have fewer options or no option at all. People with lower income level are also less likely to have workspace flexibility in industries that does not allow changes.

4.1.2. Prevention

The dependent variable Prevention Index is constructed from four related questions on how often respondents engage in four different preventative actions: (1) keeping social distance, (2) avoiding touching their faces, (3) coughing with cover, and (4) seeking medical help if COVID-19-like symptoms appear. We extract the principal components from these questions and use the first principal component as the index value in order to alleviate the collinearity issues. We add region and country dummies to control for unobserved idiosyncratic effect. We use the ordinal regression model to fit the prevention index to the sociodemographic characteristics. Compared with males, females ($\beta = 0.316$, $p < 0.01$) are more likely to engage in preventative actions. Compared with individuals from the first income quintile (who are the least wealthy), individuals from the second income quintile ($\beta = 0.127$, $p < 0.1$), the third income quintile ($\beta = 0.208$, $p < 0.01$), the fourth income quintile ($\beta = 0.369$, $p < 0.01$), and the fifth income quintile ($\beta = 0.470$, $p < 0.01$) are increasingly more likely to have engaged in preventative actions. However, other socio-economic characteristics, such as age, living area, and labor status did not have significant effects on whether respondents had taken preventative actions. This finding is consistent with Papageorge et al. (2020) that people with lower income are less likely to engage in preventive measure due to life and work limitations.

4.1.3. Reduced interactions at work

The dependent variable Reduced interactions at work has five possible responses: (1) Not at all, (2) Partly, (3) To a large extent, (4) Completely, or (5) Not applicable. We fit the ordinal regression model to the socio-demographic characteristics. Compared with males, females are less likely to reduce interactions at work ($\beta = -0.053$, $p < 0.1$), especially in the UK ($\beta = -0.452$, $p < 0.01$). Compared with unemployed individuals, individuals that are self-employed ($\beta = -0.337$, $p < 0.01$), employed full-time ($\beta = -0.233$, $p < 0.01$), and employed part-time ($\beta = -0.169$, $p < 0.01$) are less likely to have reduced interactions at work. However, in this regard, Asian countries (China, Japan, and Korea) are different, where respondents that were self-employed (China: $\beta = 1.075$, $p < 0.01$; Japan: $\beta = 1.372$, $p < 0.01$; Korea: $\beta = 1.812$, $p < 0.01$), employed full-time (China: $\beta = 1.112$, $p < 0.01$; Japan: $\beta = 1.985$, $p < 0.01$; Korea: $\beta = 1.923$, $p < 0.01$), and part-time (China: $\beta = 2.054$, $p < 0.01$; Japan: $\beta = 1.828$, $p < 0.01$; Korea: $\beta = 0.927$, $p < 0.01$) are all more likely to have reduced interactions at work compared with unemployed respondents instead of less likely.

4.1.4. Financial impacts

The dependent variable Lost job is a dummy variable that takes the value of 1 if the respondent had lost their job during COVID-19 and 0 otherwise. We fit the ordinal regression model to the sociodemographic characteristics. Compared with respondents between age 18 and 25, those from age 56 to 65 ($\beta = -0.416$, $p < 0.01$), 66 to 75 ($\beta = -0.822$, $p < 0.01$), and above 75 ($\beta = -0.610$, $p < 0.01$) are all less likely to have lost their jobs. Wealthier respondents, including second ($\beta = 0.162$, $p < 0.01$), third ($\beta = -0.324$, $p < 0.01$), fourth ($\beta = -0.490$, $p < 0.01$), and fifth ($\beta = -0.674$, $p < 0.01$) income quintile, when compared to first income quintile, are less likely to have lost their jobs. Labor status also has significant effects on job loss. Compared with unemployed individuals, self-employed individuals are most likely to have lost their jobs ($\beta = 1.604$, $p < 0.01$), following by those employed parttime ($\beta = 1.247$, $p < 0.01$), and then those employed full-time, ($\beta = 0.747$, $p < 0.01$). This makes sense because full-time employment offers more job security than part-time employment, which in turn offers more job security than self-employment.

