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Determinants of social distancing and economic activity during COVID-19: A global view[1]

William Maloney[2] and Temel Taskin[3]

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The paper uses Google mobility data to identify the determinants of social distancing during the 2020 COVID-19 outbreak. We find for the U.S. that much of the decrease in mobility is voluntary driven by the number of COVID-19 cases and proxying for greater awareness of risk. Non-Pharmaceutical Interventions (NPI) such as closing non-essential business, sheltering in place, school closings are also effective, although with a total contribution dwarfed by the voluntary. This suggests that much social distancing will happen regardless of the presence of NPIs and that restrictions may often function more like a coordinating device among increasingly predisposed individuals than repressive measures per se. These results are consistent across countries income groups with only the poorest (LICs) showing limited effect of NPIs , and no voluntary component, consistent with resistance to abandon sources of livelihood. We also confirm the direct impact of the voluntary component on economic activity by showing that the majority of the fall in restaurant reservations in the U.S., and movie spending in Sweden occurred before the imposition of any NPIs. Widespread voluntary de-mobilization implies that releasing constraints may not yield a V shaped recovery if the reduction in COVID risk not credible.

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1 The opinions are those of the authors and do not represent the official position of the World Bank. Our thanks to Richard Baldwin, Robert Beyer, Nick Bloom, Xavi Cirera, Aart Kraay, Tito Cordella, Pravin Krishna, Norman Loayza, Cedric Okou, Cevdet Cagdas Unal, and Shu Yu for excellent comments.

2 Chief Economist, Equitable Growth, Finance, and Institutions, The World Bank.
3 Economist, Prospects Group, Equitable Growth, Finance, and Institutions, The World Bank.

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I. Introduction

Understanding the determinants of social distancing is central to addressing both the medical and economic aspects of COVID-19. [4] On the one hand, reducing interactions among people is critical to reducing propagation and a variety of Non-Pharmaceutical Interventions NPIs, such as closure of non-essential businesses, stay at home orders, or school closings have been put in place to this end, with some success.[5] While there is controversy around whether this should be the goal in developing countries as well (Barnett-Howell and Mobarak 2020, Loayza 2020), there is also concern about whether such measures would work: government capabilities to enforce may be weaker, and resistance may be higher since the trade-off with livelihood is harsher. At the other extreme of the cycle - where the debate is when to loosen NPIs as it is in several advance countries – preliminary evidence from Wuhan suggests that when opened, mobility and economic activity may not respond quickly. [6] Similarly, recent polls suggesting that 58% of Americans are concerned that restrictions will be lifted too soon raise the question of how much of an impact opening will have in practice and hence the shape of the recovery, whether V or U.[7]

This paper uses Google mobility data to explore which factors are proving important during the 2020 Covid-19 outbreak in the U.S. and globally. In all but the poorest countries, it confirms that NPIs can be effective, but that voluntary de-mobilization on the part of the population is much more important, driven by fear or perhaps a sense of social responsibility. This suggests that much social distancing will happen regardless of the presence of restrictions and suggests that NPIs may often function more like a coordinating device among increasingly predisposed individuals than repressive measures per se. We also confirm a more direct link of this voluntary effect using data on restaurant reservations in the U.S. and movie releases and revenues in Sweden and show that, these, too, experience most of their fall before any imposition of NPIs. Overall, the evidence suggests that moves to unfreeze the economy will fail unless there is confidence that, in fact, the risk has passed.

[4] There are three margins upon which societies can work to reduce the death toll. 1. Detect and quarantine so the disease never gets a foothold. 2. Once established, reduce social mobility to mitigate the spread (reduce the R factor.) 3. Increase the capability to treat the sick. On the third, Favero (2020) notes that limitations on ICU beds led to the extremely high death rate in Lombardy. In practice, developing countries have far less capability to treat- 10 African countries have no respirators.https://www.nytimes.com/2020/04/18/world/africa/africa-coronavirus-ventilators.html?referringSource=articleShare If northern Italy couldn't ramp up sufficiently enough along this dimension, it is highly unlikely that most poor countries can. On the first, many advanced countries have missed the window to detect and quarantine and again, this may be more challenging in the developing world.

[5] See Chen and Qiu (2020), Gonzalez-Eira and Niepelt (2020) for conceptual treatments of optimal shut down policies. Hartl et al (2020) find for Germany that growth rates of Covid-19 cases fell 50% as a result of German restrictions to shut down schools, stadiums and eventually many restaurants and shops. See Baldwin and Weder de Mauro (2020) for a compilation of recent thinking on Covid Economics.

