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Does Individualism vs. Collectivism Affect Public Compliance with Social Distancing?

By

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Abstract

While individualism is often connected with innovation and economic growth, it may also hamper collective actions. In the context of COVID-19 which engenders negative externalities on population movement and interaction, this paper examines whether and how individualism vs. collectivism influences public response to social distancing regulations. With country- and county-day-level data of population movement, COVID-19 cases, and government policy stringency, I find that people in more individualistic countries showed less compliance with social distancing regulations, even after accounting for potential confounding demographic, political, and socio-economic factors. However, the relation was reversed across counties in the U.S. I explain the heterogeneity as related to the propensity to comply—a main property of collectivism. Under the hypothesis, collectivism leads to more compliance with social distancing regulations only when the public perceives the pandemic as a serious threat. Furthermore, I find a positive relation between collectivism and compliance in U.S. Democrat-controlled states but find the opposite in Republican-controlled states. I argue in favor of the compliance hypothesis which may be explained by Republican state government's underestimation of the severity of COVID-19.

Keywords: COVID-19, regulation, compliance, individualism, collectivism.

JEL Codes: H12, I18, Z18.

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1 Introduction

With the spread of COVID-19 over the world, most countries have implemented various types and degrees of social distancing policies, including workplace and school closure, travel bans, and stay-at-home requirements, etc. Many studies have found it effective to reduce social contact and risks of COVID-19 infection with stay-at-home orders, mask mandates, and other social distancing interventions (Hsiang et al., 2020; Viner et al., 2020; Allcott et al., 2020; Matrajt and Leung, 2020; Chudik et al., 2020; Karaivanov et al., 2020). Then, an intriguing question arises as to what factors influence people's compliance with these regulations, since local non-compliance leads to higher public health risks and regional spread of COVID-19 (Chen et al., 2020; Lewnard and Lo, 2020).

This paper focuses on public compliance with COVID-19-related regulations not only for their significance on social welfare but also because the pandemic provides an unusual environment where people's movement and interaction have obvious negative externalities upon others. My purpose is to study, under the crisis environment and among various factors, the link between *individualism-collectivism* (henceforth, *I-C*) and public compliance with COVID-19-related social distancing policies.

I-C has been considered as a fundamental cultural variation across societies by social psychologists (Triandis, 2001; Oyserman et al., 2002; Kashima and Kashima, 2003). It is widely accepted that individualists value personal freedom, self-reliance, personal choice, risk-taking, and achievement (Markus and Kitayama, 1991; Gorodnichenko and Roland, 2013; Talhelm et al., 2014; Ang et al., 2020). On the other hand, collectivists usually favor conformity, hierarchy, interdependence, cooperation, loyalty, and solidarity (Gorodnichenko and Roland, 2013; Pitlik and Rode, 2017; Ang et al., 2020).

Then, what is supposed to be the relation between I-C and public compliance with regulations in a crisis? A naive thought may be that individualists are more "selfish" and thus less willing to devote themselves for public welfare by obeying regulations. However, there are many challenges to this viewpoint. For example, one can argue that individualists are so "selfish" that they are eager to protect themselves from getting infected and therefore abide by social distancing policies better. Others may think that even though collectivists are usually more cooperative and willing to help the in-group (Ang et al., 2020)[1], the in-group favoritism does not necessarily lead to higher devotion to the whole society[2]. In addition, I-C may be considered as containing other aspects like lifestyles. For example, Vandello and Cohen (1999) deemed family structure as a characteristic of I-C. Moreover,

[1] The in-group altruism can be interest-driven, though. Some studies (Mifune et al., 2010; Yazdi et al., 2020) considered the link between the in-group altruism and reputation mechanism.

[2] For instance, there have been arguments and findings that the in-group favoritism inherent to collectivist societies generates corruption (Kyriacou, 2016; Jha and Panda, 2017; Amini et al., 2021).

one may plausibly hypothesize that collectivists engage more in contact with others since they value social networks and show dependence on organizations (Hofstede, 2001), which makes them more difficult to give up (physical) social interaction and accept self-isolation.

However, the theoretical framework in this paper focuses on another main aspect of I-C: *self-direction*. Pitlik and Rode (2017) argued that personal independence and beliefs in control of one's own life course are key components of an individualistic culture, and defined these properties as self-direction and self-determination. Apart from one's own opinion, social norms and rules also influence people's behavior. For instance, people may under social pressure exhibit altruism even though they don't when not observed. DellaVigna et al. (2012) argued that "individuals may give, despite not liking to give to the charity, because the solicitor effectively placed them under social pressure to give." Under the self-direction hypothesis, an individualist should perform less conformity to the majority. This theory can be applied to the COVID-19 environment, in which people probably wear masks, despite not thinking they need, because they are under social pressure to show altruism and civic duties. This self-direction aspect induces two possible relations between I-C and public compliance. On the one hand, in a society where most people do not wear masks, it seems more likely for a collectivist not to wear masks or not to comply with mask mandates since they are more vulnerable to the social pressure of not wearing masks. On the contrary, if most people choose to wear masks, then a collectivist in this society should be more likely to follow the majority and wear masks. In other words, collectivism helps to promote compliance with stay-at-home requirements only if enough people (i.e., the majority) choose to stay at home or, equivalently, the public perceives COVID-19 as serious enough.

In the following, I estimate the relation between I-C and compliance with stay-at-home requirements across countries and across U.S. counties, respectively. I find that individualism was negatively related to compliance with policies in the cross-country case. High-individualism countries showed around one-third less population mobility reduction by stay-at-home orders than other countries. In the U.S. cross-county case, on the contrary, residents in more individualistic states showed more compliance with stay-at-home requirements. The effects of stay-at-home policies on reducing population mobility in high-collectivism counties were nearly half as much as those in low-collectivism counties. Webster et al. (2021) achieved similar opposite results, which they called American exceptionalism. They argued that the state-level collectivism index was positively correlated with percentage of non-Whites, historical slavery prevalence, and racial inequality. Thus, systemic racial inequality may be an interference factor that trumped state-level differences in collectivism.

I provide another explanation for the differing results among U.S. counties: the self-direction aspect of I-C specified by Pitlik and Rode (2017). That is, an individualistic person is more likely to be self-directed and influenced less by others' opinions. It is possible that the U.S. government and Americans did not perceive COVID-19 as so serious and consequently did not think it necessary to stay at home[3]. In fact, Dewi et al. (2020) categorized the U.S. as "most prepared" but "under-reaction" due to its high Global Health Security Index[4] but high COVID-19 cases and deaths. Under the circumstance where people underestimated the threat of the pandemic, collectivism should lead to more conformity to the majority and consequently less social distancing. I further examine this hypothesis by making analogous estimations in U.S. Democrat- and Republican-controlled states, respectively. This is because that the Democratic Party was usually more positive about showing the severity of the pandemic and implementing stringent regulations than the Republican party (Kincaid and Leckrone, 2020, Adolph et al., 2020a, Adolph et al., 2020b). No matter did the attitude differential result from voters' opinions or the state government's private information and judgement, the official stance should influence public perception of the pandemic. Arguably, more people in Democrat-controlled states believed they should stay at home in response to the serious pandemic than those in Republican-controlled states. Then, by theory collectivism should motivate conformity to the majority's behavior of staying at home more likely in Democrat-controlled states than in Republican-controlled states.

Further estimation results support the hypothesis above. There appears a positive relation between collectivism and compliance with stay-at-home requirements within Democrat-controlled states and a negative one within Republican-controlled states. This provides evidence that public perception of the threat of the pandemic is an important condition for the relation between collectivism and compliance with social distancing. The evidence also suggests that social distancing policies such as stay-at-home requirements may have limited effects conditional on I-C and social perception of COVID-19. Potential policy implications include disclosing correct information about the pandemic, calling for citizenship, and motivating the public to care about social welfare. Practical suggestions will be discussed in more detail in Section 6.

There are two key challenges to the basic estimations, though. The first is omitted variable. Some factors related to I-C or policy stringency may influence the effectiveness of social distancing regulations. For instance, income can be a confounding factor that correlates both I-C and compliance tendency. Moreover, if I-C influences policy stringency,

[3]For instance, a report criticized the U.S. government for downplaying the danger of COVID-19 and sidelining experts, inadequate tracing and isolating, and decentralized responses, which might negatively influence the public perception of the pandemic. Another article claimed that many COVID-19 deaths might have been prevented based on the comparison with other countries under similar circumstances.

[4]The GHS Index cited by Dewi et al. (2020) was formulated by John Hopkins University. See GHS Index.

then our estimations may merely reflect a nonlinear relation between regulation strictness and social compliance. To address these problems, I add interactive items between policy stringency and a group of control variables to exclude potential confounding factors. No substantial change occurs on results after adding these controlling interactions.

The second challenge is reverse causality. It is highly possible that population movement will reversely affect policy stringency. To solve this problem, I employ the number of ventilators needed among U.S. states to instrument policy stringency. However, this instrumental variable (IV) method applies only to U.S. cross-county estimations because of no cross-country data of ventilators. With two-stage least squares (2SLS) regressions, the previous results keep robust. Later in Section 4.3, I will describe research design in more detail.

This paper contributes to two branches of literature. The first studied factors that influence public response to COVID-19 and related policies, including economic endowment (Wright et al., 2020; Chiou and Tucker, 2020; Brzezinski et al., 2020), media (Simonov et al., 2020; Bursztyn et al., 2020), partisanship (Allcott et al., 2020; Viner et al., 2020; Andersen, 2020; Barrios and Hochberg, 2020; Engle et al., 2020; Painter and Qiu, 2020; Wright et al., 2020; Ajzenman et al., 2020; Mariani et al., 2020), religion (Egorov et al., 2020), trust (Brodeur et al., 2021; Bargain and Aminjonov, 2020; Chan et al., 2020), confidence in health system (Barrios et al., 2021), civic capital (Barrios et al., 2021), individualism, and anti-statism (Bazzi et al., 2020; Bazzi et al., 2017).

Second, a great number of economic literature have tested I-C's impacts on various issues, such as economic growth (Gorodnichenko and Roland, 2011; Kyriacou, 2016; Gorodnichenko and Roland, 2017), adoption of democracy (Licht et al., 2006; Gorodnichenko and Roland, 2015; Davis and Abdurazokzoda, 2016), political stability (Ezcurra, 2021), conflict and negotiation (Thornhill and Fincher, 2020), educational expenditure (Cheung and Chan, 2008), gender equality (Davis and Williamson, 2019), attitude to market-friendly institutions (Pitlik and Rode, 2017), and acceptance of new energy technology (Xia et al., 2019; Ang et al., 2020).

The remainder of this paper is organized as follows. (i) Section 2 illustrates a theoretical model that shows how compliance tendency influences the equilibrium pattern of social distancing conditional on citizens' perception of the potential damage of the epidemic. (ii) In Section 3, datasets employed for estimations are presented. (iii) Section 4 describes the research design, including event studies and difference-in-difference (DID) estimations with some robustness checks that are expected to solve the problems of omitted variable and reverse causality. (iv) In Section 5, results of empirical estimations are demonstrated. (v) Finally, Section 6 concludes and discusses policy implications and research limits in this paper.

2 Theoretical Framework

In this paper, I focus on the self-direction aspect of I-C which can well explain the estimation results. Under this theory, individualists show less conformity to the majority[5]. In other words, they care less about the social pressure when their actions are different from the majority's behavior. In the following, I consider a coordination game[6], where a continuum of citizens choose independently whether to stay at home or work outside, of which the latter generates negative externalities on others who also work outside. I-C is depicted as the utility weight people put on their conformity behavior. The model implies that individualism is negatively associated with public compliance with social distancing only if the perceived seriousness of the epidemic is "high enough". On the contrary, when the social perception of the epidemic is mild, an individualistic society exhibits more social distancing. For simplicity of notation, I use "individualism" and "collectivism" without specifying their self-direction or compliance aspect.

2.1 Setup

Assume there is a continuum of infinite citizens, denoted by I, of which the measure is normalized to one. Each citizen i has her type x_i, distributed through the interval $[0,1]$ according to c.d.f. $F:[0,1]\to[0,1]$ with corresponded p.d.f. $f:[0,1]\to\mathbb{R}_{++}$. Thus, $F(\cdot)$ is strictly increasing. Type x_i indicates the money a citizen can obtain from working outside.

The action space for each citizen i is the same $A=\{0,1\}$. Each citizen chooses her action $a_i\in A$, where $a_i=1$ indicates working outside and $a_i=0$ represents staying at home. The former action increases income by x_i for citizen i, who also suffers from the probability of loss due to infection of an epidemic.

The utility function of any citizen i has the same form,

$$U_i = V_i + \gamma \int_0^1 \mathbb{I}(a_j = a_i)\,\mathrm{d}j, \tag{2.1}$$

where $\mathbb{I}(a_j=a_i)$ is an indicator function, and

$$V_i = \begin{cases} V(0), & \text{if } a_i = 0 \\ p(\alpha)V(x_i - D) + (1-p(\alpha))V(x_i), & \text{if } a_i = 1 \end{cases}. \tag{2.2}$$

U_i is the expected utility of citizen i, which consists of two parts. The first is the income utility V_i, while the second term measures the private value of aligning one's action to

[5]This is also named as "herd behavior" or "herding" in literature (Scharfstein and Stein, 1990; Banerjee, 1992; Agranov et al., 2021).

[6]The setting follows some literature of coordination games (Morris and Shin, 1998; Angeletos and Pavan, 2007; Antonetti and Rufini, 2008; Edmond, 2013; Goldstein and Huang, 2016).

those of others. Each citizen's income utility V_i takes the same form above, in which $p(\alpha)$ is the probability of getting infected given the proportion of citizens working outside

$$\alpha = \int_0^1 \mathbb{I}(a_i = 1)\,\mathrm{d}i. \tag{2.3}$$

$D \geq 0$ is the perceived loss from getting infected. Assume $V : \mathbb{R} \to \mathbb{R}$ is strictly increasing and (weakly) concave, and normalize $V(0) = 0$ without loss of generality. Assume $p : [0,1] \to [0,1]$ is strictly increasing and (weakly) concave.

The second term can be interpreted as the social pressure of conformity. The closer one's action is to the majority's, the smaller social pressure or equivalently greater social identification she receives. Parameter $\gamma \geq 0$ measures how important this social pressure term is to citizens. I assume all citizens are homogeneous with respect to γ.[7] Higher γ indicates lower individualism, since individualists are supposed to care less about what others judge them. Notice that first, when $\gamma = 0$, U degenerates into a standard risk-neutral expected utility function. Second, no substantial result hinges on the assumption $\gamma \geq 0$, which is made to avoid the controversial implication of a negative γ. This is because, one can deem a large negative γ as individualism because of the extreme non-compliance, but it may also be questioned as sensitive to others' behavior which is like a collectivist.