The dependent variable Experience loss in household income is a dummy variable that takes the value of 1 if the respondent had experienced household income loss as a consequence of COVID-19, and 0 otherwise. We fit the ordinal regression model to the socio-demographic characteristics. In both Italy ($p < 0.01$) and the US ($p < 0.1$), the effect of gender on experience of household income loss is significant. Compared with respondents with age 18 to 25, those with age 36 to 45 ($\beta = -0.202$, $p < 0.1$), 46 to 55 ($\beta = -0.295$, $p < 0.01$), 56 to 65 ($\beta = -0.607$, $p < 0.01$), 66 to 75 ($\beta = -1.060$, $p < 0.01$), and above 75 ($\beta = -0.972$, $p < 0.01$) are more likely to experience household income loss. Compared with the first income quintile, respondents from the fourth ($\beta = -0.287$, $p < 0.01$) and fifth quintile ($\beta = -0.329$, $p < 0.01$) are more likely to experience household income loss. There is no statistically significant difference between respondents from the countryside and those from urban areas. However, those from semi-urban areas are less likely to experience household income loss ($p < 0.5$). However, in this regard, China is different, both semi-urban ($\beta = 0.522$, $p < 0.5$) and countryside ($\beta = 1.377$, $p < 0.01$) respondents are more likely to experience household income loss, when compared to urban area. The effect of labor status on household income loss is similar to its effect on job loss. Compared with unemployed individuals, self-employed individuals ($\beta = 1.792$, $p < 0.01$) are more likely to experience household income loss, following by those employed part-time ($\beta = 1.176$, $p < 0.01$) and those employed full-time ($\beta = 0.672$, $p < 0.01$).

The dependent variable Expect loss in household income is a dummy variable that takes the value of 1 if the respondent had expected substantial household income loss as a consequence of COVID-19, and 0 otherwise. In Italy, the effect of gender on income loss expectation is similar to its effect on household income loss. females are more likely to expect income loss ($p < 0.01$). So are females in Korea ($p < 0.05$). Compared with respondents with age 18 to 25, respondents with age 46 to 55 ($p < 0.05$), 56 to 65 ($p < 0.01$), 66 to 75 ($p < 0.01$), and above 75 ($p < 0.01$) are more likely to expect household income loss. Compared with the first income quintile, respondents from the fourth and fifth quintile are more likely to expect household income loss ($p < 0.01$). There is no statistically significant difference between respondents from the countryside and those from urban areas. However, those from semi-urban areas are less likely to expect household income loss ($p < 0.1$). However, China is again different, where there is no statistical difference between respondents from semiurban and urban areas, but those from the countryside are more likely to expect household income loss, when compared with respondents from urban areas ($p < 0.01$). Compared with unemployed individuals, self-employed individuals are most likely to expect household income loss, following by those employed part-time and those employed full-time ($p < 0.01$). Perhaps compare and contrast different in income loss experience, income loss expectation, job loss.

The dependent variable Change weekly expenses has five possible response. (1) Drop of more than 10 percent, (2) Drop of less than 10 percent, (3) No change, (4) Increase of less than 10 percent, and (5) Increase of more than 10 percent. Compared with the first income quintile, respondents from second, third, fourth, and fifth quintile are less likely to increase and more likely to decrease their weekly expenses ($p < 0.01$). Compared with unemployed respondents, self-employed respondents are most likely to decrease their weekly expenses, following by those employed part-time and those employed fulltime ($p < 0.01$).

The dependent variable Chang savings has five responses. (1) Drop of more than 10 percent, (2) Drop of less than 10 percent, (3) No change, (4) Increase of less than 10 percent, (5) Increase of more than 10 percent. Compared with respondents with age 18 to 25, respondents from age 56 to 65, 66 to 75, and above 75 are more likely to have increased their savings ($p < 0.01$). Compared with respondents from urban areas, respondents from semi-urban areas and the countryside are more likely to have increased their savings ($p < 0.05$, $p < 0.01$). Compared with unemployed respondents, self employed respondents are most likely to decrease their change in savings, following by those employed part-time and those employed full-time ($p < 0.01$).