[6] https://www.bloomberg.com/news/articles/2020-04-15/wuhan-s-life-after-lockdown-isn-t-business-as-usual?

[7] NBC News-Wall Street Journal was conducted between April 13 and April 15 among a sample of 900 registered voters.

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Several recent papers suggest that NPIs have had an impact in the US. Engle at al. (2020) use daily average changes in distance traveled in every U.S. county as a proxy for reduction in exposure to COVID-19 and find that an official stay-at-home restriction order corresponds to reducing mobility by 7.87%. Brzezinski et al (2020), also using cell phone data, find that a lockdown increases the percentage of people who stay at home by 8% across US counties. Painter and Qiu (2020) show that the introduction of shelter-in-place policies is associated with a 5.1 percentage point increase in the probability of staying home (see also Andersen (2020)).

However, voluntary de-mobilizing behavior that intensifies with prevalence of the disease is also an important driver and affects the effectiveness of official measures. Auld (2006), for example finds that during the Aids epidemic, an average respondent decreased risky behavior by about 5% in response to a 10% increase in Aids prevalence. Further, the 1918 Spanish Flu epidemic suggests that the predisposition of the population to demobilize drove both the incidence of official restrictions and their effectiveness. On the one hand, as Crosby(2003) details, that restrictions were binding is revealed by the fact that in San Francisco "The places of amusement opened first, to huge crowds starved for entertainment (p. 99)" and in Philadelphia "The long thirst was over, and arrests on drunken and disorderly charges bounded back up to and beyond normal levels" (p. 85). However, it is also true that while the San Francisco Department of Health could request that people to smother coughs and sneezes, only when enough fatalities were registered were "San Franciscans…scared enough to accept drastic measures to control the epidemic" (p.95)—and ex post, "Fear had been the enforcer of the Board of Health's policies."(p. 108) not the authorities themselves. When schools in San Francisco were opened, many parents kept their children home out of continuing fear. This resonates with the reports from Wuhan today of the anemic rebounding of the small restaurant sector when restrictions were released.

Viewed through this lens, restrictions may often function more like a coordinating device among increasingly predisposed individuals than repressive measure- if we're all working from home, then I won't be viewed badly if I do; whether schools are on line or in person requires a decision that individual concerned parents cannot effect. This, in turn, raises the question of the whether the impact of lock-down measures per se and their subsequent removal is overstated.

II. Data

Mobility and Economic Activity: Using data from the Maps application on smartphones, Google generates COVID-19 Community Mobility Reports[8] that use aggregated, anonymized data to construct an index of how visits and length of stay at different places change compared to a baseline. They can then follow movement trends over time by geography, and across different high-level categories of places such as workplaces, retail and recreation, groceries and pharmacies, parks, transit stations, and residential. These measures are explicitly considered proxies for social distancing and we focus on the first, workplace related

[8] https://www.google.com/covid19/mobility/

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mobility, as most relevant to economic activity and most prominent in the policy debate. The reports consist of per country downloads (with 131 countries covered initially), further broken down into regions/counties in some cases. Because location accuracy and the understanding of categorized places varies from region to region, Google does not recommend using this data to compare changes across countries or regions with different characteristics. To address this, our empirics rely only on within area variation across time and reporting or categorization differences are absorbed in included fixed effects.

This measure is limited by the degree to which coverage of smart phones offers a representative sample of the population. As Annex 1 shows, few developing countries show coverage of smart phones above 50% and Ethiopia, Nigeria, Sudan, Bangladesh, Pakistan hold up the bottom of the top 50 countries with rates under 20% of coverage. This said, several developing countries also have reasonable coverage when we adjust for the share of adults in the population: UK 100%, Sweden: 96%, US 95%, Italy 67%, Japan 63%, Brazil 52%, South Africa 50%. While clearly not representative, the differences between Italy and Japan on the one hand and Brazil and South Africa on the other are not so large as to justifying throwing out the possible information on how developing countries may differ. Further, while we may miss the mobility of for instance, micro firm owners without smartphones, many of their customers will have them and the shutting down of the firm will be partially registered.