In the model, we see two forces that affect citizens' choices. The first is externalities (Agranov et al., 2021). Due to the infectiousness of the epidemic, a citizen is less willing to work outside if there are more people doing that. Second, on the contrary, the compliance tendency drives people to work outside if there are many others doing so. These two opposing forces jointly shape the equilibrium social choice pattern. In a collectivist community, the force of compliance should be stronger which leads to a more "polarized" equilibrium than in an individualistic community. Roughly speaking, the equilibrium in a collectivist society is either "even higher" or "even lower" than in an individualistic society depending on the position of the equilibrium. Hence, the effect of I-C upon the equilibrium is conditional on other factors including the perceived threat of the epidemic as we will see in Section 2.3.

Notice that in the model there are two functions $V(\cdot)$ and $p(\cdot)$. The action variable is a, with the collective state variable α. The type variable is x. There are also two parameters D and γ. For simplicity of notation, though, these two parameters will be implicitly contained in relevant functions, unless with additional notes. For instance, I will simply denote some $G(x_i, \alpha; D) := V_i(a_i = 1)$ by $G(x_i, \alpha)$ while omitting the parameter D.

[7] In reality, though, it is possible for an individualist to live in a collectivist society. Triandis (1995) proposed to avoid confusion between the two different concepts: for individuals, *idiocentric* (self-oriented) versus *allocentric* (social-context-oriented), and for societies, *individualist* versus *collectivist*. But for simplicity, I will not make such distinction in the paper.

There are some limits of the model. First, I define the action space to contain only two values: working outside or staying at home. In reality, though, there are possibly much more heterogeneous actions, like walking on streets, working in workplaces, attending parties, etc., either with masks worn or not. However, if we believe these different actions reflect the same tradeoff between earning money (or obtaining pleasure) and suffering from the probability of infection, the basic idea of the model should still hold.

Second, the model assumes that working outside generates higher income, but it does not apply to everyone. Some people may efficiently work remotely with the Internet. However, "income" can also be interpreted as "pleasure" (i.e., hedonic utility) from leaving home. Under this interpretation, though, the model still does not apply to those who never favor leaving home even if there is no epidemic. To include such people, one can revise the model simply by letting $x_i \in [-1, 1]$, with no significant damage on the basic deduction of the model[8].

Third, the parameters D and γ are homogeneous over all citizens. This is an obvious simplification of the reality, in which different people may have distinct D (i.e., perceived damage of infection) and γ (i.e., I-C level). A mild justification is that I want to consider only one dimension of heterogeneity. Then, among income x, perceived damage of infection D, and I-C level γ, I choose only x to be heterogeneous across citizens. This method is similar to Wright et al. (2020)'s.

Fourth, I focus on only the self-direction aspect of I-C. There are of course other theories, but I think the self-direction (or compliance) hypothesis stands as the best one to explain the estimation results below. Moreover, even if considering only the self-direction aspect, the true mechanism can be more complex. For example, the facts that your families choose to stay at home and that your friends in another state choose to stay at home should play different roles in persuading or encouraging you not to leave home. This example reflects a problem: there is no distance metric among citizens in the model. Introducing distance is indeed a more realistic idea where one can depict social pressure as a function of distance between citizens, though the above simple model should have been enough to demonstrate the basic rationale.

2.2 Equilibrium

Notice that

$$U_i(a_i = 1) - U_i(a_i = 0) = p(\alpha)V(x_i - D) + (1 - p(\alpha))V(x_i) + \gamma(2\alpha - 1). \tag{2.4}$$

[8] With x_i distributed through $[-1, 1]$ rather than $[0, 1]$, there should be no substantial change on the results. With revised assumptions corresponding to Assumption 1-2 below, one can still promise the existence and uniqueness of equilibrium.

Suppose that when a citizen is indifferent between $a_i = 0$ and $a_i = 1$, she will always choose $a_i = 1$. Nothing substantial hinges on this assumption, which is made to simplify the statement of results.

Then, a citizen i (with type x_i) will choose to work if and only if (2.4) ≥ 0. Because $V(\cdot)$ is strictly increasing, then given any proportion α, there must be some cutoff citizen with type denoted by x^c such that all citizens on the left side of her choose to stay at home while those on the right choose to work. In the meantime, this cutoff citizen will work outside unless $x^c < 0$ (i.e., all citizens stay at home). Define $x^c(\alpha)$ as a function $x^c : [0,1] \to \mathbb{R}$, such that

$$p(\alpha)V(x^c - D) + (1 - p(\alpha))V(x^c) + \gamma(2\alpha - 1) = 0. \tag{2.5}$$

For simplicity, denote the left hand side of equation (2.5) by $\Omega(x^c, \alpha)$. Notice that $\Omega(x^c, \alpha)$ is strictly increasing in x^c, thus $x^c(\alpha)$ is well defined. I will introduce an assumption below to restrict x^c within $[0,1]$.

Assumption 1. *For any* $\alpha \in [0,1]$, $\Omega(0,\alpha) \leq 0$, *and* $\Omega(1,\alpha) \geq 0$.

Since $\Omega(x^c, \alpha)$ is strictly increasing in x^c, Assumption 1 promises the existence of $x^c(\alpha) \in [0,1]$ for any $\alpha \in [0,1]$.

Furthermore, notice that in equilibrium, $1 - F(x^c(\alpha)) = \alpha$. Equivalently, $F^{-1}(1-\alpha) = x^c(\alpha)$. Because $F(\cdot)$ is strictly increasing, $F^{-1}(\cdot)$ is well defined. Define the equilibrium cutoff type x^* as below,

$$\Omega(x^*, 1 - F(x^*)) = 0. \tag{2.6}$$

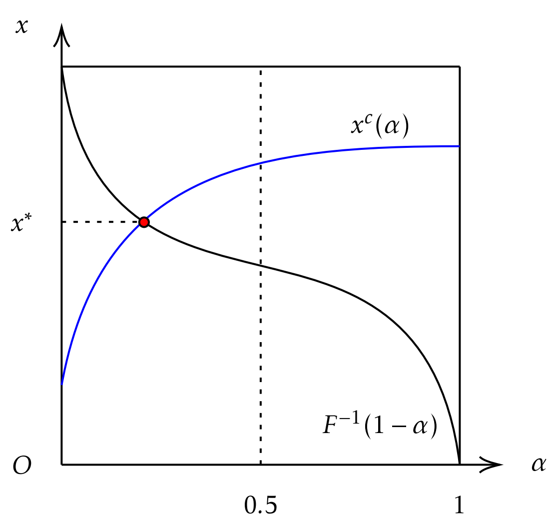

Figure 2.1: Cutoff type x^c and equilibrium x^*

Figure 2.1 provides a graphic illustration of the equilibrium cutoff type x^* as the intersection of curves $x^c(\alpha)$ and $F^{-1}(1-\alpha)$. An immediate problem occurs as there can be multiple equilibria unless some further restrictions on $x^c(\cdot)$ are assigned. Notice that we only know $F^{-1}(1-\alpha)$ is strictly decreasing in α, but put no specific restriction on its shape. Thus, once $x^c(\alpha)$ is strictly decreasing over some interval, there always exists a strictly increasing function $F(\cdot)$ such that there is more than one intersection of curves $x^c(\alpha)$ and $F^{-1}(1-\alpha)$. Therefore, to avoid potential multiple equilibria, one may want to assume that $x^c(\cdot)$ is (weakly) increasing over $[0,1]$.

By definition of $x^c(\cdot)$,

$$\frac{\mathrm{d}x^c}{\mathrm{d}\alpha} = \frac{p'(\alpha)(V(x^c) - V(x^c - D)) - 2\gamma}{p(\alpha)V'(x^c - D) + (1 - p(\alpha))V'(x^c)}. \tag{2.7}$$

The denominator is positive because (i) both $p(\alpha)$ and $1-p(\alpha)$ are positive for any $\alpha \in [0,1]$, and (ii) $V(\cdot)$ is strictly increasing. It remains to require the numerator to be nonnegative. Notice the numerator is (weakly) decreasing in α because $p(\cdot)$ is (weakly) concave, $D \geq 0$, and $V(\cdot)$ is strictly increasing. The numerator is (weakly) decreasing in x^c because $p(\cdot)$ is strictly increasing, $D \geq 0$, and $V(\cdot)$ is (weakly) concave. Hence, it suffices to require $x^c(\alpha)$ is nondecreasing at $\alpha = 1$.

Assumption 2. *$\frac{\mathrm{d}x^c}{\mathrm{d}\alpha} \geq 0$ at $\alpha = 1$, i.e., $D \geq D_1$ where*

$$D_1 = x^c(1) - V^{-1}\left(V(x^c(1)) - \frac{2\gamma}{p'(1)}\right).$$

Note that the inverse function $V^{-1} : \mathbb{R} \to \mathbb{R}$ is well defined since $V(\cdot)$ is strictly increasing. Moreover, $p'(1) > 0$ because $p(\cdot)$ is strictly increasing.

With Assumption 1–2, one can guarantee the existence and uniqueness of an equilibrium cutoff type $x^* \in [0,1]$. In other words, given any parameters D and γ, there exists a unique x^* satisfying equation (2.6).

2.3 Comparative Statics

Now I'm interested in how I-C, represented by γ, affects citizens' choice pattern in equilibrium. As shown in Figure 2.1, changes of γ only shift the curve $x^c(\alpha)$. By equation (2.5), an increase of γ "rotates" the curve $x^c(\alpha)$ clockwise around the point $(0.5, x^c(0.5))$. Thus, x^* is increasing in γ if and only if $x^* \leq 0.5$.

Proposition 1. *With Assumption 1–2,*

(i) *x^* is strictly increasing in γ if $D > D_2$,*

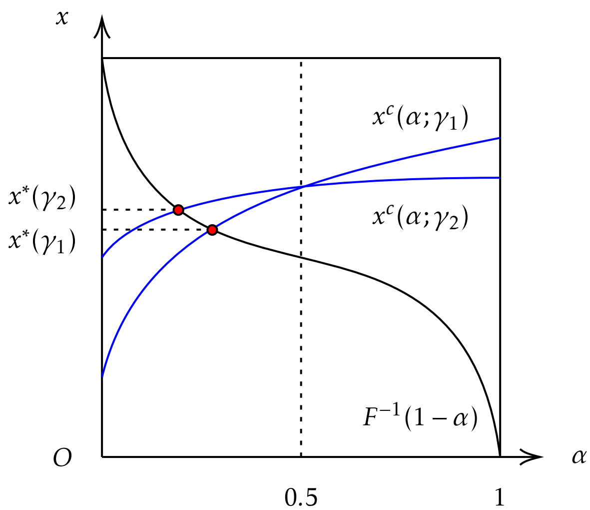

Figure 2.2: Comparative statics of γ, with $\gamma_2 > \gamma_1$

(ii) *x^* is constant in γ if $D = D_2$,*

(iii) *x^* is strictly decreasing in γ if $D < D_2$,*

where

$$D_2 = F^{-1}(0.5) - V^{-1}\left(\frac{(p(0.5)-1)V\left(F^{-1}(0.5)\right)}{p(0.5)}\right).$$

Proof. With some algebra, one can show that for each of the three cases in Proposition 1, $x^c(0.5)$ is greater, equal, or less than $F^{-1}(0.5)$, respectively. Because $F^{-1}(1-\alpha)$ is strictly decreasing in α, and with Assumption 2 $x^c(\alpha)$ is (weakly) increasing in α, the intersection of the two curves in Figure 2.1 must be less, equal, or greater than 0.5 for each of the three cases in Proposition 1, respectively. We also know, by definition of x^c, that an increase of γ shifts the curve $x^c(\alpha)$ upward over $[0, 0.5)$ and downward over $(0.5, 1]$ (Figure 2.2). Hence, an increase of γ will shift x^* upward, unchanged, or downward for each of the three cases in Proposition 1, respectively.

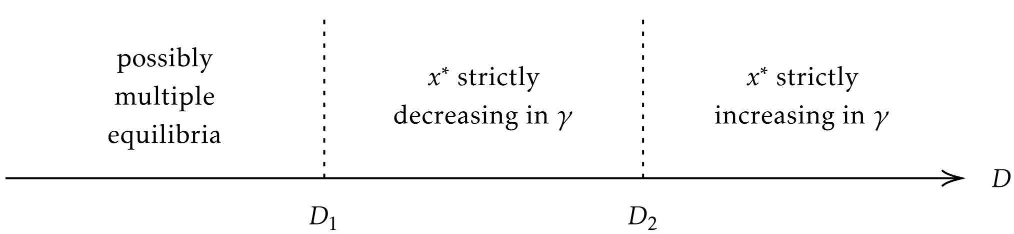

Figure 2.3: Comparative statics of γ dependent on D

Figure 2.3 shows only a possible classification of parameter D. This is because, without further assumptions about $p(\cdot)$ and $V(\cdot)$, one cannot compare D_1 and D_2. Note that larger x^* implies fewer people working outside in equilibrium. Thus, Proposition 1 predicts that higher collectivism (i.e., higher γ) is related to more compliance with stay-at-home requirements only when the perceived threat of the epidemic is large enough (i.e., $D > D_2$).

The model correlates the effects of I-C on public compliance with social distancing with public perception of the epidemic's threat. As shown in the following estimation sections, the model helps to explain the differing results across U.S. counties. That is, even though individualism was negatively related to compliance with social distancing regulations across countries, the relation was opposite across U.S. counties. In addition, I also estimate the relation within Democrat- and Republican-controlled states, respectively, and find evidence supporting the model's prediction if we are convinced that a Democratic state government tended to send a signal about the severity of COVID-19 significantly stronger than a Republican state government did.

3 Data

In the estimation part later, empirical tests on the effects of I-C upon social compliance with stay-at-home requirements are implemented in two contexts. One is the cross-country case, while the other one is among U.S. counties. In this section, though, I will first demonstrate relevant data employed for estimations in both environments.

3.1 COVID-19 Cases

The data about reported COVID-19 cases (and deaths) are provided by Our World in Data (OWID). OWID is a scientific online publication that focuses on large global problems. They constructed the dataset about COVID-19 over the world from various sources, in which new cases per day are based on data from Johns Hopkins University[9]. The dataset contains country-day-level new COVID-19 cases over around 200 countries since January 22, 2020.

However, OWID does not provide data among counties in the U.S. Thus, I turn to New York Times by which county-day-level data about reported new COVID-19 cases (and deaths) are collected. The dataset begins with the first reported coronavirus case in Washington State on January 21, 2020.

[9] See OWID's explanation.

3.2 Hospital Capacity

In the following estimations, I will use ventilators needed among states in the U.S. as an instrument for stay-at-home requirements to address reverse causality. The data about the daily number of ventilators required in each U.S. state are based on official estimates from the Institute for Health Metrics and Evaluation (IHME)[10].

3.3 Policy Stringency

Both country-day-level and U.S. state-day-level data on social distancing policies are sourced from the Oxford Coronavirus Government Response Tracker (OxCGRT). The tracker, constructed by the University of Oxford's Blavatnik School of Government, collects publicly available information on around 20 indicators about government responses, spanning containment, and closure policies to measure the stringency of the governments' policy responses since February 2020. Their stringency index is composite with 8 indicators that reflect social distancing and closure policies, which are supposed to best capture the stringency of social distancing regulations, and from which I select the stay-at-home requirements as the major policy indicator in the estimations. The stay-at-home requirements are scaled between 0 and 3, with 3 representing the highest level of restrictions[11]. I also choose the composite policy stringency index for alternative estimations as a robustness check. For more details about OxCGRT, see Hale et al. (2020)'s paper.

