

Social distancing in risk society: a cross-national analysis of policy responses to the COVID-19 pandemic

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Research Article

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Abstract

Countries that implement strict policy measures to combat coronavirus contagion increase their probability of achieving successful social distancing practice when compared to the countries without such strict policies. I used Regression Discontinuity Design (RDD) to perform regression models and show differences in social distancing efforts. I utilized 3,997 observations for 132 countries, drawn from the Oxford CGRT Stringency Index and Google Community Mobility data. The results show that people's community mobility to various locations has flattened significantly as policy measures become stricter. I considered the current underlying health situation to be symptomatic of a risk society and argued that policy interventions' effectiveness in response to COVID-19 depends on political leaders, public health authorities, and institutions' credibility. Political rhetoric, politically motivated scientific solutions, and political downplaying of the underlying health implications weaken the responsible organizations and institutions, particularly when political leaders undermine inclusive stringent policies and their implementation.

Introduction

Since the coronavirus was first identified in China, nearly one million people have died amid significant outbreaks in the United States, India, Brazil, Russia, and over 200 other countries. Although this worldwide battle against invisible forces echoes the severity of the Spanish flu that killed 50 million people almost a century ago, advances in science and technology have kept the death toll at just one million in the current pandemic. However, even with many countries taking part in the race to develop an effective vaccine, a widely available and effective solution may not be available anytime soon. In the meantime, using scientific and technological tools such as artificial intelligence, machine learning, health intelligence, and simulations has proven successful in preventing the spread of the virus. Most policymakers recommend these technologies to check and trace the spread from person to person during the pandemic.

We now know that the coronavirus spreads through respiratory droplets that scatter when we cough, sneeze, or speak. Therefore, public health experts have affirmed that physical distance can help prevent the spread. Some nations have observed unprecedented decreases in cases as a result of the public following this advice. It is clear that government-implemented COVID-19 prevention policies have played a significant role in raising awareness. Some countries discussed in this article have already been able to contain the rate of COVID-19 infection, while others are still struggling. In most states where outbreaks have remained a problem, blame has rested on a lack of social distancing policy implementation and enforcement. WHO Director-General, Dr. Tedros Ghebreyesus, recently said that, the greatest threat we face now is not the virus itself; rather, it is the lack of leadership and solidarity at the global and national levels.

Amid the coronavirus pandemic, the advice to implement social distancing has become one of the most widely applied and arguably effective recommendations among countries. In relation to the idea of social distancing and contact tracing, the classic mantra of “person-place-time” takes on an even greater significance in controlling the spread of the coronavirus (Pearce et al. 2020). Social distancing plays a significant role in mitigating the public health impact of pandemics and has a direct positive impact on flattening the curve, preventing an overwhelming spike in cases, and keeping the number of cases manageable (Caley et al. 2007; Yilmazkuday 2020). When social distancing measures in the form of government-implemented policy responses are more stringent, COVID outbreaks can go down (Hale et al. 2020). Therefore, policies restricting people’s mobility within the community during the pandemic have played a notable role in curbing disease growth rates.

This article aims to study whether any significant relationship exists between the strictness of country-wide policies and social distancing. For the purposes of this paper, social distancing refers to limitations on the number of people who can gather in a certain area and recommendations not to visit certain non-essential locations, both of which public health experts say can help prevent infection. It is the state’s responsibility to create awareness among the people about policies through strict and proper implementation. Given that most countries failed to tackle the initial outbreak, their different governments have emphasized developing large-scale social policies to tackle virus transmissions. Such policies, in general, attempt to slow down the rate of transmissions by reducing contact between individuals within or between populations.

Obviously, less-strict policy responses result in a lower positive social distancing outcome, which ultimately puts more human life at risk (Cano et al. 2020). While long-term social distancing can have different impacts on people’s social lives and their mental and emotional wellbeing, most state policymakers have imposed straightforward movement restrictions from the get-go. However, the “life-or-economy” dilemma shakes major economies of the world, which triggers some governments to fumble their policy responses to COVID-19. Although social distancing has a positive public health outcome, it also brings negative social consequences, such as psychological distress among certain age groups, genders, occupations, and immigrant statuses (Stein 2020; Qiu et al. 2020). Rather than taking a rigid approach to social distancing, it is important to pay more attention to these susceptible groups of populations and implement inclusive responses to COVID situations (Stein 2020; Qiu et al. 2020).

I consider this underlying health situation as symptomatic of the “risk society.” According to Ulrich Beck (1992), risk depends on decisions, but when risk grows, decisions are not politically reshaped into preventive risk-management policy. To him, the most important and primary risk is that of social dependency upon institutions and actors. However, the question of how to handle this risk, politically,

stands in stark contrast to the growing need for action and policymaking (Giddens 1990). Therefore, calculated, probable, timely, and inclusive policy measures can reduce the risk. The COVID-19 outbreak has shown us that the risk society leads to a vulnerable society. The risks and transformations discussed in Beck's *Risk Society* remain very much matters of contemporary concern, particularly surrounding the COVID-19 pandemic. In the context of the risk society, the scientific and legal calculation of risk is considered to be collapsing. The parameters of the risk society—risk and trust, and politics of trust—explain why the public has largely lost confidence in science, scientists, and scientific institutions (Ekberg 2007). These parameters have links with power and knowledge and with the political values of liberty, equality, justice, human rights, and democracy (Ekberg 2007). In this pandemic situation, the voice of politics seems to undermine the voice of science in many countries, including the United States.

This study's data analysis reveals that in most countries, the population's mobility is relative to government initiatives. As a result, people have stayed at home and reduced their mobility to workplaces, public parks, retail and recreation centers, transit stations, grocery stores, and pharmacies to varying levels. The principal reason for initiating policy measures is to motivate people to minimize social contact with others to help limit the rise of COVID-19 cases. The results of this study suggest that countries with stricter policies and implementations are more likely to achieve better social distancing behaviors compared to those without. Infectious disease has re-emerged as a public health threat in an increasingly globalized world that involves transnational, national, and local government actors (Dingwal, et al. 2013), and therefore, the effectiveness and societal impact of social distancing will largely depend on the credibility, in the eyes of the community, of the public health authorities, political leaders, and institutions that encourage such measures (Lewnard, et al. 2020). Building on the analysis of this study about policy responses to the COVID-19 pandemic, I suggest that people's community mobility largely depends on policy compliance, which varies significantly across nations due to their relative degrees of stringency.