Data on restaurant reservations in the US is taken from OpenTable.[9] Movie release and theater revenue data for Sweden from International Movie Database.[10]

Covid-19 Cases: Though there may be several mechanisms through which cases translate into lower mobility, we interpret this as a signal to individuals about the likelihood of a serious negative health outcome. National cases can inform about the overall evolution of the disease, while local numbers fine tune the proximate threat. We standardize by the corresponding population in the figures. In some regressions, we can expand the sample by using log (cases) and the population scaling is absorbed in the corresponding fixed effect. Global data are drawn from the Johns Hopkins Coronavirus Resource Center. Country specific regional data comes from national sources: US: Johns Hopkins Coronavirus Resource Center; Brazil, Italy, Japan, South Africa, Sweden, UK from national sources (see Annex II).

Non-Pharmaceutical Interventions (NPIs): We use mandatory closures of non-essential business as both most relevant to the issue of economic mobility as figuring most prominently in the policy debate. State level data for the US are collected from Raifman et al (2020) and NPIs enter as indicator variables taking a value of 1 if a given NPI is implemented and 0 otherwise. Globally, we employ information on national NPIs available

[9] www.opentable.com
[10] https://www.boxofficemojo.com/

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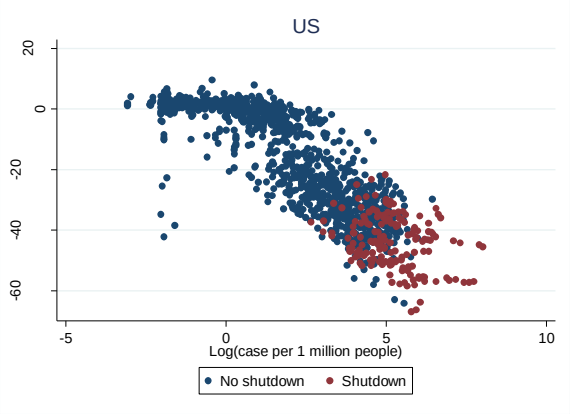
from the Blavatnik School of Government at Oxford University. For select countries for which we employ subnational mobility data to explore the impact of local case incidence, we use national data on the nationally implemented NPIs as controls. The exception is Brazil for which NPIs are established by states, and we collect data at that level.

III. Results: United States

Figure 1 plots the level of mobility against the log of the number of cases per capita by US state for the US. It further divides the sample by whether the states are covered by restrictions on non-essential businesses (red) or not (blue). Two drivers appear as potentially important. First, the data are consistent with restrictions leading to lower levels of mobility. However, more strikingly, there is a clear downward sloping relationship between reported cases and mobility independent of such restrictions.

Figure 1: Mobility, COVID Cases and Official Restrictions, United States



Notes: Workplace mobility is Google measure of work-related mobility index. See text for sources.

Table 1 more formally tests this relationship by estimating

$$Mobility_{it} = \beta_{0+}\beta_1 Cases_{it-1} + \beta_2\ Aggregate\ Cases_{t-1} + \beta_3\ NPI_{it-1} + \mu_i + v_t + \varepsilon_{it} \qquad (1)$$

Where mobility is the Google measure, Cases is the log incidence, Aggregate Cases is the national analogue, NPI are Non-pharmaceutical intervention(s), and u_i are subnational (state) fixed effects that also effectively put cases in per capita terms, and v_t, time fixed effects. There are clear issues of bi-directional causality here. Lower mobility, in theory, lowers the number of cases and may also possibly affect the likelihood of imposing restrictions. This should induce a downward bias to both coefficients on the right-hand side and our results should be taken as a lower bound. As we are working with a larger group of countries, we do not attempt to

instrument which would not be feasible in most, but we lag both explanatory variables 1 period. The results change modestly in magnitude, with even more lags, but the overall patterns remain consistent.