3.4 Population Movement

The measures that capture population movement are from Google's COVID-19 Community Mobility Reports. These reports aggregate location data from users who have turned on the location history setting for their Google accounts. The mobility index indicates how visitors to, or time spent in, categorized places change compared to the baseline period corresponding to January 3–February 6, 2020[12]. There are six location categories: (i) retail and recreation, (ii) grocery and pharmacy, (iii) park, (iv) workplace, (v) transit station, and (vi) residential area. In the following estimations, I select the "residential area" as the dependent variable. One may expect, for example, a significant increase of time spent in residential areas during the pandemic, especially after stay-at-home ordinances were issued. The dataset begins on February 15, 2020.

[10] See IHME's projections.

[11] 0: No measures. 1: Recommend not leaving house. 2: Require not leaving house with exceptions for daily exercise, grocery shopping, and "essential" trips. 3: Require not leaving house with minimal exceptions (e.g., once only a week, or only one person at a time).

[12] See COVID-19 Community Mobility Reports.

The four subsections above have introduced all region-day-level data employed in the following estimations. I choose February 15, 2020 as the start date since this is the earliest date with all relevant data available. I select August 31, 2020 as the end date for the purpose of mitigating interference of other events like the 2020 U.S. presidential election.

3.5 I-C Indicators

First, to represent country-level I-C, I employ the individualism index developed by Geert Hofstede. The selection of Hofstede's index as an indicator of I-C follows a bunch of literature that studied individualism (Oyserman et al., 2002; Schimmack et al., 2005; Gorodnichenko and Roland, 2011; Ezcurra, 2021). Hofstede (2001) initiated the study with information from interviews of IBM workers in about thirty countries in the 1960–70s. Incorporating new surveys, these original data have been expanded in recent years and currently cover more than 70 countries. From a methodological perspective, Hofstede's index of individualism uses factor analysis to summarize the data from different survey questions. Particularly, the index is the first component in work goal questions about freedom, the value of personal times, interesting and fulfilling work, and so on (Ezcurra, 2021). According to Hofstede Insight[13], the individualism index can represent a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. Its opposite, collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty. A society's position on this dimension is reflected in whether people's self-image is defined in terms of "I" or "we". The individualism index ranges from 0 to 100, with a higher score representing more individualism.

Second, concerning the estimations across U.S. counties, I choose Vandello-Cohen's collectivism index as the indicator. This index has been widely used in researches (Allik and Realo, 2004; Conway et al., 2006; Kemmelmeier et al., 2006). Vandello and Cohen (1999) created an eight-item index ranking U.S. states in terms of collectivism versus individualism tendencies. For more details about the eight items that compose the collectivism index, see Appendix 1, copied from Vandello and Cohen (1999)'s paper.

3.6 Socio-Economic Indicators

A number of control variables are incorporated into both datasets. Some country specific variables are organized by OWID, including population, percentage of population

[13] See Hofstede Insight.

aged 65 above, and GDP per capita. Apart from these variables, I also include Polity V index and government effectiveness index (GEI).

As for in the U.S., county specific control variables include population, percentage of non-White population, median income, bachelor rate[14], and percentage of Democratic voters in the 2020 presidential election. The only state-level control variable is percentage of population aged above 65. For more details about the control variables, see Appendix 2.

3.7 Summaries

Statistic summaries for the cross-country dataset and the U.S. dataset are offered in Tables A.1 and A.2, Appendix 4. In addition, weekly trends of population movement (i.e., changes of residential time) and policy stringency index are provided in Figures A.1–A.8, Appendix 3. The reason for showing policy stringency index rather than stay-at-home requirements is that the discreteness of the latter (e.g., ranged through only four values, with even no record of 3 across U.S. states) may disclose little information from its time trends.

From figures of time trends, one may notice that in all four cases (i.e., cross countries, cross counties in the U.S., cross counties in Democrat- and Republican-controlled states, respectively), individualism was associated with both lower time in residential areas and lower policy stringency. Thus, one cannot conclude about the link between I-C and compliance with social distancing unless controlling either of the two variables. Moreover, not only policy stringency (e.g., degrees of stay-at-home requirements) but also local reported COVID-19 cases can influence residents' decision of whether staying at home. For example, an individualist county may show less average residential time not because of less compliance with regulations, but due to less stringent policies and fewer recent cases. These possible confounding factors should be carefully taken into consideration. Finally, the three main variables (i.e., population movement, policy stringency, and reported COVID-19 cases) are likely to be interwoven with each other. For example, stringent regulations should reduce new COVID-19 cases, which in turn leads to less strict policies. In the following section, we will see how the endogeneity problem is handled.

4 Research Design

One major purpose of this paper is to empirically examine how I-C influences people's compliance with social distancing policies. To do that, I apply two estimation strategies: (i) event study, and (ii) DID estimation. In the following section, I will introduce the two

[14] Percentage of population with a bachelor's degree or higher.

estimation strategies and describe robustness checks implemented on DID estimations including an IV method for dealing with the problem of endogeneity.

4.1 Event Studies

For both the cross-country and the U.S. cross-county cases, I make event study estimations generally as follows.

$$Residential_{i,t} = \alpha_i + \mu_t + \lambda Cases_{i,t} + \sum_{k=-k_1}^{k=k_2} \beta_k I_{i,t}^k + \sum_{k=-k_1}^{k=k_2} \gamma_k I_{i,t}^k \times HighIC_i + \varepsilon_{i,t}. \tag{4.1}$$

Residential is the outcome of interest, representing the percent change of time spent in residential areas in each region (i.e., country or county) compared to the baseline period, based on Google's COVID-19 Community Mobility Reports. α_i and μ_t are region- and date-fixed effects. I^ks are a group of led and lagged dummies. For any $-k_1 < k < k_2$, $I_{i,t}^k = 1$ if and only if in region i at date t, there have been exactly k weeks since the first implementation of stay-at-home orders. But $I^{-k_1} = 1$ if and only if there are no fewer than k_1 weeks before the first implementation of stay-at-home ordinances, and $I^{k_2} = 1$ if and only if there have been no fewer than k_2 weeks since the first implementation. The reason for doing so is to cover all observations with these leads and lags such that I can normalize β_{-1} and γ_{-1} to be zero. $Case_{i,t}$ represents the ratio of the number of new COVID-19 cases to the local population in region i at date t. $HighIC_i$ is a binary variable that equals one if the individualism (collectivism) index in country (county) i is above the median, and zero otherwise. All errors are clustered on the region level.

The variables of interest are γ_ks, which represent the additional effects of the first implementation of stay-at-home requirements upon residents' residential time in high-individualism (collectivism) regions. For example, positive γ_ks for $k \geq 0$ imply that individualism (collectivism) leads to more residential time and therefore more compliance with social distancing. In the following, call β_ks the (dynamic) effects of stay-at-home requirements on local average residential time, and γ_ks the additional (dynamic) effects over high-individualism (collectivism) regions.

In addition, I extend the event studies by replacing weekly dummies with daily dummies. For weekly event studies, I introduce 4 leads and 8 lags (i.e., $k_1 = 4$, $k_2 = 8$), while in daily event studies, there are 14 leads and 14 lags (i.e., $k_1 = k_2 = 14$). The selection of event periods follows usual literature and respects the time period of the data.

4.2 DID Estimations

The event studies above help us to learn the dynamic effects of I-C on compliance with the first implementation of stay-at-home requirements. In addition, I also apply DID regressions, which allow us to clearly focus on only one coefficient of interest.

$$Residential_{i,t} = \alpha_i + \mu_t + \lambda Case_{i,t} + \beta Stringency_{i,t} + \gamma Stringency_{i,t} \times HighIC_i + \varepsilon_{i,t}. \quad (4.2)$$

Residential is still the region-day-level average change of time spent in residential areas. α_i and μ_t are region- and date-fixed effects. $Case_{i,t}$ records new COVID-19 cases per capita in region i at date t. *Stringency* represents the level of stay-at-home requirements, ranged through 0–3, though never with 3 among states in the U.S. *HighIC* is still the binary variable indicating if the individualism (collectivism) index is above the median. All errors are clustered on the region level. Similar to those in the event studies, β represents the effects of stay-at-home requirements on local population's residential time over low-individualism (collectivism) regions, while γ represents the additional effects over high-individualism (collectivism) regions.

Moreover, for fear of a discrete indicator *HighIC* losing important information, I make analogous estimations with *HighIC* replaced by the continuous individualism (collectivism) index. In addition, I also substitute stay-at-home requirements with the OxCGRT policy stringency index. With the latter index, regulations other than shelter-at-home orders are included, like school closure, workplace closure, public transport closure, and restrictions on gathering size, internal movement, and international travel, etc.

4.3 Robustness Checks

yThere are two key challenges to identifying the coefficient γ in equation (4.2). The first challenge is omitted variable, where other factors associated with I-C or policy stringency may influence the effectiveness of social distancing regulations. For instance, if I-C is related to GDP per capita, then a significant γ may actually reflect the impact of economic endowment upon public compliance with regulations. Moreover, it is also possible that I-C influences policy stringency and that social compliance is nonlinear with respect to policy strictness. In this case, a significant γ may appear representing a nonlinear relation between policy stringency and social compliance, the former of which is related to I-C. First, to control potential omitted variables related to I-C, I add interactions of stay-at-home requirements and a group of control variables listed in Appendix 2. These variables include demographic, political, and sicio-economic features that may interfere with the identification of the variable of interest, γ. Second, as for potential confounding factors associated with policy stringency, I add an interaction of the I-C indicators and the number of new COVID-19 cases per capita. Since policy stringency and recent COVID-19 cases are usually highly correlated, by doing so we can exclude the possibility that I-C influences population movement through new cases instead of regulation stringency. Finally, to address the concern that the real drive of a non-zero γ is government enforcement effort that can be affected by I-C, I put in the square of policy stringency as a control term. This aims to control the situation that I-C influences policy strictness which has a nonlinear effect on population mobility.

The second challenge is reverse causality. It is plausible that population movement, reported cases, and policy stringency are interrelated with each other. Higher cases per capita and policy stringency may drive residents to stay at home, which in turn helps to reduce new cases and thus leads to less stringent regulations. There are three potential mutual causality relations between the three variables. However, among these three simultaneities we only need to deal with one. First, the simultaneity between population movement and COVID-19 cases should only lead to a biased estimators of λ but have no direct harmful effect on γ in equation (4.2). Second, the correlation between COVID-19 cases and policy stringency will generally cause multicollinearity. However, this potential problem will be left out for three reasons. First, with region- and time-fixed effects, I have controlled the correlation between the parts of COVID-19 cases and policy stringency that are invariant across regions or over time and thus, the remaining parts should be more erratic and less likely to be significantly correlated. Second, we have no evidence that the two variables are perfectly correlated and thus, either dropping one or combining them can be even a worse idea than doing nothing. Third, the multicollinearity will lead to large variances but have no impact on the estimators' best-linear-unbiased-efficient (BLUE) property (Gujarati and Porter, 2009). From this perspective, it seems acceptable to leave it out.

Finally, to solve the potential simultaneity between population movement and policy stringency, I select the number of ventilators needed in each U.S. state to instrument state-level stay-at-home requirements. This strategy follows Brzezinski et al. (2020). The validity of this instrument should be explained below. First, a current or predicted need of ventilators will increase pressure on politicians to impose lockdown policies (Brzezinski et al., 2020), so the instrument should be related to the policy variable, stay-at-home requirements. Then, it suffices to check that the instrument is unrelated to population movement through other channels. On the one hand, the information of ventilators needed is hardly disclosed to the public, or only with a lag (Brzezinski et al., 2020). Therefore, one may expect a need of ventilators with no direct effect on population movement. On the other hand, in our estimations, the county-level population movement should have no significant impact on the state-level need of ventilators, since the latter at the aggregate level is unlikely to be driven by population movement in a particular county (Pennings, 2021). Therefore, one can expect the need of ventilators to be a valid instrument for stay-at-home requirements in the estimations. Disappointingly, I find no data of ventilators among countries, and therefore this IV strategy applies only to U.S. cross-county cases.

4.4 State Partisanship

We will see in the following that individualism was negatively related to compliance with social distancing policies across countries, but positively across counties in the U.S. To study this interesting phenomenon, I examine the basic idea of the theoretical model by making estimations with subsamples of U.S. Democrat- and Republican-controlled states, respectively. A state is defined to be Democrat-controlled, for instance, if both legislature and governor were occupied by the Democrats on April 1, 2020. Under the definition, there are 15 Democrat-controlled states and 21 Republican-controlled states[15]. All other "mixed" states are excluded. Compared to that controlled by the Republicans, the state government occupied by the Democrats usually sent stronger signals about the severity of COVID-19 and called for more stringent and urgent policy measures (Kincaid and Leckrone, 2020, Adolph et al., 2020a, Adolph et al., 2020b). Then, the theoretical model predicts that a positive relation between collectivism and public compliance with social distancing is more likely to appear in Democrat-controlled states.

One challenge to the state-division-by-partisanship strategy is the potential correlation between partisanship and collectivism across states. If so, the subsample estimations may reflect no role of the parties' attitudes toward pandemic control, but a nonlinear relation between I-C and compliance with soc'ial distancing policies. To check this problem, I regress state partisanship, which is a dummy variable representing "Democrat-controlled" (=0), "mixed" (=1), or "Republican-controlled" (=2), on Vandello-Cohen's collectivism index. The result in Table A.3, Appendix 4, shows no significant relation between state partisanship and the collectivism index, with a large $p = 0.72$[16]. This supports the argument that state partisanship is orthogonal to I-C on the state level.

5 Results

In this section, I will describe the results of the above estimations and discuss the implications with an emphasis on their correspondences with the theoretical model. For

[15] See State Partisan Composition.

[16] A graphic illustration of the relation between state partisanship and the collectivism index is shown in Figure A.17, Appendix 3.

consistency of illustration, the state-partisanship subsample estimations will be integrated into each estimation strategy instead of being presented independently.

5.1 Event Studies

Figures 1–4 show weekly event study plots based on equation (4.1) in the four empirical cases (i.e., cross countries, cross counties in the U.S. and states controlled by the two parties, respectively). In all these four cases, the plots generally show positive effects of stay-at-home requirements on improving average residential time (i.e., generally $\beta_k > 0$ for $k \geq 0$). These findings are within expectation once we believe some degree of effectiveness of self-isolation regulations on reducing population mobility.

Things become a bit more complex as to the additional effects γ_ks in equation (4.1). In the cross-country case, Figure 1 shows that lagged coefficients are negative, none of which is significant. However, borrowing the idea of multi-hypothesis tests, one may expect at least (randomly) some of these lagged coefficients to be significant. In other words, based on the event study plot, it is unlikely to accept the hypothesis that all lagged coefficients are zero. The results imply negative dynamic effects of individualism upon public compliance with stay-at-home requirements across countries.