Policy responses to COVID-19 pandemic

As governments around the world respond to the COVID-19 outbreak, it has been essential to have the latest information about the effectiveness of their policies in order to offer more options for tackling this pandemic or any other health crisis that may arise in the future. Organizations worldwide have been collecting data on the socio-political dimensions at play in order to understand disease outbreaks and consequent policy responses. For example, the Johns Hopkins University Center for Systems Science and Engineering created a publicly available data repository from sources like the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and ministries from multiple countries. Additionally, the Oxford COVID-19 Government Response Tracker (OxCGRT), which produced a robust new Stringency Index that assesses the rigidity with which national governments have implemented policy measures to tackle the spread of the virus, addresses the issue from a social and political perspectives (Hale et al. 2020). Moreover, Google has made reports on community mobility available to

the public, in an aim to provide insights into changes being made to these policies (Google 2020; Chan et al. 2020). The reports use Google's location services function (in the countries where it is available) in order to track users' movements. Using this method, Google has identified six major location types people visit in their everyday life: home, work, parks, transit stations, retail and recreation centers, and groceries/pharmacies. In this article, I will consider people's relative mobility towards these six categories as indicators of their social distancing efforts. Retail and recreation centers include restaurants, cafes, shopping centers, theme parks, museums, libraries, and movie theatres. Groceries/pharmacies include grocery markets, food warehouses, farmers markets, food shops, drug stores, and pharmacies. Public parks include national parks, public beaches, plazas, and public gardens. Locations in transit stations include subways, bus stations, and train stations. Workplaces are where people travel during workdays. Finally, residential places are where people live.

Governmental policy responses, which attempt to enforce social distancing and limit community mobility, have included limiting public gatherings, school and public service closures, and changes to prison-related policies. Socioeconomic and government measures have involved decisions related to declarations of a state of emergency, economic measures, activation of emergency administrative structures, and limiting imports and exports. Meanwhile, governmental initiatives related to public health introduce, implement, and strengthen quarantine policies, awareness campaigns, behavioral recommendations, public health systems, testing policies, psychological assistance, and medical social work. Globally, policy responses have also been targeted at people's movements and mobility, including surveillance and monitoring, border closures, visa restrictions, domestic travel restrictions, additional health requirements upon arrival at ports of entry, and curfews. Finally, with some exceptions, countries have declared partial or full lockdowns at the national or state levels.

In order to fight against COVID, different countries follow different measures to tackle the pandemic's impact on their populations. China and France implemented strict restrictions on citizens' freedom of movement, while New Zealand intervened with a mandatory two-week quarantine for those arriving from outside (Green et al. 2020). On the other hand, South Korea and Sweden followed a policy of rapid and thorough testing and contact tracing (Green et al. 2020). In Scandinavia, unlike Sweden's reluctant policy response to the outbreak of COVID-19, the Norwegian government announced a fine and jail sentence for breaking home quarantine and violating the ban on cultural events, sporting events, or sporting activities (The Local 2020).

Willingness to distance is also highly dependent on populations' socioeconomic characteristics: women, elderly people, the highly educated, and vulnerable groups are more prone to stay distant than their counterparts (Olsen et al. 2020). Studies also found a high positive correlation between political trust and

willingness to distance and a weak negative correlation between social trust and willingness to distance (Olsen et al. 2020). It is also true that misleading information and a shortage of data and statistics trigger policymakers to take imperfect interventions. Therefore, surveillance and descriptive epidemiology remain inevitable foundations for a strong health science and policy responses (Pearce et al. 2020). The difficulties of drawing policy decisions from inadequate data are illustrated by the situation in the United Kingdom, which initially took a “wait-for-herd-immunity” approach but later took measures similar to those of other major European nations (Pearce et al. 2020).

Social distancing has proved to be the most important defense against COVID infections (Anderson et al. 2020; Okell et al., 2020). However, studies show that compliance with social distancing depends on people’s socioeconomic conditions: social distancing is more effective among upper-income group than low-income people (Lou et al. 2020 and Wright et al. 2020). In countries with poor socioeconomic conditions, stringent policies and income support programs help flatten the curve of cases and fatalities (Ashraf 2020). In many countries, including India, where the COVID cases are just a step behind the United States, a large segment of the population lives in poor socioeconomic conditions, but the government’s inclusive responses are absent. Although studies have considered the poor economic and infrastructural conditions of poor countries where societies are less individualized than they are in most developed countries, the evidence proved that the pandemic can equally affect any country. A concerned government should act in line with public health measures to tackle the rise of the pandemic, which is why governments should extend their other economic and social measures to all citizens, particularly to the most vulnerable groups.

During the Spanish flu, cities that adopted at least one of the major non-pharmaceutical interventions, such as school closures, cancellation of public gatherings, and isolation, had a statistically significant association with reduced overall mortality rates (Markel et al. 2007). During the same influenza pandemic, two US cities—St. Louis and Philadelphia—adopted different policies and had different outcomes. St. Louis authorities responded strictly and had fewer fatalities, while Philadelphia experienced unprecedented loss of lives (Rotonde et al. 2020). Studies claim that early intervention of strict social distancing significantly reduces the virus; therefore, stepped social distancing—epicenter city first, then state, and finally the whole country—could flatten the rise of infections (Zhang et al. 2020). In this COVID pandemic, most countries failed to avoid the initial outbreak, but later introduced a wide-ranging social policy to contain the virus transmission. However, it is timely to explore how people in their everyday life responded to those policy measures.

Data, Models, And Analyses

To explore the differences in social distancing practices relative to stricter policy responses to the COVID-19 pandemic, I used two sources of data: the OxCGRT (Oxford COVID-19 Government Response Tracker)

Stringency Index and Google's data on community mobility. The OxCGRT developed a stringency index for each country depending on its policy responses to the COVID-19 pandemic. It used 11 indicators of government response to COVID-19 and created an index that scores each country's stringency level. A score of zero indicates the lowest degree of stringency and 100 marks the highest strictness level in policy responses. For each country, OxCGRT has collected data on policy responses and calculated the composite scores on a daily basis since January 1, 2020. In order to use country-specific social distancing data, I have used Google Community Mobility data. Google has country-specific daily observations from February 16, 2020 to March 29, 2020. As explained by Google, this dataset contains information about people's movement between different locations and compares it to a baseline period between January 3, 2020 and February 6, 2020. Therefore, I merged two datasets with the condition that they have daily observations for the actual timeline, which is February 16, 2020 to March 29, 2020. Provided that data from the OxCGRT and Google are available for the actual time period, I looked at 132 countries[i], totaling 3,997 observations. In this analysis, social distancing indicators in policies are phrases such as: "at home," "mobility to workplaces," "mobility to public parks," "mobility to transit stations," "mobility to retail and recreation centers," and "mobility to groceries/pharmacies."

I used R programming language for the data wrangling, visualizations, and analysis. In this study, I utilized different packages such as *tidyverse*, *lubridate*, *ggplot2*, and *rddensity* (RStudio Team 2020, Wickham 2016, Wickham et al. 2019, McCrary 2008). To show the differences in policy responses and resultant changes in people's social distancing across countries, I used Regression Discontinuity design (RD). As a quasi-experimental design, RD determines whether a program or treatment is effective, and it is one of the most popular and powerful techniques for evaluating the causal effects of policy interventions. In RD design, cases are assigned to intervention or control groups on the basis of a cutoff score that may be rule-based. In my present study, it is not rule-based; rather, I created a cutoff point based on the median value of cluster analysis. Table 1 demonstrates the results of cluster analysis which utilized K-median clustering for the running variable—in this case, policy stringency score.