Table 1: Mobility, COVID Cases and NPIs, United States

	(1) Workplace	(2) Workplace	(3) Workplace	(4) Workplace	(5) Residential	(6) Residential
Close N.E. business	-4.373***	-5.281***	-2.071	-3.075***	2.047***	0.830*
	(1.235)	(0.689)	(2.006)	(1.051)	(0.356)	(0.463)
Log cases	-4.502***	-1.291***	-2.904***	-1.284***	0.551***	0.577***
	(1.153)	(0.437)	(0.915)	(0.385)	(0.185)	(0.161)
Log national cases	-2.671**	-3.038***	-2.193**	-2.837***	0.957***	0.875***
	(1.063)	(0.425)	(0.860)	(0.383)	(0.225)	(0.177)
Close K-12			-11.975***	-0.866		-0.092
			(1.704)	(1.169)		(0.407)
Stay home/SIP			-3.289	-3.855***		2.144***
			(2.630)	(1.134)		(0.485)
Constant	24.030***	10.503***	18.981***	9.574***	-4.472***	-3.986***
	(5.191)	(1.756)	(4.526)	(1.509)	(1.250)	(0.968)
Time FE	No	Yes	No	Yes	Yes	Yes
Day of the week FE	Yes	No	Yes	No	No	No
State FE	Yes	Yes	Yes	Yes	Yes	Yes
# of States	51	51	51	51	51	51
Obs.	1189	1189	1189	1189	1189	1189
R-squared	0.836	0.963	0.875	0.964	0.956	0.959

Notes: Regression of Google measure of work/residential related mobility on NPIs, the log of cases, the log of national cases, state, days of the week/time fixed effects. Robust clustered errors are in parenthesis. *** p<0.01, ** p<0.05, *<0.1

Table 1 suggests that both effects are at work although with surprising relative contributions. Columns 1-2 present the impact on mobility of just business closure restrictions, the log of local cases and the log of national cases with and without time fixed effects. Of the roughly 60-point decline in mobility seen in Figure 1, roughly 5 points appear due to official workplace closures. This is of the order of magnitude identified in previous studies on other measures of mobility. However, the component due to case incidence, both national and local appears to be able to account for much of the fall in mobility by itself. For instance, with the 10-log point increase in local cases in Figure 1, roughly 43 points (2/3) of the fall in mobility are accounted for, and more without FE by "voluntary" self-restriction.

Columns 3 and 4 introduce two other NPIs- School closures for K-12 and Stay at Home/Shelter in Place orders. The impact of imposing restrictions on business falls significantly suggesting that, as expected, it was picking up the effects of other correlated measures. The three together can account for almost 8 points of the fall in mobility. This remains dwarfed by the roughly 40% arising from the number of local and national cases whose impact stays roughly the same. Hence, it appears that in the US, the largest effect is due to protective measures taken by individuals as they learn more about the prevalence of the disease. The question then arises, will the effect of removing those restrictions in fact lead to the hoped-for rejuvenating effect on the economy if case numbers remain high?

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As a confirmatory test on the complement to workplace mobility, columns 5 and 6 show that increased NPIs and case incidences lead to a *rise* in residential mobility.

IV. Results: Global Sample

Figures 2 plot the same relationship for six countries of potential interest: Italy, Japan, Sweden and the UK and two upper middle-income countries, Brazil and South Africa, for which we have reasonable smart phone coverage. In every case, the figures show evidence of decreased mobility with the increase in case numbers.

Table 2 formalizes the graphs by running subnational mobility against sub-national and national COVID case incidence, including NPIs appropriate to the country case. The fact that the NPIs are at the country level makes us treat them more as controls than precise estimations of effects for most cases. However, again, alone among the six, Brazil NPIs are set at the state level and the data are therefore subnational. Three findings emerge. First, in Brazil, Italy, South Africa, Sweden, and the UK the semi-elasticities of mobility with respect to case incidence are comparable to those found in the US while Japan has much lower, but still significant effects.

Second, our tentative estimates suggest that NPIs have large effects Italy, South Africa (some with unexpected sign however), and the UK. For Brazil, Italy, South Africa, Sweden, and the UK, however, the "voluntary" component still contributes the largest share.

Third, Sweden and Japan, two countries with limited NPIs show curiously divergence paths. In Sweden, mobility falls 60 points or almost that seen in the U.S. (The extreme 80 point falls are due to the April 10 long holiday weekend). Hence, the sharp contrast often depicted between Sweden and more interventionist countries appears overdrawn- mobility has fallen drastically. It has not, however, in Japan and this presents a puzzle given that it is a country also with both effective governance and high social capital. We argue that this may offer additional evidence for the importance of NPIs as important coordination mechanisms. Although schools were closed and large events were cancelled since early March, business continued as normal until early April 7 when the State of Emergency was declared. But even under the SoE, governors could only request that people stay home and that businesses close. Tokyo's governor asked that people not go out at night but said restaurant and bars could remain open until 8 PM. These tepid measures faced strong headwinds in other social norms. For instance, there is resistance rooted in the country's work culture where employees fear being seen as slackers if they don't appear for work in person.[11] Unless everyone is sent home, everybody goes to work. The lack of