In the U.S. cross-county case, however, Figure 2 shows that the coefficients of the additional effects do not exhibit an obvious increasing or decreasing trend after the implementation of stay-at-home requirements. The corresponded daily event study plot (Figure A.12, Appendix 3) also shows no significant difference between led and lagged coefficients.

The results of the state-partisanship estimations are less ambiguous. In Figure 3, the weekly plot over U.S. Democrat-controlled states, there exhibits an increase of coefficients γ_ks after the implementation of stay-at-home requirements. The trend implies that prior to the event shock, collectivism was negatively related to the inclination to stay at home. But after the implementation of stay-at-home requirements, the relation was reversed and people in a more collectivist region exhibited better compliance with regulations. Within Republican-controlled states, on the contrary, collectivism was negatively related to social compliance after the implementation of stay-at-home regulations. Given the previous argument that the Republican Party was more likely to underestimate the gravity of COVID-19 control that might influence the public perception, the findings above are consistent with the theoretical model.

Finally, corresponded daily event study plots are shown in Figure A.9–A.16, Appendix 3. There is no substantial difference between weekly and daily event study plots.

5.2 DID Estimations

The main results of DID estimations and relevant robustness checks are shown in Tables 1–4, and other minor results are recorded in Table A.4–A.5, Appendix 4. Figure 1 shows the estimation results generally based on equation (4.2). For example, the first column shows that a higher degree of stay-at-home orders increased regional average residential time by 4.28% in low-individualism countries with an additional −1.41% in high-individualism countries. This finding implies a negative relation between individualism and compliance with stay-at-home requirements across countries. The second column shows the result of an analogous estimation in which only the binary variable $HighIC$ is replaced by the continuous individualism index. The result also implies a negative relation between individualism and compliance with stay-at-home orders at 90% confidence level. More specifically, a one-standard-deviation[17] increase of the collectivism index leads to an additional 0.61% less residential time, which is around one eighth of the virtual effects of stay-at-home requirements on a country with zero individualism index. In other columns, I introduce three interaction terms step by step to control potential confounding factors discussed in Section 4.3. The results keep robust. Similar results of the estimations with stay-at-home requirements substituted by the OxCGRT policy stringency index are shown in Table A.4, Appendix 4.

Tables 2 shows the estimation results in the U.S. cross-county estimations. The estimations are analogous to those in the cross-country case. However, there appears a negative relation between collectivism and public compliance with social distancing policies, opposite to that across countries. In the first column of Table 2, it is presented that a higher degree of stay-at-home requirements increased regional average residential time by 1.69% in low-collectivism counties and an additional −0.82% in high-collectivism counties in the U.S. When the binary variable is replaced by Vandello-Cohen's collectivism index itself, the result keeps robust as shown in the second column. In the remaining three columns, with a number of controlling interactions added, no huge change occurs on the results. Furthermore, I also replace stay-at-home requirements with the OxCGRT policy stringency index and achieve similar results, shown in Table A.5, Appendix 4.

However, there may be reverse causality between population movement and government policies. To alleviate this problem, I employ 2SLS estimations with ventilators needed among U.S. states instrumenting stay-at-home requirements, expounded in Section 4.3. Relevant results are exhibited in Table 3. Under the instrument strategy, though, the coefficient of interest diminishes to non-significance. The 2SLS estimation results imply hardly any significant relation between I-C and compliance with stay-at-home regulations

[17] Shown in Table A.1, Appendix 4.

in the U.S. Go back to the theoretical model, it can be the case that the equilibrium in the whole U.S. society is so close to the midpoint that a change of γ does not significantly alter x^* (Figure 2.2).

The results of the state-partisanship estimations are shown in Table 4. I use stay-at-home requirements as the policy variable, the interaction of stay-at-home requirements and the binary variable $HighIC$ as the variable of interest, and make both OLS and 2SLS regressions. The first two columns show the results of OLS estimations which are opposite in the two subsample cases. Within Democrat-controlled states, residents in high-collectivism counties showed around three-fourth more increase of time spent in residential areas driven by stay-at-home requirements. Within Republican-controlled states, on the contrary, high-collectivism counties were associated with about four-fifth less increase of residential time. In the third and fifth columns, the results of corresponded 2SLS estimations are presented. With ventilators needed among U.S. states instrumenting stay-at-home requirements, I achieve similar results to those of OLS estimations. In Democrat-controlled states, collectivism was associated with more population mobility reduction, which was reversed within Republican-controlled states. An odd thing is that the coefficient β in equation (4.2) is negative in the fifth column, which seemingly implies a negative effect of stay-at-home requirements upon reducing population movement. This is possibly because of weak identification since the value of Kleibergen-Paap Wald rk F is fairly low. To address this concern, I add the square of stay-at-home requirements to constitute a quadratic polynomial and the estimation results are shown in the fourth and sixth columns. No substantial change appears therein and we see a positive effect of collectivism on social compliance with stay-at-home requirements within Democrat-controlled states but the opposite within Republican-controlled states. As argued previously, a state occupied by the Democrats often delivered stronger signals about the seriousness of the pandemic and demanded more strict regulations. Thus, the results are consistent with the theoretical model which predicts a positive relation between collectivism and public compliance with regulations to appear more likely in a society where people deem the pandemic as a serious threat.

6 Conclusion and Discussion

The outbreak of COVID-19 provides an environment where people's movement and interaction will produce negative externalities on others and various regulations have been applied to reduce population movement in most countries and regions. This paper examines the link between individualism-collectivism (I-C) and people's compliance with social distancing policies, especially stay-at-home orders. I find a negative relation between individualism and compliance with social distancing across countries that was reversed across counties in the U.S. I provide a simple model to explain the findings, according to which individualism leads to less or more compliance with social distancing depending on public perception of the threat of the pandemic. There should be a negative relation between individualism and social compliance with regulations when the public perceives the pandemic[18] as a serious threat. Under the hypothesis, individualism was positively associated with compliance with COVID-19-related social distancing regulations in the U.S. because fairly many Americans and the U.S. government underestimated the severity of the pandemic.

To further examine the explanation above, I make analogous estimations in Democrat- and Republican-controlled states, respectively. Then, I find a positive relation between collectivism and compliance with stay-at-home requirements in Democrat-controlled states but a negative link in Democrat-controlled states. The results are in accord with the model since the Republicans did not treat COVID-19 as a severe crisis compared to the Democrats (Kincaid and Leckrone, 2020, Adolph et al., 2020a, Adolph et al., 2020b) and the state government's position should reflect or influence the public perception of the danger of the pandemic.

However, there are several limits remained to be improved with further studies. At the beginning, measurement error due to data limits is worth noting. The first is sample selection bias. Take the data of population movement as an example. They are from Google's Community Mobility Reports, which were produced with cellphone location records. These records depend on Google users' choices of turning on the location history setting. Thus, these data do not necessarily reflect real population movement due to potential confounding factors. For instance, residents in some regions may prefer not to use Google but other systems (e.g., iOS) or not to turn on the location history setting. If there are such systemic heterogeneities across regions, then we may suffer from sample selection bias. For COVID-19 cases data, one can also meet sample selection bias if the rule of testing and information publishing is heterogeneous across regions. In fact, I do have noticed a selection bias problem, which I call big-county bias. That is, U.S. counties with small populations are more likely to have missing data. For instance, nearly all counties with a population of less than 10 thousand have no record of changes of residential time. Therefore, the estimations can be questioned as reflecting only big counties' situations.

Second, our data are at region level rather than individual one. This restricts the ability to study the heterogeneity within a region. In reality, however, residents in different subregions may show distinct preferences and responses to the same policy. Moreover,

[18]The substance of the pandemic is a crisis which causes negative externalities on population movement and interaction.

this limit encourages me to assume citizens with homogeneous I-C property in the model, the society in which is corresponding to a region in estimations. Nevertheless, one can make finer estimations with some questionnaire data, for example. Furthermore, the questionnaire data may even help to examine and estimate the self-direction aspect of collectivism. For instance, Bailey et al. (2020) found that U.S. Facebook users whose friends lived in areas with worse coronavirus outbreaks reduced their mobility more than their counterparts. Corresponded with Bailey's work, with appropriate questionnaire data, one may estimate how people are heterogeneously influenced by family-, friend-, and neighbor-exposure to COVID-19 cases as well as their propensity to agree to the public attitudes conditional on I-C. In addition, such estimations may shed light on introducing metrics into the theoretical model as discussed in Section 2.1.

Third, the two I-C indicators (i.e., Hofstede's individualism index and Vandello-Cohen's collectivism index) are different as to their components. This probably leads to a misidentification of I-C in the two contexts. However, it will take lots of efforts to "duplicate" one indicator's components into the other context which is far beyond this paper's plan.

Fourth, I failed to find an instrument for policy stringency in the cross-country case, like the number of ventilators needed in the U.S. context. Thus, the cross-country estimators may suffer from the potential simultaneity between population movement and policies.

Apart from the data limits above, one has to be cautious about interpreting the theoretical model. In reality, it seems impossible to pinpoint the threshold D_2 and the single-equilibrium threshold D_1 defined in Section 2.3. Hence, on the one hand, there can be multiple equilibria that destroy the prediction of the model. On the other hand, given no method to identify the threshold D_1, typically one cannot "predict" the relation between I-C and compliance with social distancing but only "interpret" it. Thus, we must be very careful applying the model to explain the results. For instance, the results in the cross-country case cannot be explained by the model because there is no reference (e.g., another earth with anything the same except for a different perception of the threat of the pandemic). The results of the cross-county estimations among the U.S. can be explained by the model only after comparing other countries' population perceptions of COVID-19. Instead of directly checking this, I compare the government's stance and expect it to influence population perception. Similarly, the results of the state-partisanship estimations can be explained by the model if we believe that the state government's attitude toward COVID-19 will have an impact on residents' perception. Further studies are needed for identifying public perception. For instance, with appropriate questionnaire data, the local population perception of the danger of COVID-19 can be directly measured rather than employing the government's stance as an instrument.

Moreover, the model focuses on only one aspect of I-C: self-direction vs. compliance.

There are of course many other theories of I-C, but I think the compliance hypothesis can best explain the heterogeneous results of estimations in different cases. It should be noted that the attention on the particular aspect does not mean rejection of other characteristics of I-C, but it is just made to explain the estimation results in a clear and reasonable way.

Next, think about policy implications. The empirical evidence in the paper suggests that the effects of social distancing regulations are conditional on I-C and social perception of the severity of the pandemic. On the one hand, I-C is a profound cultural dimension that cannot be easily changed. Education may do it in the long run. This seems a bit disappointing as we can hardly alter I-C properties among population for better compliance with regulations. However, a feasible alternative in practice is to call for citizenship and social awareness of public welfare. Under the environment with grave externalities, a sense of responsibility for the public good should help internalize externalities and thus improve the efficiency of the equilibrium. On the other hand, an institution should be promised to disseminate authorized and professional information about the pandemic such that citizens can form a correct perception and expectation of the crisis.

Finally, one probably notices that collectivism leads to a more polarized equilibrium social pattern than individualism. If there are multiple equilibria, the intrinsic inclination to conform in the population of a collectivist society seems more likely to induce drastic social changes. This interesting inference remains to be studied further.

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Appendices

Appendix 1. Eight Items of Vandello-Cohen's Collectivism Index

Percentage of people living alone (reverse scored; Almapi, 1994). One of the major facets of the individualism-collectivism dimension is the family structure. Individualists, who view themselves as autonomous, should be more likely to live alone than collectivists, who see themselves as part of a group and tend to have larger families.

Percentage of elderly people (aged 65+ years) living alone (reverse scored; Almapi, 1994). A related marker of the individualism-collectivism dimension is the choice of living arrangements for elderly people. Collectivist children should be more likely to take personal care of their parents by sharing living quarters with them, and individualist elderly people should be more likely to try to maintain independence by living alone rather than with their children or in a nursing home.

Percentage of households with grandchildren in them (Almapi, 1994). Collectivist households should be more likely to include extended family members rather than simply nuclear family members.

Divorce to marriage ratio (reverse scored; U.S. Bureau of the Census, 1996). Naroll (1983) argued that extreme individualism leads to several forms of social pathology, including divorce. The argument is based on the idea that strong ties to a normative reference group provide emotional support and warmth and punish deviant behavior. Indeed, individualist cultures around the world have higher rates of divorce than do collectivist cultures (Vandello & Cohen, 1998). Thus, states with higher marriage-to-divorce ratios should be more collectivist.

Percentage of people with no religious affiliation (reverse scored; Kosmin & Lachman, 1993). Religion as an institution promotes social integration through ritual and community and also regulates norms and moral conduct (Ellison, Burr, & McCall, 1997). Thus, religious affiliation should contribute to collectivism. Conversely, individualism has been correlated with less interest in religion (according to Daab, as cited in Triandis, 1995, p.87).

Average percentage voting Libertarian over the last four presidential elections (1980-1992; reverse scored; Congressional Quarterly, 1994). More than other political parties, Libertarianism provides the most direct parallel to the individualism-collectivism dimension. Libertarianism places heavy emphasis on individual freedoms and self-governance. These attributes' are at the core of individualism, and thus states with higher Libertarian voting percentages should be more individualist.

Ratio of people carpooling to work to people driving alone (Almapi, 1994). Sharing a ride to work is seen as reflecting a collectivist tendency, and individualists should be more likely to travel to work alone. It is, of course, important to look at this figure as a ratio of carpoolers to people driving alone (as opposed to just percentages of people carpooling) to control for the percentage of people driving in general.

Percentage of self-employed workers (reverse scored; Almapi, 1994). Schooler (as cited in Triandis, 1995, p.83) emphasized modes of production as an explanation of the emergence of individualism. Self-employment is the prototypical act of individualism in the workplace. Not only does it entail being one's own boss, but it also typically means less opportunity for social integration with coworkers and for the unity and collective spirit that accompany teamwork.

Appendix 2. Descriptions of Control Variables

The Cross-Country Dataset

Population. Population in 2020, from United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects 2019 Revision.

Aged above 65. Share of the population that is 65 years and older, most recent year available, from World Bank World Development Indicators based on age/sex distributions of United Nations World Population Prospects 2017 Revision.

GDP Per Capita. Gross domestic product at purchasing power parity (constant 2011 international dollars), most recent year available, from World Bank World Development Indicators, source from World Bank, International Comparison Program database.

Polity V Index. A composite index measuring the level of democracy for most independent states. Values for 2018, imported from http://www.systemicpeace.org/inscrdata.html, from Integrated Network for Societal Conflict Research (INSCR).

Government Effectiveness Index. An index measuring government capacity to effectively formulate and implement sound policies, from World Bank Worldwide Governance Indicators. Values for 2019, imported from https://info.worldbank.org/governance/wgi/.

The U.S. Dataset

Population. Population in 2018, from U.S. Department of Agriculture.

Median Income. Median household income in 2018, from U.S. Department of Agriculture.

Non-White. Percent of non-White population in 2018, from U.S. Census Bureau, Population Division.