Table 1: K-Median clusters of policy responses across countries

Clusters	Centers (K-Medians)	Variable	Descriptions
Cluster 1	67.29	Policy stringency	Method: K-Medians
Cluster 2	95.24	Policy stringency	Number of locations: 132 Number of clusters: 5
Cluster 3	80.95	Policy stringency	Initialization method: Random
Cluster 4	85.71	Policy stringency	Initialization re-runs: 150
Cluster 5	100	Policy stringency	Maximum iterations: 1000 Transformation: Standardize (Z)
			Distance function: Manhattan

Using GeoDa (Anselin et al. 2006) software for geospatial analysis, I calculated center values (median in this case) for each cluster and distributed them using the world map (Figure 1). I considered the policy score of 67.29 to be the lowest median score for countries with minimum policy stringencies. Therefore, the cutoff point for this study is 67.30, which separates two groups of countries—treatment and control countries—that are with or without strict policy responses (Strictness = TRUE or FALSE) to the COVID-19 pandemic, respectively.

Assumptions of Research Design

I followed a few steps to confirm the research design’s underlying assumptions and make it robust. First, I determined whether the process of assigning treatment is rule-based. No rule rigorously determines strictness of policy interventions in response to COVID-19. However, I utilized cluster analysis to identify five clusters and their corresponding median scores. According to the results of cluster analysis, 67.29 is the lowest cluster’s median score. I used this value as a cut-point for running the study variable (policy stringency index score). Therefore, I considered this cut-point as a global threshold value of minimum policy stringency. The countries which received policy responses of 67.29 or less are considered countries with softer policy responses, while countries with responses of 67.30 or above are considered to have stricter policies.

In the second step, I determined whether the research design is fuzzy or sharp in its distribution. To identify whether the design falls into the fuzzy or sharp category, I attempted to see if any cases are present above and below the threshold. The charts in Figure 2 show that the distribution of the intervention and non-intervention groups of countries that divide cases with or without strict policies does

not overlap. No case of a FALSE group (Strictness = FALSE) presents in a TRUE group (Strictness = TRUE), or vice-versa. Therefore, this regression discontinuity design follows a sharp discontinuity. In this design, 3,197 cases fall into the non-intervention group (FALSE) and 800 cases fall into the intervention group (TRUE).

Discontinuity in running variable (stringency score) around cut-point (Right)

In the third step, I verified whether any discontinuity exists in the running variable (policy stringency score) around the cut-point. At this stage, regression discontinuity design requires confirmation about whether there is manipulation or a big jump around the cut-point score. To confirm this issue, the most popular technique is to demonstrate it using a histogram underscoring cut-point line. In this histogram, big jump is not visible around the threshold score. However, a small jump is visible in the FALSE group area. The question is how big or significant this jump. To test its significance, I used the McCrary Density Test (Figure 3). Since the confidence intervals overlap, or almost overlap, the test confirms that no significant difference exists around the cut-point (McCrary, 2008). This result means that the McCrary test confirms that no big difference exists near the threshold policy stringency score.

Later, I also verified whether any discontinuity exists in outcome variables across the running variable. Based on the set of charts demonstrated in Figure 6, there is a clear discontinuity in outcomes (social distancing). It looks like stricter policy responses to COVID-19 have improved social distancing practices. Finally, I measured the size of the policy stringency score's effect on social distancing practices. To determine how big discontinuity and its statistical significance is, I ran parametric estimations using linear regressions. The estimations explained variations in outcome variables (in this study, outcome variables are: "stay at home," "mobility to workplace," "transit station," "public park," "groceries/pharmacies," and "retail and recreation centers").

Models in the Research Design

I considered six different locations that Google has used to explain people's community mobility, and I measured each location's variability due to policy stringencies. So, in this study, I have six regression models that I fit in the regression discontinuity design. The models are:

$$Y_{\text{home}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

$$Y_{\text{work}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

$$Y_{\text{park}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

$$Y_{\text{transit}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

$$Y_{\text{retail}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

$$Y_{\text{grocery}} = \beta_0 + \beta_1 \text{stringency score} + \beta_2 \text{strict policy} + \varepsilon$$

Here, β_0 is the intercept;

β_1 is the coefficient of centered policy stringency score; and

β_2 is the coefficient of treatment variable (Strictness = TRUE or FALSE).

[i] Countries included in this study are: Afghanistan, Angola, Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Belize, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, Colombia, Costa Rica, Croatia, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Hong Kong, Hungary, India, Iraq, Ireland, Kuwait, Kyrgyz Republic, Laos, Lebanon, Libya, Malaysia, Mali, Mauritius, Mexico, Mozambique, Myanmar, Namibia, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Rwanda, Saudi Arabia, Singapore, Slovak Republic, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Trinidad and Tobago, Turkey, Uganda, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe.

Results

How Stringent are Policy Measures?

The map (Figure 1) demonstrates five clusters relative to average COVID-19 pandemic policy stringencies. Out of the 132 countries that this study considered, only 17 countries responded strictly in their policies to tackle the rise of the outbreak. However, the highest number (46) of countries fell into the lowest stringency cluster. Regionally, Asia Pacific and Europe implemented stricter policies in response to the current pandemic. Among the countries hardest hit with the virus, India had exceptionally high levels of stringencies, followed by Peru and Colombia. The United States Brazil, on the other hand, experienced a moderate level of stringencies. The degrees of stringency used to ensure social distancing vary over time and space. Australia, Ireland, Japan, Singapore, South Korea, Sweden, Taiwan, Thailand, the United Kingdom, and the United States implemented less stringent measures than the other countries studied. Countries with a Stringency Index over 90 include: Austria, Denmark, Finland, France, India, Israel, Italy, Malaysia, Netherlands, New Zealand, Norway, Philippines, Saudi Arabia, South Africa, Spain, and Turkey. Among the countries hit hardest by COVID-19, the United States and the United Kingdom had the least stringent policies in response to the pandemic. As of September 15, 2020, the United States was responsible for one-fifth of the total COVID-19 death toll in the world, while among European nations, the United Kingdom has the third-highest number of deaths per million. Several Asian countries on this list—

India, Israel, Malaysia, the Philippines, Saudi Arabia, and Turkey—are among those with the most stringent policies. However, some other Asian nations, such as Japan, Singapore, South Korea, and Taiwan, had less stringent policies. Singapore, which had a minimal number of confirmed cases up until late March 2020, now has one of the highest numbers of cases among ASEAN countries.