[11] https://www.nytimes.com/2020/04/19/world/asia/tokyo-japan-coronavirus.html?smid=em-share

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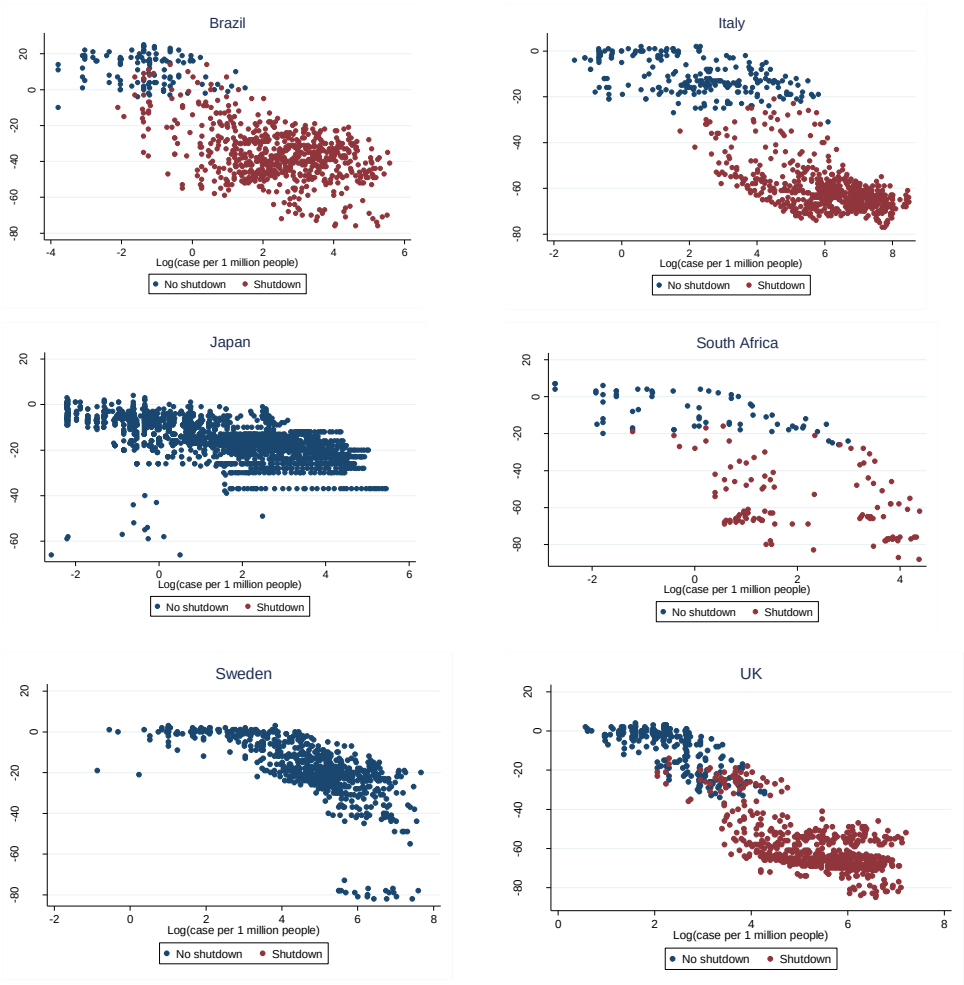
a stronger coordination mechanisms through official measures is a plausible explanation for both for the absence of much of an impact of formal measures, as well as limited self-motivated reductions in mobility.

Figures 2a-f: Workplace Mobility vs. Cases and Closure of Non-Essential Businesses



Notes: Workplace mobility is Google measure of work-related mobility index. See Annex II for country-specific sources.