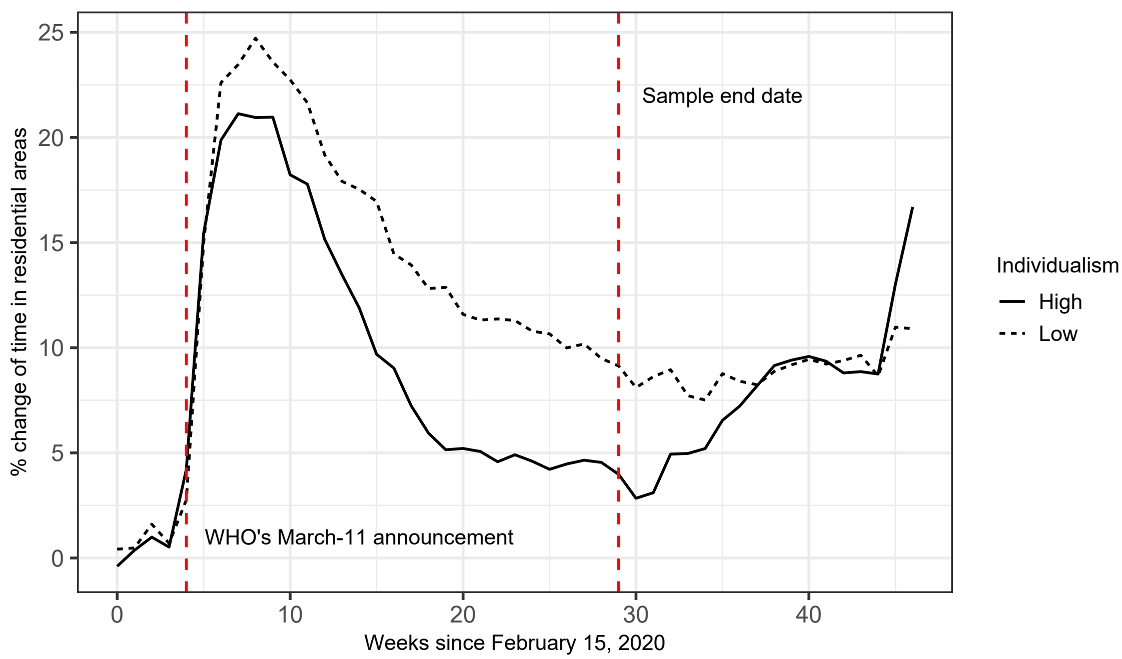
Bachelor Rate. Percent of adults with a bachelor's degree or higher through 2014–18, from U.S. Department of Agriculture.

Democrats. Percent of Democratic voters in the 2020 U.S. presidential election, from MIT Election Data and Science Lab (MEDSL).

Aged above 65. Percent of population that is 65 years and older. Value for 2018, sourced from U.S. Census Bureau, Population Estimates Program (PEP) and American Community Survey (ACS).

Appendix 3. Figures

Figure A.1: Weekly trends of average changes of residential time over high- and low-individualism countries[19]



[19]The curves show weekly trends of average changes of residential time over high- and low-individualism countries, respectively. The left red dashed line indicates March 11, when WHO categorized COVID-19 as a pandemic. The right red dashed line shows the end date of observations selected for estimations, August 31, 2020, which was around 29 weeks after February 15, 2020. The same below.

[20]Figure A.9 shows the event study plot of equation (4.1), in which the first lead's coefficient (i.e., $k = -1$) is normalized to zero. The same below.

[21]The blue dashed line in Figure A.11 represents the average value of lags' coefficients (i.e., $k \geq 0$), while the red dashed line indicates that of leads' coefficients (i.e., $k < -1$). The same below.

[22]*State partisanship* is a dummy variable that represents "Democrat-controlled" (=0), "mixed"(=1), or "Republican-controlled" (=2). The result of the regression of state partisanship on the collectivism index is shown in Table A.3, Appendix 4.

Figure A.2: Weekly trends of average policy stringency index over high- and low-individualism countries

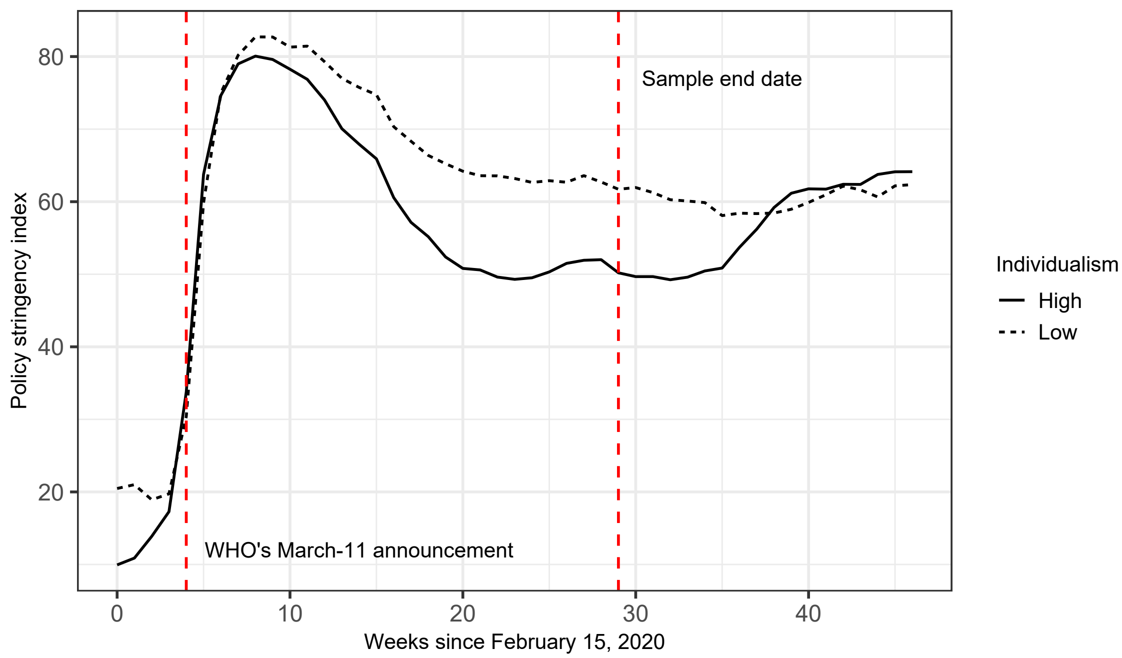


Figure A.3: Weekly trends of average changes of residential time over high- and low-collectivism U.S. states

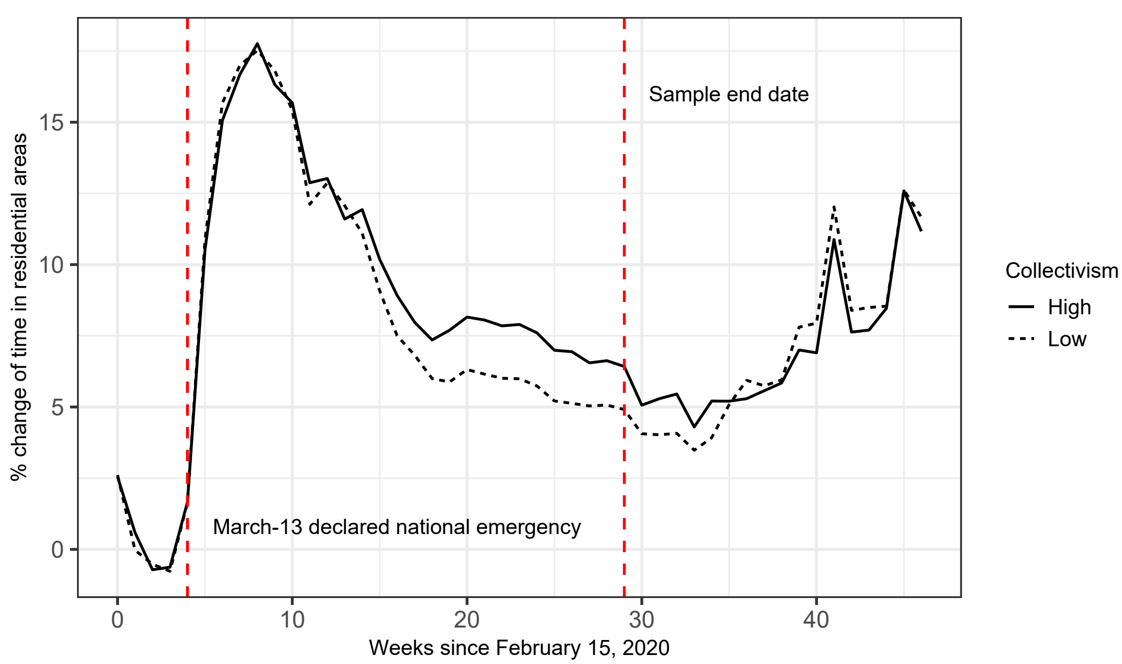


Figure A.4: Weekly trends of average policy stringency index over high- and low-collectivism U.S. states

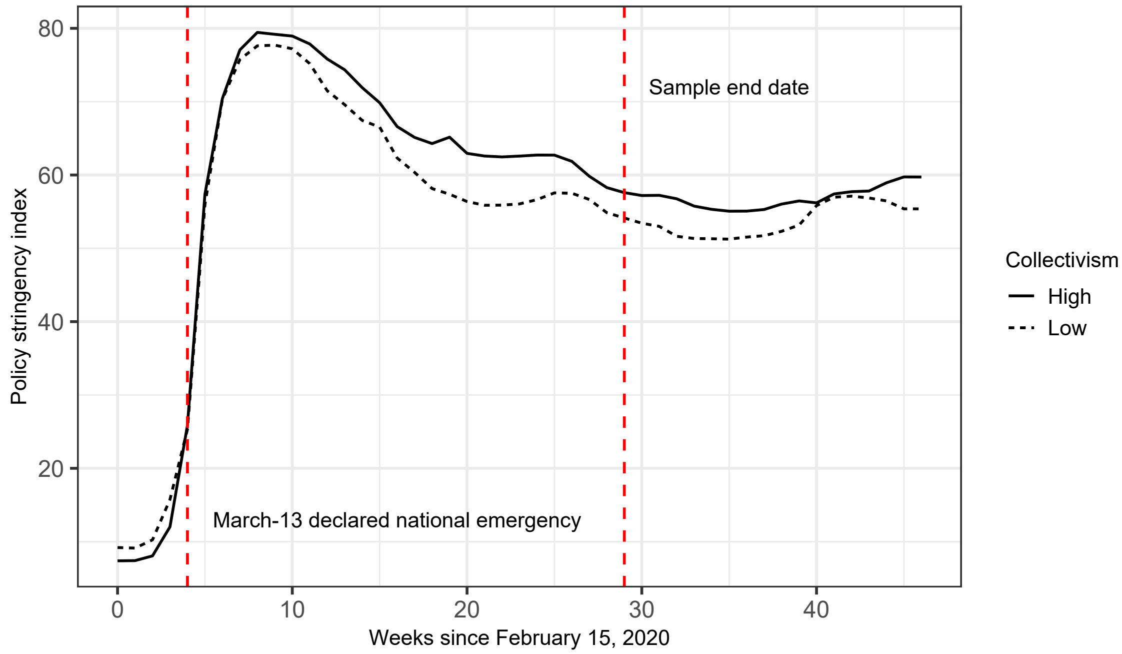


Figure A.5: Weekly trends of average changes of residential time over high- and low-collectivism U.S. Democrat-controlled states

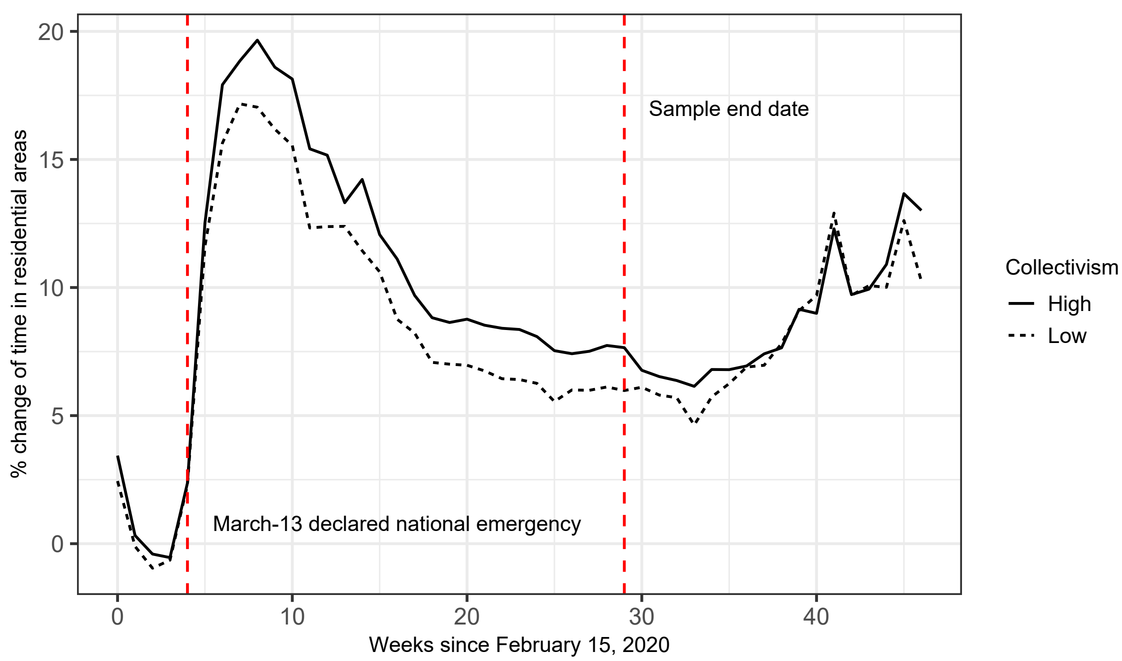


Figure A.6: Weekly trends of average policy stringency index over high- and low-collectivism U.S. Democrat-controlled states