Policy Responses and Social Distancing across Countries

In terms of regional distributions of social distancing over time, comparative smooth line charts (Figure 4 and Figure 5) demonstrate that South American countries have the highest level of “stay at home” compliance followed by Oceania, while the North American and African nations have the lowest performance. The European nations, which are now in the second wave of the coronavirus pandemic, had rising shelter-in-place practices until the end of March that began when WHO declared COVID a pandemic. The Asian countries followed the same trend, although many of the Southeast and Far East nations had unprecedented success in tackling the early attack of coronavirus outbreaks. The United States (approximately 18-unit) and Brazil (approximately 24-unit) had the lowest stay-at-home behavior, in contrast with Peru and Colombia, which reached the peak among the hardest-hit countries— a 40-unit more stay-at-home compliance than the previous month. The countries in the Oceania performed best at social distancing in all six locations; they were almost the same as South American nations’ (except Brazil) performances. On the other side, North America—particularly the United States—had the worst performance in the areas of community mobility.

The results of the analysis of comparative impacts of policy interventions have been summarized in Table 2 and Figure 6. Implementing stringent social distancing policies to prevent coronavirus infections yields an increase in the probability of achieving individual social distancing behavior. To make coefficient interpretations easier to follow, I centered the “policy stringency index score.” This score shows how many cases are above and below the cut-point score (67.30). Since I centered the stringency index score, it shows the average stringency index score at the 67.30 point cut-point.

Table 2: Model summary (policy responses and social distancing across countries)

Names	Full data	Bandwidth = 10	Bandwidth = 20
Stay at home			
(Intercept)	9.592 *** (0.209)	11.044 *** (0.596)	12.130 *** (0.433)
stringency.centered	0.146 *** (0.004)	-0.066 (0.139)	0.317 *** (0.035)
strict.policy = TRUE	8.771 *** (0.330)	7.224 *** (1.403)	3.735 *** (0.857)
R²	0.699	0.166	0.372
Mobility to workplace			
(Intercept)	-12.834 *** (0.573)	-17.009 *** (1.546)	-18.187 *** (1.073)
stringency.centered	-0.264 *** (0.012)	-0.474 (0.361)	-0.634 *** (0.088)
strict.policy = TRUE	-25.396 *** (0.903)	-16.933 *** (3.636)	-14.163 *** (2.121)
N	3997	484	079

R²	0.617	0.232	0.391
Mobility to public park			
(Intercept)	-15.805 *** (0.827)	-16.110 *** (2.067)	-20.371 *** (1.502)
stringency.centered	-0.262 *** (0.017)	1.208 *(0.483)	-0.426 *** (0.123)
strict.policy = TRUE	-18.307 *** (1.303)	-25.775 *** (4.863)	-10.269 *** (2.970)
R²	0.354	0.090	0.138
Mobility to transit station			
(Intercept)	-25.384 *** (0.557)	-29.830 *** (1.635)	-31.240 *** (1.097)
stringency.centered	-0.423 *** (0.011)	-0.229 (0.382)	-0.732 *** (0.089)
strict.policy = TRUE	-24.723 *** (0.878)	-19.699 *** (3.846)	-13.770 *** (2.168)
R²	0.729	0.221	0.412

Mobility to retail and recreation center			
(Intercept)	-23.595 *** (0.575)	-26.070 *** (1.687)	-29.536 *** (1.190)
stringency.centered	-0.400 *** (0.012)	0.780 *(0.394)	-0.697 *** (0.097)
strict.policy = TRUE	-27.920 *** (0.907)	-29.762 *** (3.968)	-16.909 *** (2.352)
R²	0.725	0.233	0.406
Mobility to grocery and pharmacy			
(Intercept)	-4.522 ** (1.570)	-17.009 *** (1.546)	-18.187*** (1.073)
stringency.centered	1.310 *** (0.367)	-0.474 (0.361)	-0.634 *** (0.088)
strict.policy = TRUE	-30.552 *** (3.693)	-16.933 *** (3.636)	-14.163 *** (2.121)
R²	0.208	0.232	0.391

N = 3,997, N = 484, N = 1,079. * p < 0.001; ** p < 0.01; * p < 0.05.**

For example, countries that scored 67.29 points in their policy stringency score have an average of 9.592 points for “stay-at-home.” Here, β_0 is the intercept and B_1 is the coefficient of the centered policy stringency score. Therefore, for every point above 67.30 that countries score on the policy stringency index, they score 0.146 points higher on their “stay-at-home.” B_2 is the coefficient for the programmed variable—whether the group of countries implemented strict policy (strictness=TRUE, strictness=FALSE). This coefficient is the most important one in the examining models that this analysis cares about the most. This is the shift in intercept when the model has strict policy (strictness = TRUE). In other words, this is the difference between scores at the cut-point score. Complying with the strict policy (TRUE) increases a country’s “stay-at-home” by 8.771 points.

In this analysis, I considered all models to be parametric and included all observations (N = 3,997). However, in real situations, researchers may be interested in the cases around the cut-point score. Observations with very high and low scores should not influence effect size, since the Regression Discontinuity design (RDD) only cares about the score that are not so distant from the threshold score. To determine whether any big difference exists in the effect size, I used two different bandwidths (Table 2); for example, 10 and 20 points before and after the actual cut-point. I created six in-vivo charts (Fig 6) to demonstrate effects of policy strictness on the social distancing outcomes in six different community mobility locations. In the charts, the horizontal line (X axis) and the vertical line (Y axis) respectively represent the policy stringency index and social distancing outcomes in the design. The vertical, solid line differentiates the two groups of countries with (TRUE) and without (FALSE) strict policies. In the RD design, I used three different linear regression lines: a blue dotted line (for countries with stricter and softer policies) counting the total observations (3,997), a purple dotted line considering 10 bandwidths (before and after) from the cut-point (67.30) score of stringency index, and a red solid line taking the 20 bandwidths (before and after) from the cut-point score.

For the first model (*Yhome*), counting the full data (N = 3,997), the countries with strict policies (TRUE) increased “stay-at-home” by 8.771 points. In the occasion of counting 10 bandwidths (N = 484), the same countries with stringent policies rose “stay-at-home” efforts by 7.224 units. When the same model considers 20 bandwidths (N = 1079), the countries that had stronger policies increased “stay-at-home” by 3.735 points. In the second model (*Ywork*), I considered people’s “mobility to workplace” to be an outcome variable as a consequence of strict policy interventions across countries. The results (N = 3,997) show that when strict policies (TRUE) are in place in response to COVID, the countries see a huge

decrease (-25.396 unit) in the community mobility towards workplaces. The results show similar trends but a slower decrease for the model if it considers closer bandwidths of 10 (-16.933 unit) and 20 (-14.163 unit) before and after the cut-point. The same declining but variable trends were found in other models where *Ypark*, *Ytransit*, *Yretail*, and *Ygrocery* are the dependent variables. The analysis found that the countries with strict policies (TRUE) had a probability of significant reductions in people's mobility to public parks (-18.307, -25.775, -10.269 unit), transit stations (-24.723, -19.699, -13.770 unit), retail and recreation centers (-27.920, -29.762, -16.909 unit), and groceries/pharmacies (-30.552, -16.933, -14.163unit). The results of counting bandwidth of 10 represent more closely with the results when the models count total observations. Therefore, the analysis confirms a steep rise in people's tendency to stay at home (7.224 unit) in response to state's stricter policies. The analysis also confirms a sharp decline in people's community mobility toward workplaces (-16.933 unit), public parks (-25.775 unit), transit stations (-19.699 unit), retail and recreation centers (-29.762 unit), and groceries/pharmacies (-16.933 unit).