4.2. Social-demographics effects on perceptions

4.2.1. Non-financial impact

The dependent variable Positive feeling index is an aggregation of five questions on five different positive non-financial impacts. (1) enjoying more free time, (2) enjoying time with family, (3) reduction of air pollution, (4) reduction of noise pollution, and (5) other. We extract the principal components from these questions and use the first principal component as the index value, in order to alleviate the collinearity issues. We added region and country dummies to control for unobserved idiosyncratic effect. Wealthier respondents from wealthier quintiles are more likely to experience positive impact ($p < 0.01$). In China, respondents with age 46 to 55, 56 to 65, and above 75 are less likely to experience positive non-financial impacts compared with age 18 to 25 ($p < 0.01$). Respondents who are employed full-time or part-time are more likely to experience positive non-financial impacts. However, in Japan, self-employed respondents are more likely to have experienced such positive impacts.

The dependent variable Positive feeling index is an aggregation of six questions on different negative impacts that might be felt by respondents. (1) boredom, (2) loneliness, (3) trouble sleeping, (4) general anxiety and stress, (5) increased conflicts with friends, relatives and neighbors, and (6) other. We extract the principal components from these questions and use the first principal component as the index value, in order to alleviate the collinearity issues. We added region and country dummies to control for unobserved idiosyncratic effect. Compared with males, females are more likely to experience negative non-financial impacts from COVID-19, while older respondents are less likely to experience such negative impacts. In the case of older Chinese, although they are less likely to experience positive effects, they are also less likely to experience negative impacts. In both China and Japan, compared with unemployed respondents, self-employed respondents are more likely to experience negative effects, following by those employed part-time and those employed full-time ($p < 0.01$).

4.2.2. Policy belief

The dependent variable Policy Belief Index is an aggregation of seven questions on how effective different policies are in the belief of the respondents. (1) shutting down schools, (2) shutting down public transport, (3) shutting down nonessential businesses, (4) limiting mobility outside home, (5) forbidding mass gatherings, (6) introducing fines for citizens that do not respect public safety measures, and (7) requiring masks to be worn in public space. We extract the principal components from these questions and use the first

principal component as the index value, in order to alleviate the collinearity issues. We added region and country dummies to control for unobserved idiosyncratic effect. Females and older people, respectively compared with males and younger people, are more likely to believe in the effectiveness of policies ($p < 0.01$). In Korea ($p < 0.01$) and the US ($p < 0.05$), respondents with higher income are more likely to believe policy effectiveness. In Japan, unemployed respondents are more likely to believe policy effectiveness than those employed fulltime or part-time ($p < 0.01$). In Italy, self-employed individuals are also likely to believe policy effectiveness ($p < 0.05$). In China and Japan, none of the social-demographic variables, except for labor status for Japan, has a significant effect on respondents' belief in policy effectiveness. This suggests that in both countries people are consistent on belief in government policy effectiveness throughout the country. A reason that individuals from China generally believe in policy effectiveness might be because the government and the fact that it's a socialist country. And for Japan, the workaholic trend among individuals makes them less likely to believe policy effectiveness.

4.2.3. Interplay between behavior changes and perception changes

Our regression results demonstrate the disparate impact of COVID-19 on both people's behavior changes and perception changes, conditional on their socio-demographic characteristics. We further explore how people's behavior changes would influence their perception changes and vice versa. Understanding what factors drive the people's attitude with respect to government actions would provide important policy implications for government to issue the follow-up contingency policies. We decide to employ the Partial Least Square Path Modeling (PLS-PM) approach to model the interplay between behavior changes and perception changes [51]. Essentially, PLS-PM is a statistical method for studying complex multivariate relationships among observed and latent variables. It is often considered as the structural equation modeling approach that has important advantages to work with observational data because it does not impose any distributional assumptions on the data unlike most regression models. In the case of understanding people's agreement attitude toward the government actions, related behavior and perceptions changes are represented as blocks of variables, also known as constructs, also shown in figure 1:

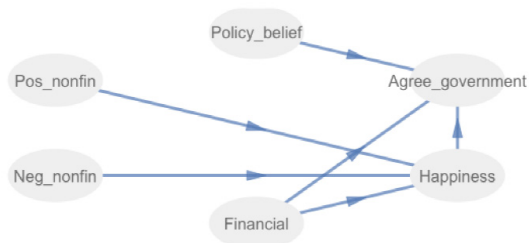


Figure 1. Path diagram depicting the structural modeling

Each construct contains a set of questions that together summarizes the people's behavior and perceptions. In other words, we believe that the above behavior and perception changes serve as the determinants of people's agreement of government actions. Moreover, given that the happiness is a subjective measure, we also hypothesize it is subject to both the financial and non-financial impact of COVID-19. More specifically, financial impact includes whether the individual lost the job, experienced income loss and changed savings. Non-financial impact includes both positive impact such as enjoy free time, experience less air and noise pollution, and negative impact such as boredom, loneliness, anxiety, trouble with sleep, etc.