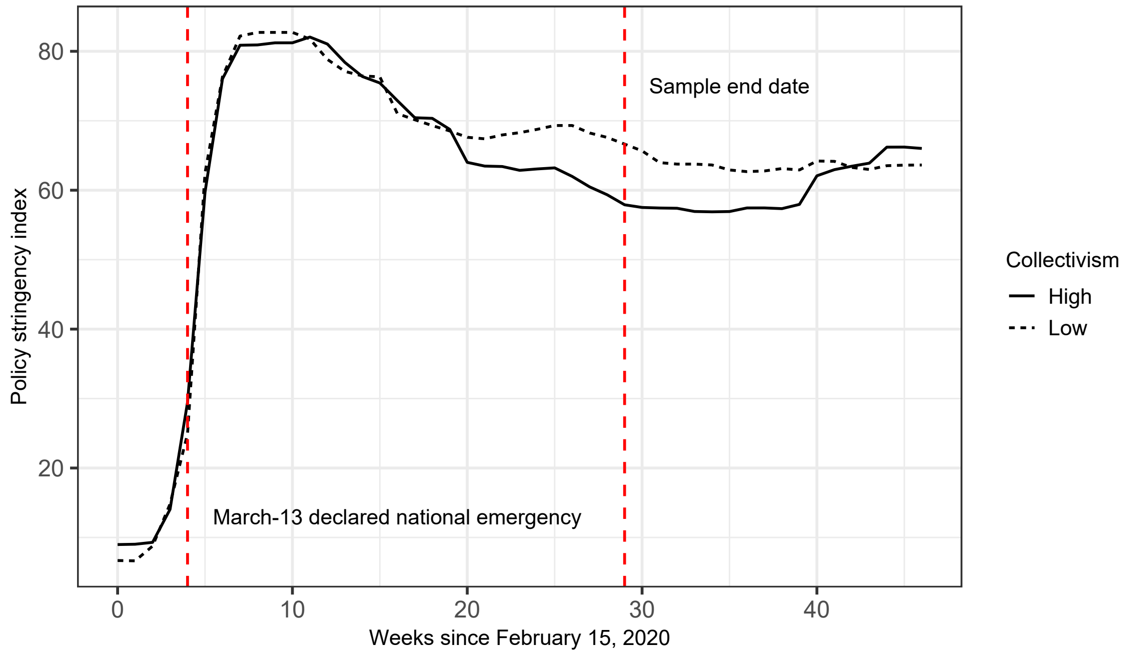


Figure A.7: Weekly trends of average changes of residential time over high- and low-collectivism U.S. Republican-controlled states

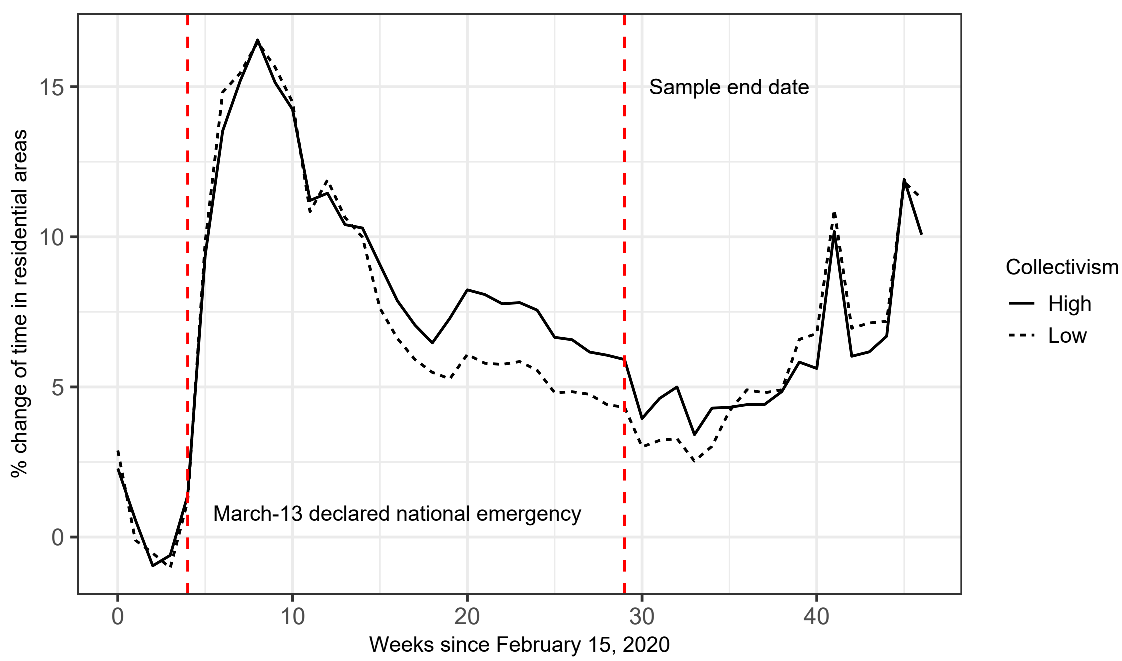


Figure A.8: Weekly trends of average policy stringency index over high- and low-collectivism U.S. Republican-controlled states

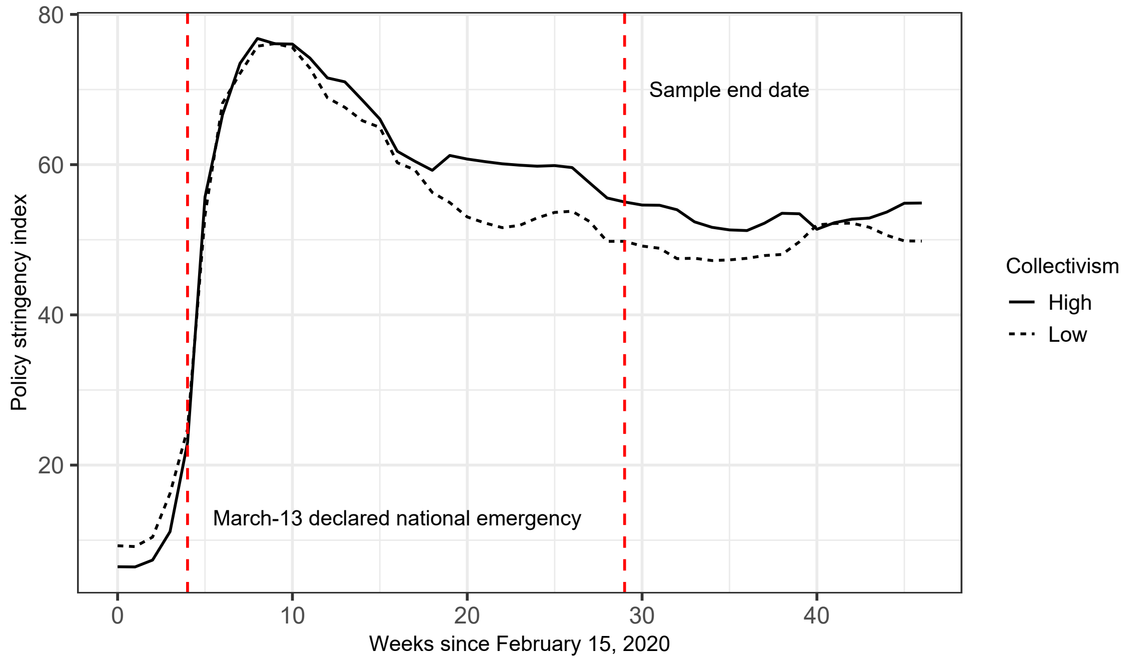


Figure A.9: Daily event study plot of the effects of the first implementation of stay-at-home requirements on changes of residential time over low-individualism countries[20]

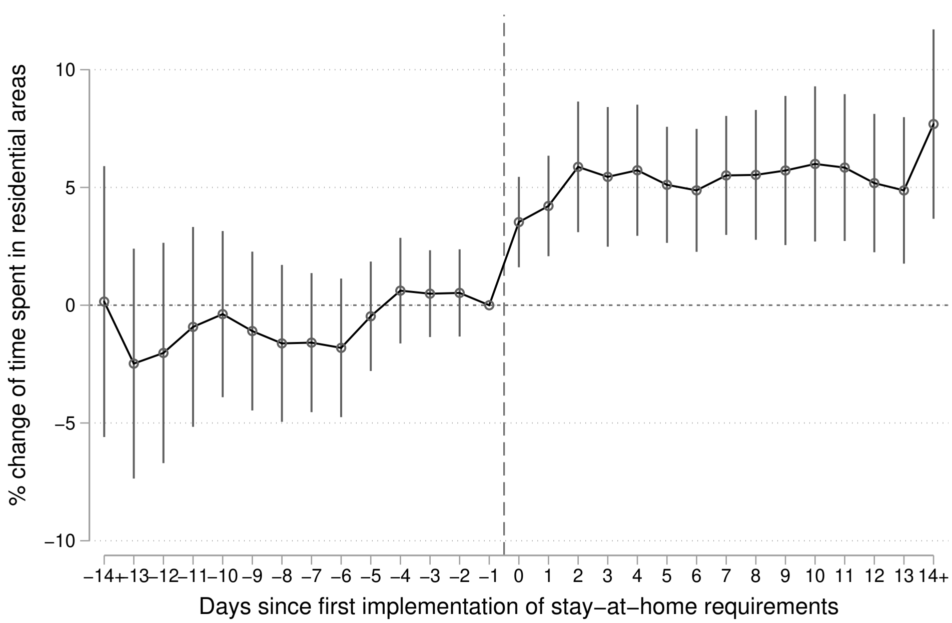


Figure A.10: Daily event study plot of the additional effects of the first implementation of stay-at-home requirements on changes of residential time over high-individualism countries

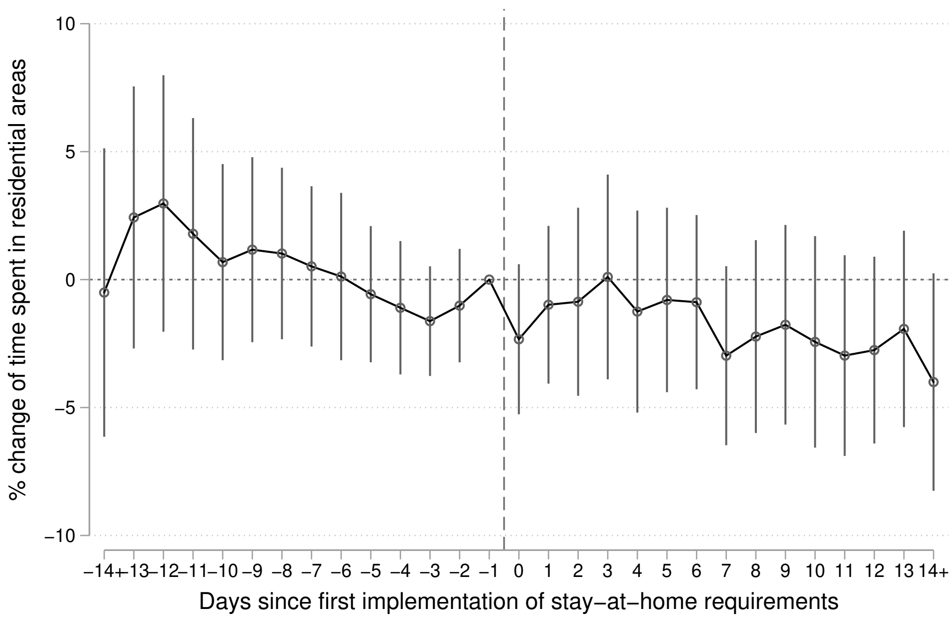


Figure A.11: Daily event study plot of the effects of the first implementation of stay-at-home requirements on changes of residential time over low-collectivism U.S. counties[21]

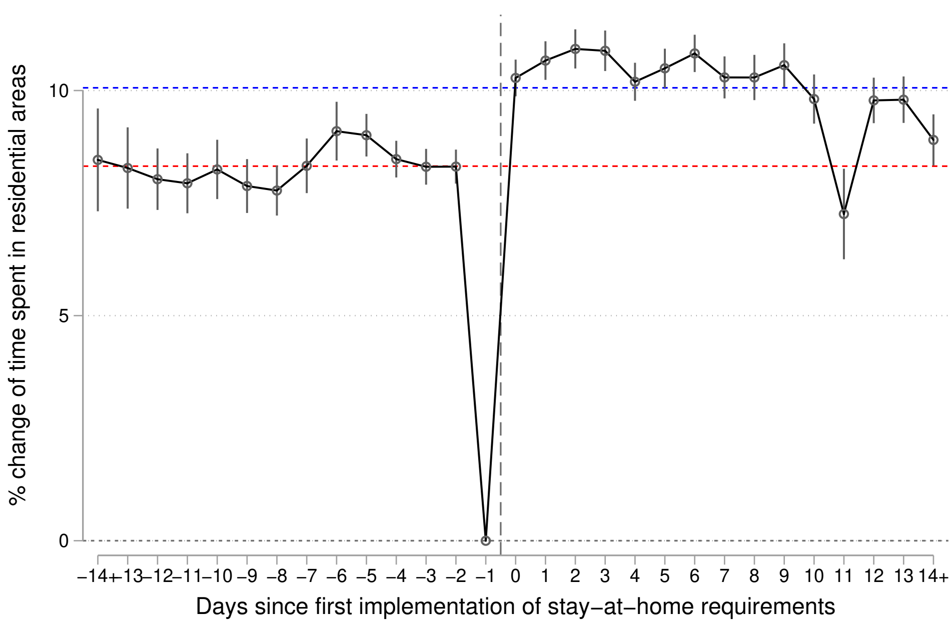


Figure A.12: Daily event study plot of the additional effects of the first implementation of stay-at-home requirements on changes of residential time over high-collectivism U.S. counties

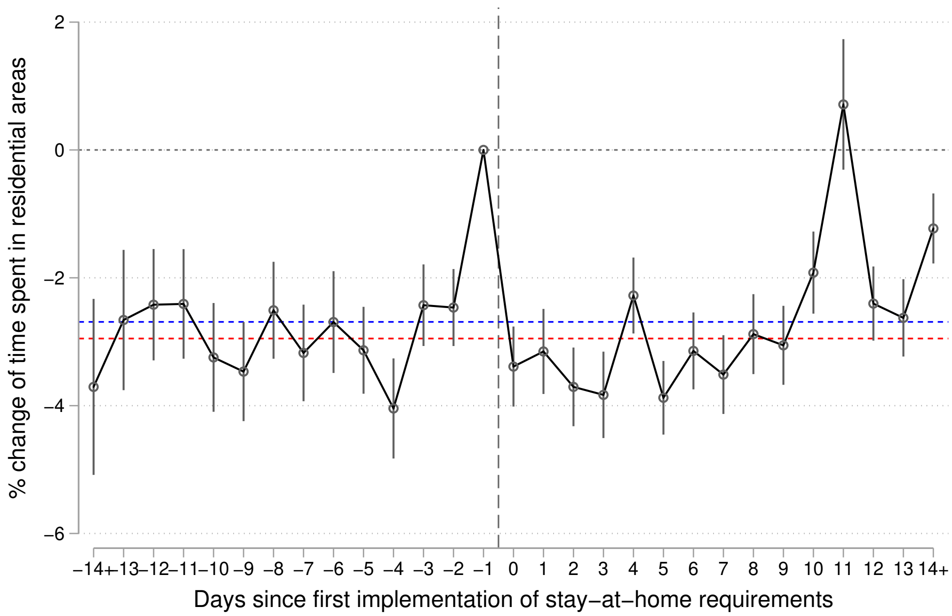


Figure A.13: Daily event study plot of the effects of the first implementation of stay-at-home requirements on changes of residential time over low-collectivism U.S. Democrat-controlled counties