Discussion And Conclusions

The data analysis reveals that in most countries, people's physical movement to particular places is relative to government policy initiatives. As a result of those policies, people have stayed at home and reduced their physical mobility to workplaces, public parks, retail and recreation centers, transit stations, and grocery stores/pharmacies—to varying levels. The principal reason for initiating policy measures is to motivate people to minimize their social contact with others and thereby limit the rise of COVID-19 cases. The results of this paper suggest that those countries with stricter policies are more likely to achieve more social distancing practice compared to those with more lenient guidelines. By and large, effectiveness of policy interventions in response to COVID-19 depend on credibility of the political leaders, public health authorities, and institutions connected to them. People's trust in pandemic-like situations depends on policy maker's handling of evidence-based, transparent, and fact-based intervention communications (Lewnard et al. 2020). We have seen many political leaders try to ignore science, offer up the rhetoric of normalcy, and avoid realities in what Habermas calls a "rationality crisis" and "legitimacy crisis." In this pandemic situation, states may run the risk of a rationality crisis when they fail to meet the economy's demands, but they may also run the risk of a legitimacy crisis when they fail to meet the citizens' demands.

Studies represent a mixed picture regarding the role of national leadership in managing and implementing policies. In some cases, national leadership plays an effective role by making prompt and effective decisions to implement their policies. Responding to these diseases at their source, rather than awaiting their arrival on our shores, is the best and most prudent public health approach (Smith and Fraser 2020). For instance, the Vietnamese government had started to make decisions even before China experienced any fatalities due to the COVID-19 pandemic. This effort crowned Vietnam as champion among the least-affected countries, despite its geographical proximity with China (La et al. 2020). Wilder-smith and Freedman (2020) argue that China's national leaders play a crucial role in managing and

implementing proper policies: within a matter of weeks, China introduced every available method of containment, ranging from case identification with immediate isolation, to contact-monitoring of all communications with quarantine, and medical observation of all contacts. In contrast, Brazil's national leaders didn't play a crucial role in managing the pandemic. Without imposing a lockdown, the government of Brazil has urged its population to stay at home. Otherwise, the government has taken measures such as school and university closure and bans on public events (Crokidakis. 2020). The government did not impose a strict lockdown, although a significant number of their population has been affected. According to Malta et al. (2020), absence of proper leadership, lack of infrastructure, and omnipresent corruption have placed Brazil among the COVID-19 highly affected countries.

While social distancing policies are vastly important among political leaders, public health experts, and policymakers, some studies also urge that political leaders must introduce social-distancing policies that do not show bias against any particular population or group (Lewnard et al. 2020). The Covid-19 pandemic disproportionately affects different groups of people depending on age, gender, and health conditions. The sweeping movement-restriction policies most countries take can increase employment insecurity and job loss, reduce income and food security, and increase the risk of mental health problems, particularly for low-income households, women, families with children, older adults, and disabled persons. State policies should be socially inclusive; while restricting people's movements, they should also take care of socially and economically vulnerable citizens. The reality is that the effectiveness and societal impact of social distancing largely depend on the credibility of public health authorities, political leaders, and institutions.

The fear of virus exposure has resulted in irrational behavior in the general population and in some policymakers implementing ridiculous, non-scientific policies in some countries. Resilience has reached its lowest levels in many countries, and people are doing anything to escape from the virus. This phenomenon had its own effect on policymakers and forced them to do some things even though they were informed that they wouldn't help and were not cost effective (Sadati 2020). In the crisis-like situations like this current pandemic, people used to believe political leaders, policymakers, and scientists. However, in countries with the highest infection levels, political leaders often downplay the situation's severity and utter self-congratulations, which may influence people's willingness to comply with the policy measures and to trust scientific institutions.

Risks that are created and activated in social systems must be controlled and managed by a society's relevant organizations and institutions (Beck 1992). In this current COVID-19 pandemic, political rhetoric, politically motivated scientific solutions, and political downplaying of the underlying health implications weaken the responsible organizations and institutions, particularly when political leaders undermine

inclusive stringent policies and their implementation. The 'cold race' for a vaccine, whether it ends up being effective or not, intensifies the magnitude of physical risks, which according to Beck is a direct function of the quality of social relations and processes. Focusing attention and resources on medicine and biomedical science, then, tells less than half the story of how societies identify new diseases, how they respond, and what the consequences might be (Dingwall et al. 2013). Therefore, sociological imagination regarding policies and practices is critical to see how different scientific organizations and institutions can be changed when other socio-political actors are changed. Since this strange state presents such an immediate threat to public order, it can also powerfully influence the size, timing, and shape of the social and political response in many other areas the epidemic has affected (Strong 1990).

Given the significant impact of social distancing on COVID cases and fatality rates, this study makes an effort to examine the impact of stringent policies on social distancing performances across countries. The Regression Discontinuity design gives this study extra strength to compare countries with and without such policies. By counting three different research situations in this type of Quasi-experimental study, this analysis confirms that strict policies largely affect people's community mobility in a pandemic. Among the hardest-hit regions, the Americas stand at the top in the list of softer policy responses and non-compliance with the policies. At the same time, the United States appears to be the leader of less-strict countries and countries with the least social distancing behaviors. The Oceania, Southeast Asia, and Scandinavia are among the top of the regions with stricter policy measures that have experienced relatively lower case growth and death tolls. This study suggests further research incorporating more socioeconomic and political parameters with a special focus on spatially integrated social distancing efforts.

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Declarations

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Conflict of interest

The author declares that he has no conflict of interest.