After assessing the quality of the path model, we obtain the estimated path in the structural model, as shown in figure 2:

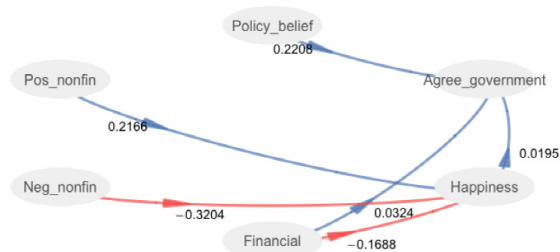


Figure 2. Inner model with estimated path

From the structural model results, we find that people's belief in the effectiveness of government actions, happiness is positively associated with people's agreement to government actions. Also, it is just unsurprising that financial impact is negatively associated with the happiness, i.e. if the individual is impacted by the COVID-19 financially, he/she is less likely to feel happy. Likewise, non-financial impact also influences the happiness as expected, that positive/negative impact is positively/negatively associated with the happiness. Interestingly, we find that people financially impacted by the COVID-19 are more likely to agree with government actions. This finding has several possible explanations. First, people who suffer from COVID-19 may expect government to provide financial assistance such as the stimulus package in the U.S. Second, they may also expect the

government actions may reopen the economy that make them better off. As such, government should provide dedicated financial assistance to those who are financially impacted, that in turn lends more support to the government.

5. DISCUSSIONS AND CONCLUSIONS

COVID-19 has tremendously upended normal life, putting an end to most of people's everyday activities and associated well-beings. Such massive shock leading to people's both behavior and perception change raises the concern about ensuring both the overall healthy life and economy. However, this is challenged by the socio-demographic inequality, which in turn worsens not only the spread of the coronavirus, but also people's normal life amidst and post the crisis. In this paper we look at how people's behavior and perception change and the disparate role of their socio-demographic characteristics. We used a large-scale survey that ask comprehensively questions regarding different aspects of impact of COVID-19 on people from six representative countries. We performed regression analysis to discover how different socio-demographic backgrounds affect behaviors and perceptions changes. We also explored how people's agreement attitude toward government policy relate with their behavior and perception changes, by delving into the interplay between them using structural modeling approach.

Our results are largely consistent with the existing literature that shows the how socio-demographic characteristics affect people's behavior change and perception change during the COVID-19 [34]. For example, females are more likely to suffer from the financial damage, which is likely due to their less job security [33, 38]. Also, psychological difference in gender may also be a cause of extra negative feelings from female, and their belief in effectiveness of policies [52]. The belief may also be why females are more likely to change their behavior and be engaged in prevention actions. The older individuals are less likely to be experiencing financial damage, especially elders above the age 60. A possible explanation is that the financial crisis mainly acts on firms and doesn't effect the pensions that they receive. They are also less likely to experience negative feelings, and are more likely to agree on government actions, as we further demonstrate the interplay between these behavioral and perceptual factors.

Individuals from a higher income quintile are more likely to encounter financial lost but less likely to lost job. They are more likely to work at highly specialized and skilled jobs which may not be replaceable and are likely to support working from home. Also, more choices are available for these individuals, which may cause them more likely to implement actions that are

protective [36]. Regarding labor status, self-employed individuals are most likely to experience financial damage, including loss in job, household income, decrease in expenses and savings that reflects their socio-economic status. Individuals employed full-time generally experience less damage. This makes sense because full-time employment offers more job security than part-time employment, which in turn offers more job security than self-employment.

These findings are important for understanding the impacts of COVID-19 on different socio-demographic backgrounds and how we can apply policy to decrease the inequality to better restrain transmission and recover from the economic downturn.

For example, as low income, self-employed and female individuals are more likely to suffer from financial crisis, government could provide financial support for them. Social support on pursuing prevention actions could be given to low income individuals. Also, media with primarily female audiences should not be fear-mongering the consequences and seriousness, as female audiences are already experiencing more negative effects and consequences. Government policy should consider the socio-economic backgrounds, rational policy that meet people's needs are easier to be carried out.

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