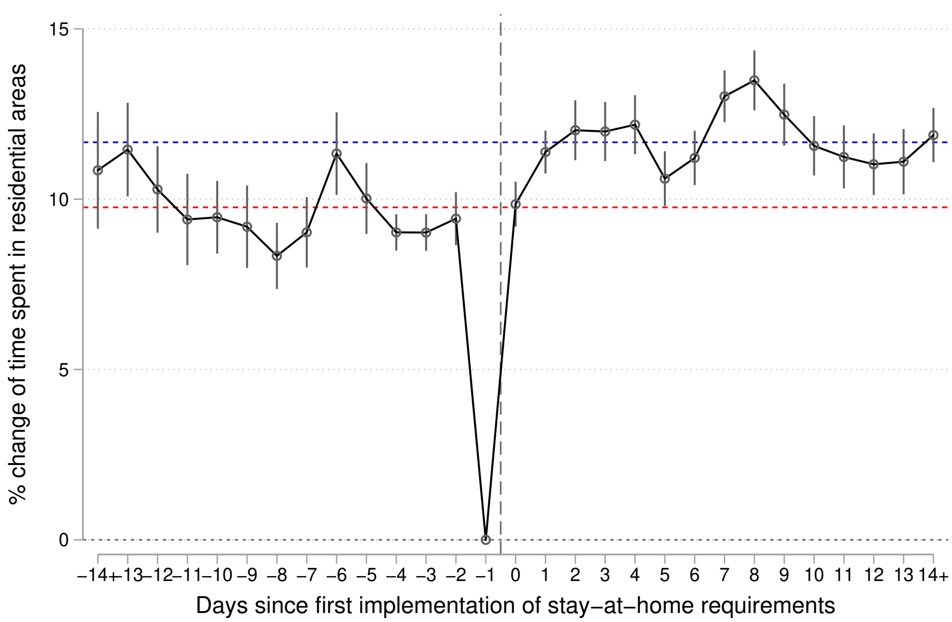


Figure A.14: Daily event study plot of the additional effects of the first implementation of stay-at-home requirements on changes of residential time over high-collectivism U.S. Democrat-controlled counties

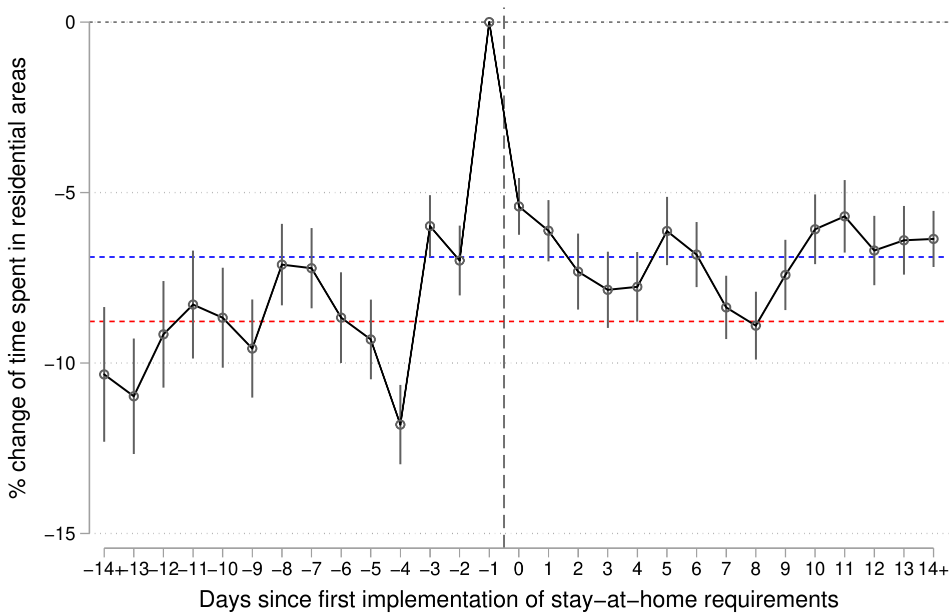


Figure A.15: Daily event study plot of the effects of the first implementation of stay-at-home requirements on changes of residential time over low-collectivism U.S. Republican-controlled counties

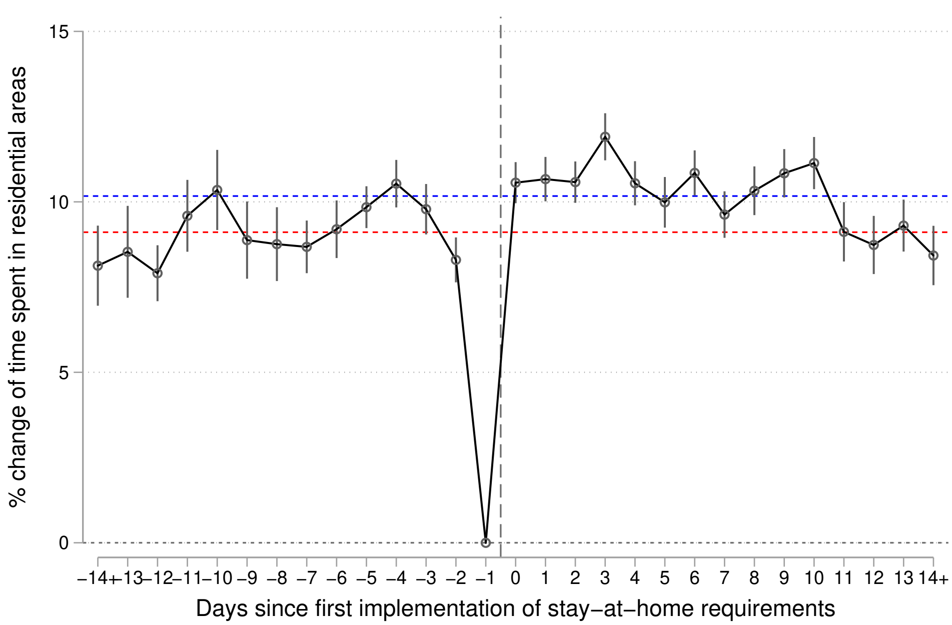


Figure A.16: Daily event study plot of the additional effects of the first implementation of stay-at-home requirements on changes of residential time over high-collectivism U.S. Republican-controlled counties

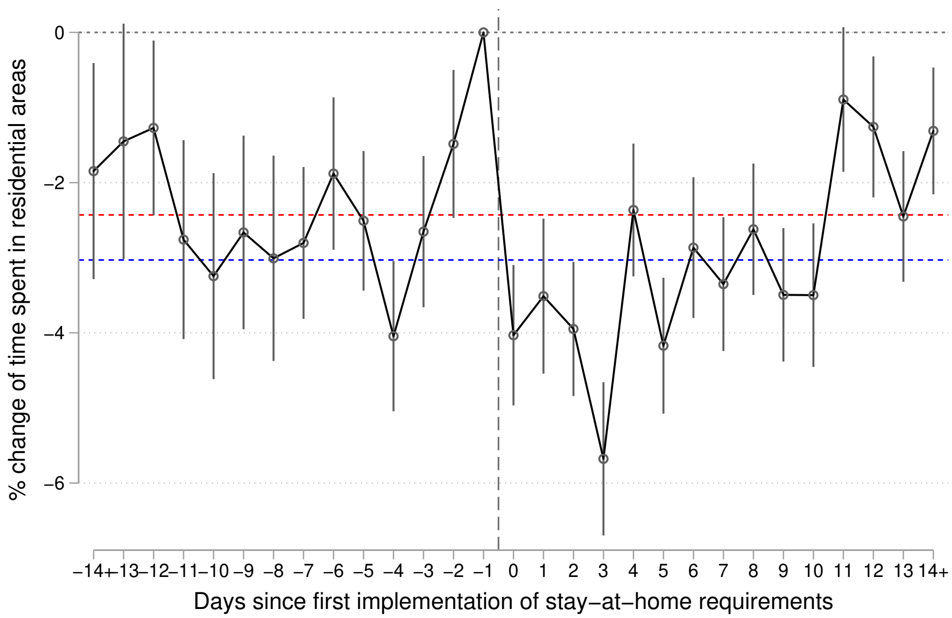
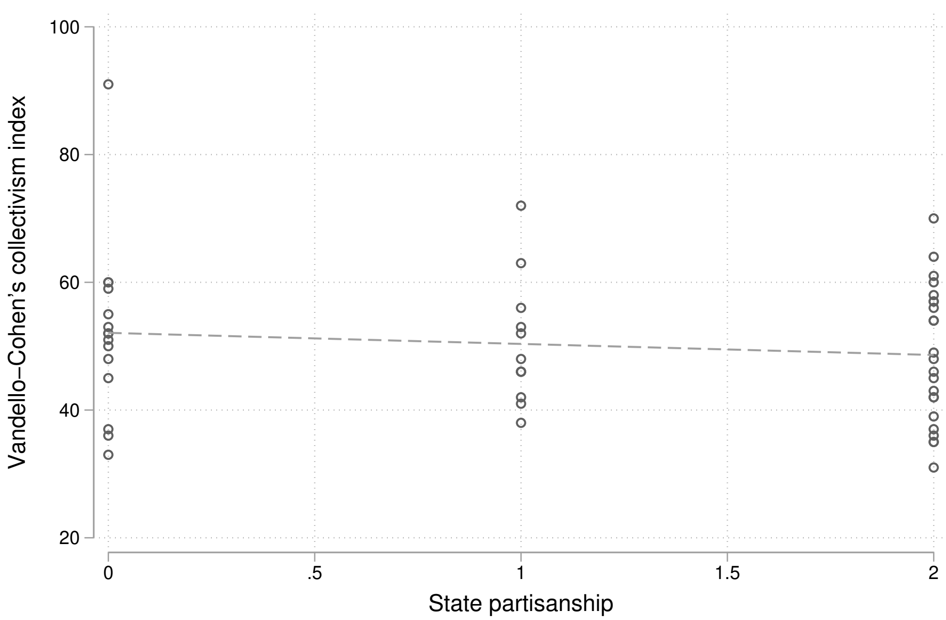


Figure A.17: Relation between U.S. state partisanship and Vandello-Cohen's collectivism index[22]



Appendix 4. Tables

Table A.1: Statistic summary for the cross-country dataset

	Mean	SD	Min	Max	N
COVID-19 Indicators					
Changes of Residential Time (%)	11	10	-35	55	25190
New Cases	1,053	5,139	0	85,687	23349
Stay-at-Home Requirements	1.08	0.97	0	3	24935
Policy Stringency Index	63	24	0	100	22923
Socio-Economics Indicators					
Individualism Index	44.34	24.44	6	91	12736
Population	43,326	129,432	38	1,380,004	25870
Aged above 65 (%)	9.72	6.60	1.14	27.05	25472
GDP per Capita ($)	21,363	20,527	926	116,936	25472
Polity V Index	4.95	5.67	-10	10	25870
Government Efficiency Index	0.15	0.97	-2.28	2.22	25870

Note: COVID-19 indicators are on the country-day level. Socio-economic indicators are country specific. *Population* is calculated in thousands. *GDP per capita* is calculated in dollars per year. The dataset begins on February 15, 2020, and ends on August 31, 2020.

Table A.2: Statistic summary of the U.S. cross-county dataset

	Mean	SD	Min	Max	N
COVID-19 Indicators					
Changes of Residential Time (%)	8	7	-46	38	234813
New Cases	13	73	0	5,501	437365
Stay-at-Home Requirements	1.10	0.67	0	2	557971
Policy Stringency Index	58.38	21.44	6	94	557971
Ventilators Needed	392	747	0	11,557	550788
Socio-Economics Indicators					
Collectivism Index	51.21	9.45	31	91	557971
Population	113	343	1	10,074	555911
Aged above 65 (%)	16.07	1.76	11.10	20.60	557971
Non-White (%)	15.83	15.92	1.26	94.90	557774
Median Income ($)	53,327	14,172	25,385	140,382	555911
Bachelor Rate(%)	21.81	9.67	5.40	78.50	555911
Democrats (%)	32.97	14.95	6.25	89.33	557774

Note: Changes of residential time, *new cases*, *stay-at-home requirements*, and *policy stringency index* are on the county-day level. *Ventilators needed* are recorded on the state-day level. *Population*, *non-White*, *median income*, *bachelor rate*, and *Democrats* are at county level. *Collectivism index* and *aged above 65* are at state level. *Population* is calculated in thousands. *GDP per capita* is calculated in dollars per year. The dataset begins on February 15, 2020, and ends on August 31, 2020.

Table A.3: Relation between U.S. state partisanship and Vandello-Cohen's collectivism index

	State Partisanship
	(1)
Vandello-Cohen's Collectivism Index	-0.0039
	(0.0108)
Observations	50
R^2	0.003

Note: The outcome of interest is the partisanship of each U.S. state, a dummy variable that represents "Democrat-controlled" (=0), "mixed" (=1), or "Republican-controlled" (=2). A state is defined to be Democrat-controlled, for instance, if both legislature and governor were occupied by the Democrats on April 1, 2020. Standard errors are shown in parentheses. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.4: Heterogeneous effects of policy stringency on changes of residential time across countries

	% Change of Residential Time				
	(1)	(2)	(3)	(4)	(5)
Policy Stringency	0.2494***	0.2667***	0.2453***	0.2828***	-0.0223
	(0.0229)	(0.0323)	(0.0226)	(0.0389)	(0.0733)
Policy Stringency × Individualism above Median (=1)	-0.0563**		-0.0523*	-0.0505**	-0.0441*
	(0.0273)		(0.0272)	(0.0247)	(0.0225)
Policy Stringency × Individualism		-0.0010*			
		(0.0005)			
Country FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
New Cases per Capita	Y	Y	Y	Y	Y
New Cases per Capita × Individualism	N	N	Y	Y	Y
Policy Stringency × Controls	N	N	N	Y	Y
Policy Stringency Squared	N	N	N	N	Y
Error Clustered by	Country	Country	Country	Country	Country
Observations	11955	11955	11955	11756	11756
Countries	64	64	64	63	63
R^2	0.770	0.769	0.771	0.786	0.797

Note: The table reports the results of estimations generally based on equation (4.2). The outcome of interest is the percent change of time spent in residential areas. *Policy stringency* ranges through 0–100, with higher value representing more stringent policies, sourced from OxCGRT. *Individualism above median* is a binary variable that equals 1 if and only if the individualism index in some country is above the median. *Individualism* is a continuous variable. Control variables include population, percentage of population aged 65 and above, GDP per capita, Policy V index, and the government effectiveness index. Standard errors are shown in parentheses, clustered at country level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure A.5: Heterogeneous effects of policy stringency on changes of residential time across U.S. counties

	% Change of Residential Time				
	(1)	(2)	(3)	(4)	(5)
Policy Stringency	0.0819***	0.1515***	0.0796***	-0.1185***	-0.2722***
	(0.0051)	(0.0164)	(0.0051)	(0.0192)	(0.0261)
Policy Stringency × Collectivism above Median (=1)	-0.0348***		-0.0323***	-0.0420***	-0.0398***
	(0.0055)		(0.0055)	(0.0055)	(0.0052)
Policy Stringency × Collectivism		-0.0017***			
		(0.0003)			
County FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
New Cases per Capita	Y	Y	Y	Y	Y
New Cases per Capita × Collectivism	N	N	Y	Y	Y
Policy Stringency Squared	N	N	N	Y	Y
Policy Stringency × Controls	N	N	N	N	Y
Error Clusterd by	County	County	County	County	County
Observations	190080	190080	190080	190080	190074
Counties	1633	1633	1633	1633	1632
R^2	0.784	0.784	0.784	0.785	0.790