Figures

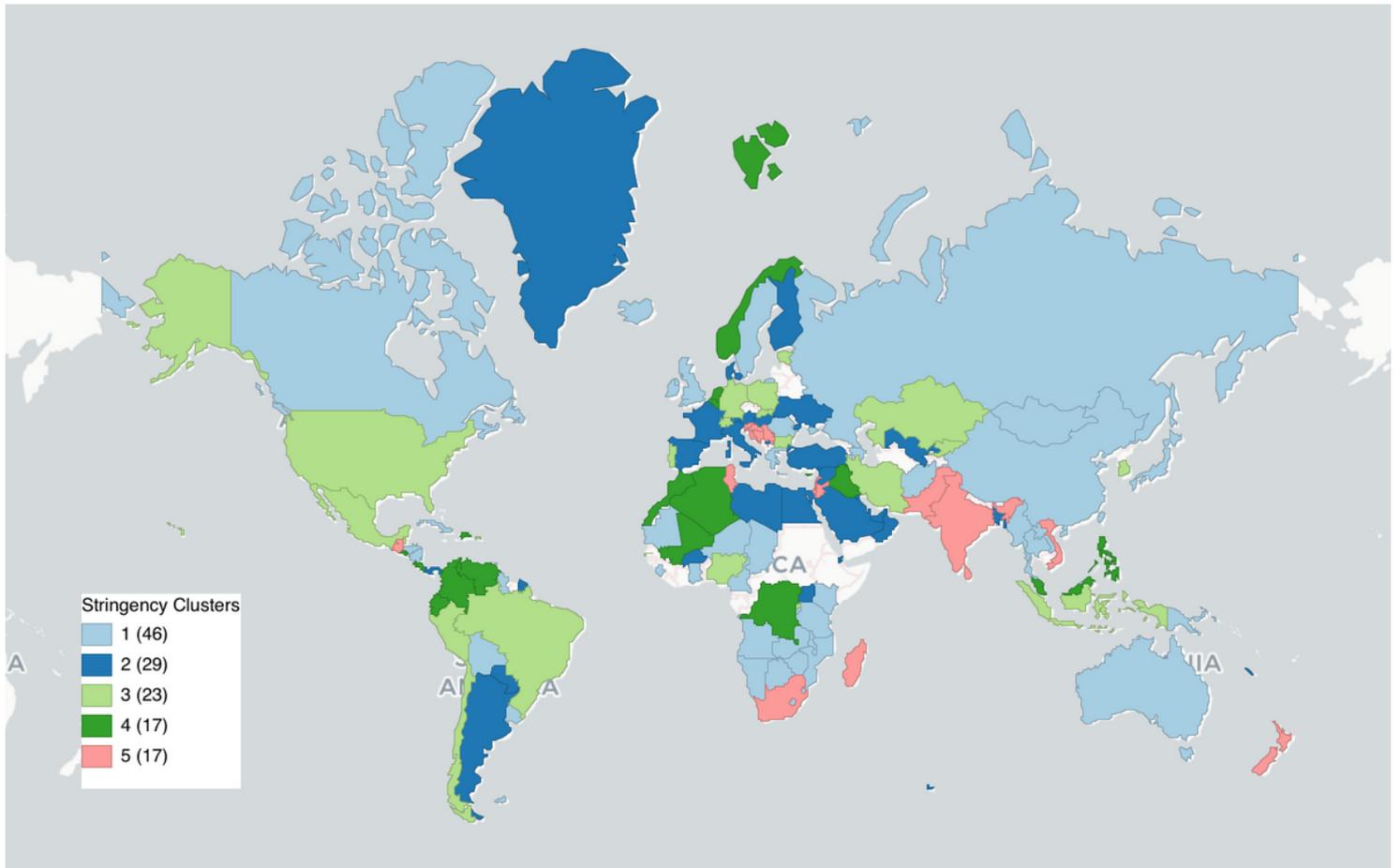


Figure 1

Cluster map of policy responses to the COVID-19 pandemic. Number of countries under each cluster mentioned within the parenthesis. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

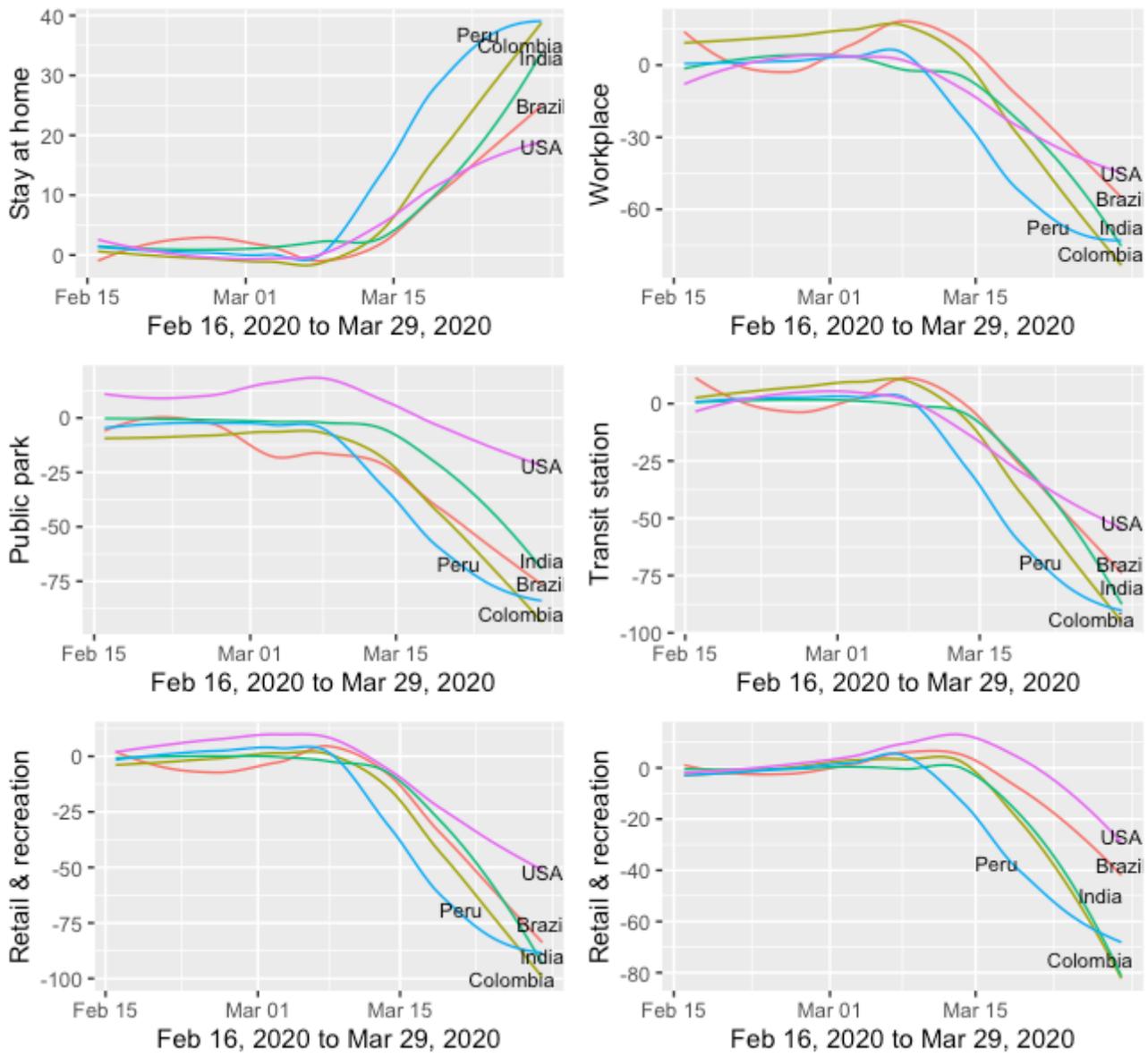


Figure 2

Differences in social distancing efforts over time among coronavirus hit hardest countries