Note: The table reports the results of estimations generally based on equation (4.2). The outcome of interest is the percent change of time spent in residential areas. *Policy stringency* ranges through 0–100, with higher value representing more stringent policies, sourced from OxCGRT. *Collectivism above median* is a binary variable that equals 1 if and only if the collectivism index in some county (state therein) is above the median. *Collectivism* is a continuous variable. Control variables include population, percentage of population aged above 65, percentage of non-White population, median income, bachelor rate, and democrats rate. Standard errors are shown in parentheses, clustered at county level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figures

Figure 1: Weekly event study plot of the heterogeneous effects of the first implementation of stay-at-home requirements on changes of residential time across countries

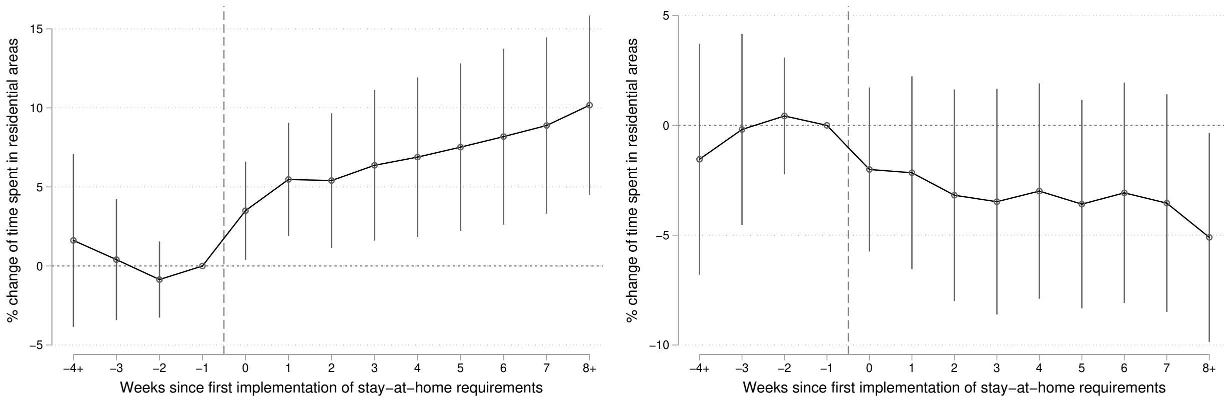


Figure 2: Weekly event study plot of the heterogeneous effects of the first implementation of stay-at-home requirements on changes of residential time across U.S. counties

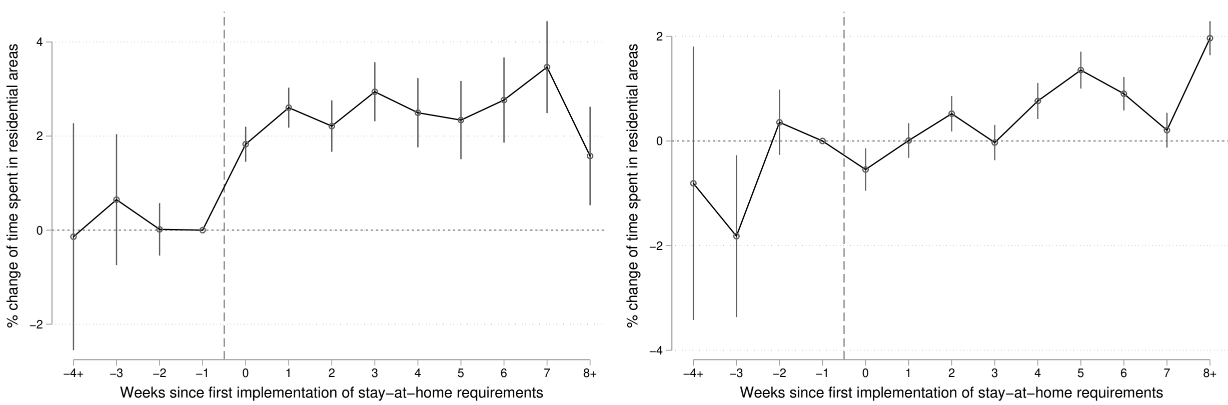


Figure 3: Weekly event study plot of the heterogeneous effects of the first implementation of stay-at-home requirements on changes of residential time across U.S. Democrat-controlled counties

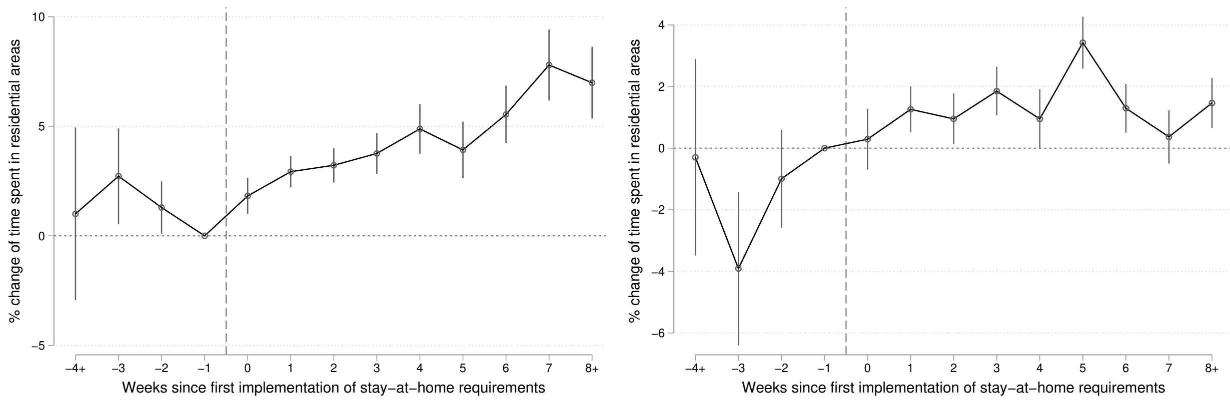
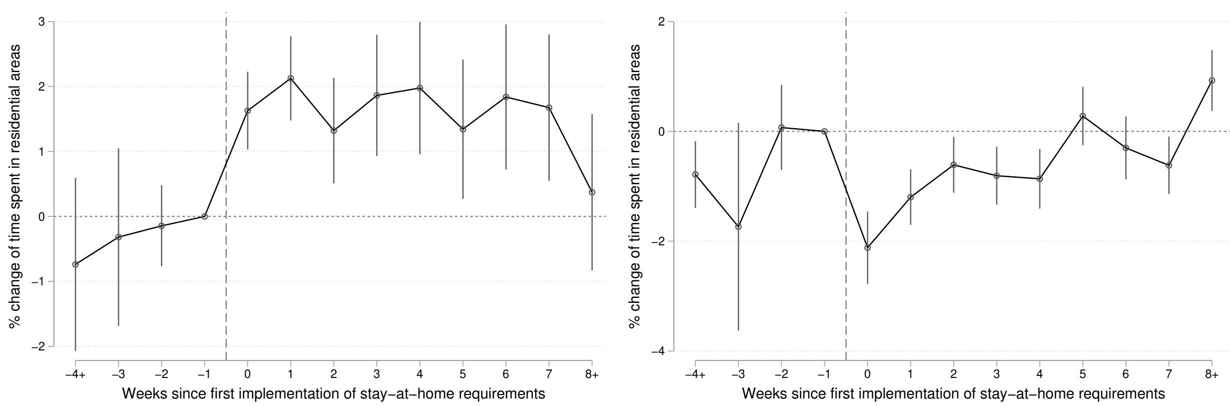


Figure 4: Weekly event study plot of the heterogeneous effects of the first implementation of stay-at-home requirements on changes of residential time across U.S. Republican-controlled counties



Tables

Table 1: Heterogeneous effects of stay-at-home requirements on changes of residential time across countries

	% Change of Residential Time				
	(1)	(2)	(3)	(4)	(5)
Stay-at-Home Requirements	4.2839***	4.6637***	4.1825***	4.5158***	5.6433***
	(0.4850)	(0.7041)	(0.4789)	(0.7689)	(1.4987)
Stay-at-Home Requirements × Individualism above Median (=1)	-1.4125**		-1.3053*	-1.4964*	-1.4548*
	(0.6648)		(0.6634)	(0.7971)	(0.8300)
Stay-at-Home Requirements × Individualism		-0.0250*			
		(0.0138)			
Country FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
New Cases per Capita	Y	Y	Y	Y	Y
New Cases per Capita × Individualism	N	N	Y	Y	Y
Stay-at-Home Requirements × Controls	N	N	N	Y	Y
Stay-at-Home Requirements Squared	N	N	N	N	Y
Error Clustered by	Country	Country	Country	Country	Country
Observations	11955	11955	11955	11756	11756
Countries	64	64	64	63	63
R^2	0.743	0.742	0.744	0.760	0.760

Note: The table reports the results of estimations generally based on equation (4.2). The outcome of interest is the percent change of time spent in residential areas. *Stay-at-home requirements* range through 0–3, with higher value indicating more strict ordinances, sourced from OxCGRT. *Individualism above median* is a binary variable that equals 1 if and only if the individualism index in some country is above the median. *Individualism* is a continuous variable. Control variables include population, percentage of population aged above 65, GDP per capita, Policy V index, and the government effectiveness index. Standard errors are shown in parentheses, clustered at country level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2: Heterogeneous effects of stay-at-home requirements on changes of residential time across U.S. counties

	% Change of Residential Time				
	(1)	(2)	(3)	(4)	(5)
Stay-at-Home Requirements	1.6929***	3.0371***	1.6632***	1.3236***	-4.0233***
	(0.0988)	(0.3038)	(0.0986)	(0.1907)	(0.4557)
Stay-at-Home Requirements × Collectivism above Median (=1)	-0.8172***		-0.7844***	-0.7857***	-0.4564***
	(0.1057)		(0.1056)	(0.1054)	(0.1056)
Stay-at-Home Requirements × Collectivism		-0.0359***			
		(0.0054)			
County FE	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y
New Cases per Capita	Y	Y	Y	Y	Y
New Cases per Capita × Collectivism	N	N	Y	Y	Y
Stay-at-Home Requirements Squared	N	N	N	Y	Y
Stay-at-Home Requirements × Controls	N	N	N	N	Y
Error Clusterd by	County	County	County	County	County
Observations	190080	190080	190080	190080	190074
Counties	1633	1633	1633	1633	1632
R^2	0.786	0.785	0.786	0.786	0.790

Note: The table reports the results of estimations generally based on equation (4.2). The outcome of interest is the percent change of time spent in residential areas. *Stay-at-home requirements* range through 0–3, with higher value indicating more strict ordinances, sourced from OxCGRT. *Collectivism above median* is a binary variable that equals 1 if and only if the collectivism index in some county is above the median. *Collectivism* is a continuous variable. Control variables include population, percentage of population aged above 65, percentage of non-White population, median income, bachelor rate, and democrats rate. Standard errors are shown in parentheses, clustered at county level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Heterogeneous effects of stay-at-home requirements on changes of residential time across U.S. counties with 2SLS estimations

	% Change of Residential Time	
	(1)	(2)
Stay-at-Home Requirements	17.3198***	12.3564***
	(1.4182)	(2.4128)
Stay-at-Home Requirements × Collectivism above Median (=1)	-0.3154	
	(0.6286)	
Stay-at-Home Requirements × Collectivism		0.0692*
		(0.0419)
	First Stage Stay-at-Home Requirements	
Ventilators	0.0002***	0.0002***
	(0.0000)	(0.0001)
Ventilators × Collectivism above Median (=1)	-0.0002***	
	(0.0000)	
Ventilators × Collectivism		0.0000***
		(0.0000)
First-Stage F (excl.)	106.31	62.05
County FE	Y	Y
Date FE	Y	Y
New Cases per Capita	Y	Y
Error Clusterd by	County	County
Observations	189912	189912
Counties	1495	1495
Kleibergen-Paap Wald rk F	102.40	63.99

Note: The table reports the results of estimations generally based on equation (4.2) with ventilators needed among U.S. states to instrument stay-at-home requirements, both at state level. The outcome of interest is the percent change of time spent in residential areas. *Stay-at-home requirements* range through 0–3, with higher value indicating more stringent regulations, sourced from OxCGRT. *Collectivism above median* is a binary variable that equals 1 if and only if the collectivism index in some county is above the median. *Collectivism* is a continuous variable. Control variables include population, percentage of population aged above 65, percentage of non-White population, median income, bachelor rate, and democrats rate. At the first stage, only regressors with respect to *stay-at-home requirements* are reported in the table. Standard errors are shown in parentheses, clustered at county level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: Heterogeneous effects of stay-at-home requirements on changes of residential time across U.S. counties with state partisanship and 2SLS estimations

	% Change of Residential Time					
	Dem	Rep	Dem IV		Rep IV	
	(1)	(2)	(3)	(4)	(6)	(6)
Stay-at-Home Requirements	0.6591***	1.2949***	3.7518***	111.1010*	-8.0576***	-57.7616***
	(0.1020)	(0.1316)	(1.2535)	(61.5666)	(3.0238)	(11.1795)
Stay-at-Home Requirements × Collectivism above Median (=1)	0.4964***	-1.0533***	4.8033***	9.5391***	-11.4498***	-2.2477*
	(0.1276)	(0.1239)	(0.6101)	(3.1064)	(2.3830)	(1.3153)
Stay-at-Home Requirements Squared				-45.2960*		21.2223***
				(25.6878)		(4.4080)
			First-Stage F (excl.)			
Stay-at-Home Requirements			158.49	261.36	91.87	75.31
			[0.0000]	[0.0000]	[0.0000]	[0.0000]
Stay-at-Home Requirements × Collectivism above Median (=1)			100.31	87.54	121.83	100.51
			[0.0000]	[0.0000]	[0.0000]	[0.0000]
Stay-at-Home Requirements Squared				187.82		55.95
				[0.0000]		[0.0000]
County FE	Y	Y	Y	Y	Y	Y
Date FE	Y	Y	Y	Y	Y	Y
New Cases per Capita	Y	Y	Y	Y	Y	Y
Error Clusterd by	County	County	County	County	County	County
Observations	48517	90716	48494	48494	90606	90606
Counties	370	821	349	349	738	738
R^2	0.833	0.768				
Kleibergen-Paap Wald rk F			62.05	4.01	7.43	47.46

Note: The table reports the results of estimations generally based on equation (4.2) with ventilators needed among U.S. states to instrument stay-at-home requirements, both at state level, and with division of state partisanship. The outcome of interest is the percent change of time spent in residential areas. *Stay-at-home requirements* range through 0–3, with higher value indicating more stringent regulations, sourced from OxCGRT. *Collectivism above median* is a binary variable that equals 1 if and only if the collectivism index in some county is above the median. *Collectivism* is a continuous variable. Control variables include population, percentage of population aged above 65, percentage of the non-White, median income, bachelor rate, and democrats rate. F tests for first-stage regressions with the three instrumented variables are presented in the table, with P-values in square brackets. Standard errors are shown in parentheses, clustered at county level. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.