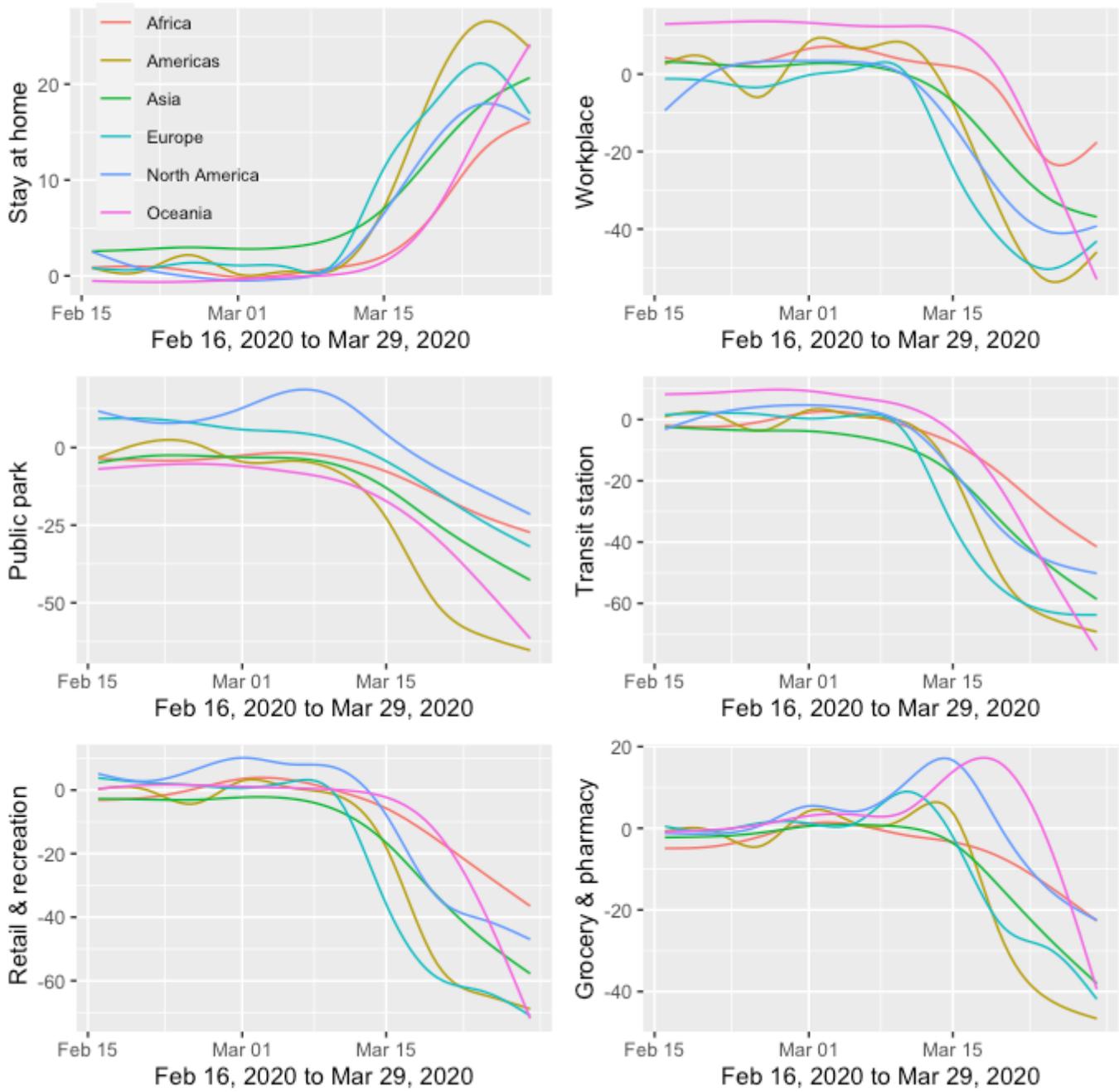


Figure 3

Regional differences in social distancing efforts over time

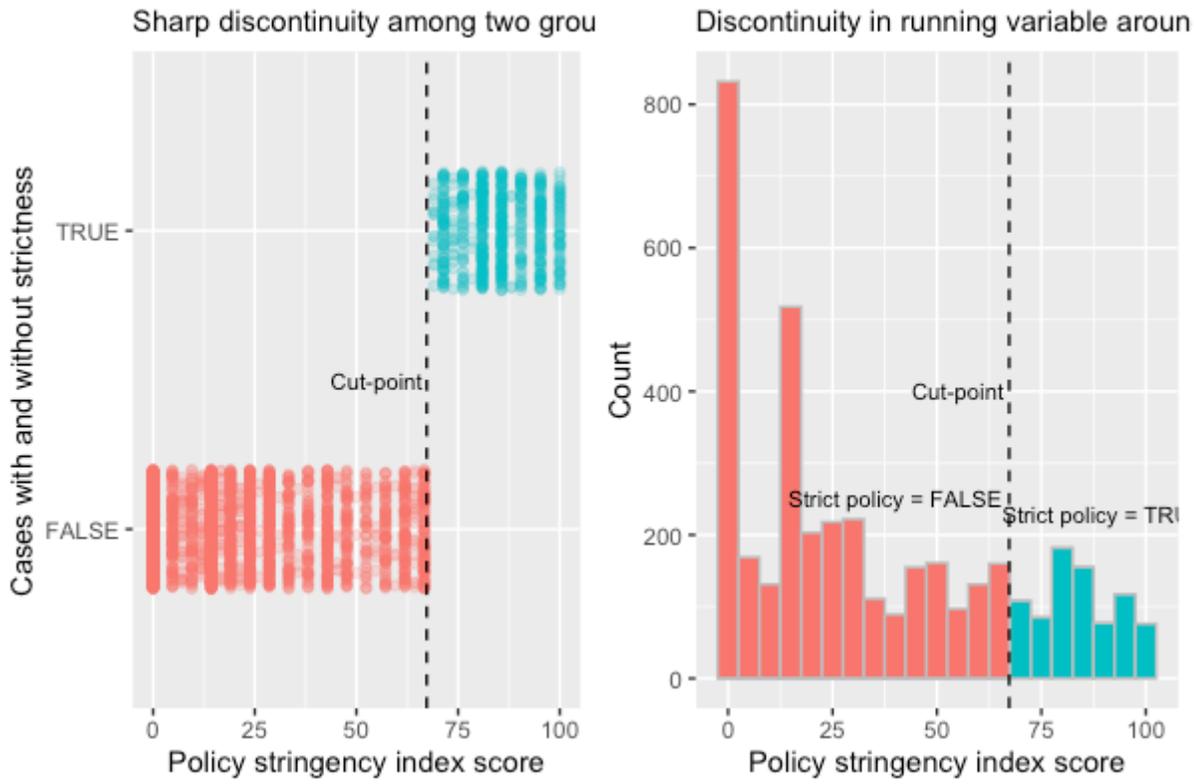


Figure 4

Nature of distribution of cases before and after cut-point (Left). Discontinuity in running variable (stringency score) around cut-point (Right)

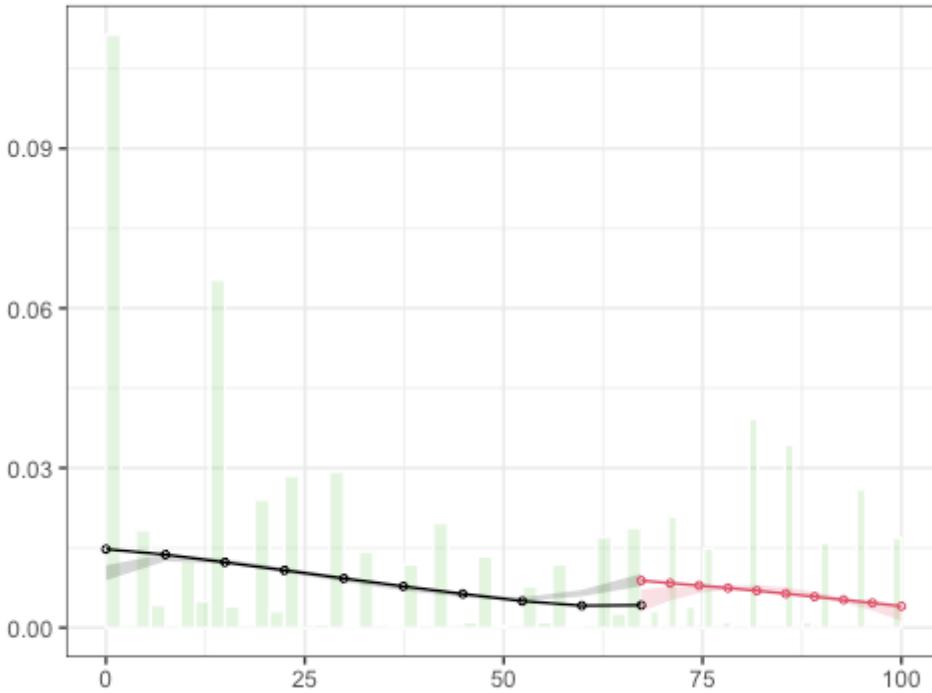


Figure 5

McCrary Density Test plot to verify the significance of jump around threshold score

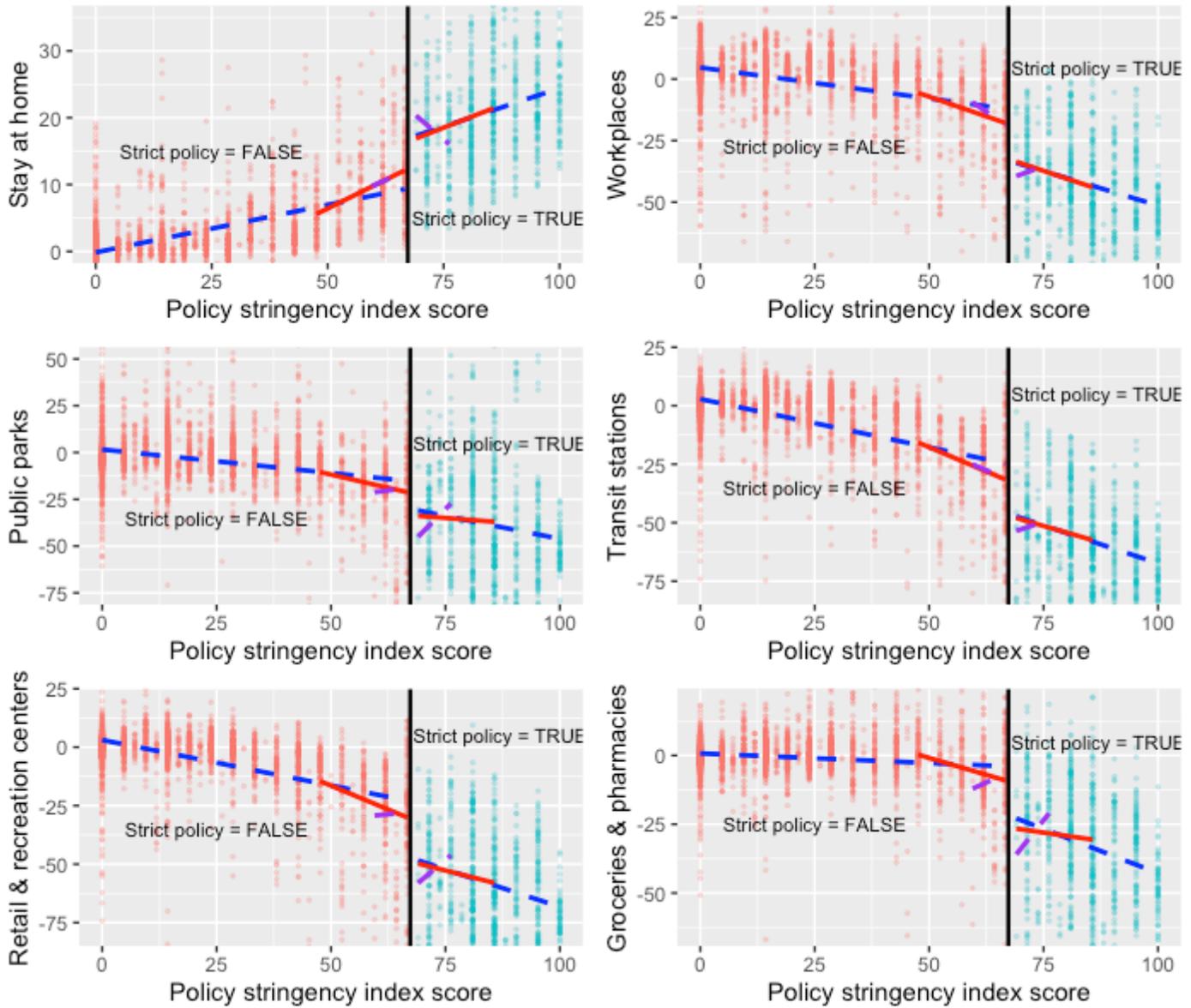


Figure 6

Regression discontinuity in social distancing across policy stringency index score. The blue dotted lines indicate regression discontinuity before and after the cut-point (horizontal solid line) for 3,997 cases. The purple dotted lines demonstrate regression discontinuity before and after the cut-point (horizontal solid line) for 484 cases (bandwidth = 10). The red solid lines demonstrate regression discontinuity before and after the cut-point (horizontal solid line) for 1,079 cases (bandwidth = 20).