Table 2: Mobility, COVID Cases and NPIs, Select Countries

	(1) Brazil	(2) Italy	(3) Japan	(4) S. Africa	(5) Sweden	(6) UK
Close N.E. business	2.996	-28.781***	3.054	-5.871**		-20.337***
	(2.375)	(0.836)	(2.190)	(2.166)		(0.322)
K-12 closure	-2.135			-13.583***		-12.670***
	(1.680)			(2.275)		(0.462)
Cancel public events	-1.697			10.798***	-7.837***	
	(1.842)			(2.150)	(2.039)	
Close public transport.				4.102*		
				(1.782)		
Public info. camp.				46.285***	12.420***	
				(7.338)	(1.794)	
Restr. on internal mov.				-37.443***		
				(0.924)		
Log cases	-1.413**	-2.775***	0.166	-1.294	-4.499**	0.719
	(0.595)	(0.865)	(0.561)	(1.982)	(1.796)	(0.517)
Log national cases	-3.544***	-3.157**	-3.229***	-4.371**	-2.601	-6.994***
	(0.464)	(1.134)	(0.553)	(1.711)	(2.290)	(0.566)
Constant	9.550***	22.787***	3.909*	25.710***	18.885*	39.349***
	(1.982)	(6.500)	(1.976)	(5.624)	(9.309)	(2.783)
Time FE	Yes	No	No	No	No	No
Day of the week FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
# of States	27	20	46	7	21	95
Obs.	762	865	2361	169	758	2566
R-squared	0.811	0.945	0.484	0.956	0.637	0.956

Notes: Regression of Google measure of work-related mobility on NPIs, the log of cases, the log of national cases. Mobility, Cases and National Cases at subnational level. NPIs at national level with the exception of Brazil for which all data is at the subnational level. Robust clustered errors are in parenthesis. *** p<0.01, ** p<0.05, *<0.1

Global Sample

Figure 3a-c groups the global sample of countries which have national data on mobility and NPI. Figure 3a divides the sample into those with and without restrictive orders. As in the individual case, there appears to be evidence for both the impact of restrictions and of the relationship with cases incidence. Figure 3b breaks the data apart into 4 income categories, Low Income Countries (LIC), Lower Middle Income (LMIC), Upper Middle Income (UMIC) and High Income (HIC) which include primarily the wealthier OECD countries (see Annex III for categorization). Figure 3c is the same, but only for country/periods when official restrictions on non-essential businesses are in place. In both cases, the downward slope appears across all income categories.

Table 3 largely confirms previous findings. Each specification is presented with and without time fixed effects which, in some categories, consume substantial degrees of freedom. Preliminary explorations suggest that world COVID case incidence does not enter and we drop that term. This makes sense if we think that citizens of a country may pay attention to national trends, as was the case in the US, but maybe less cases across the

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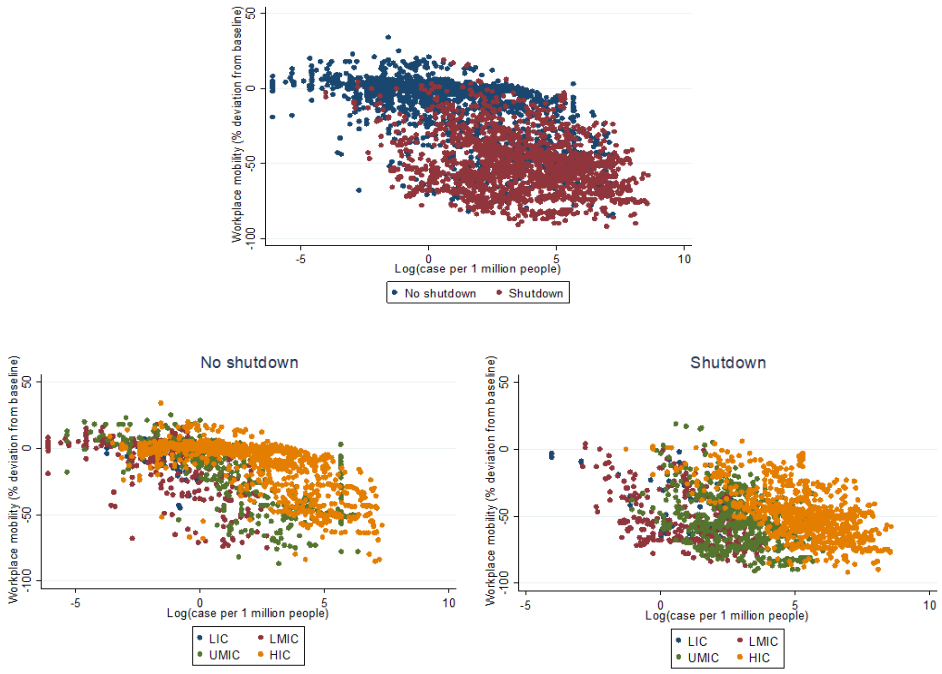
ocean. The semi-elasticity on home case incidence appears both of larger magnitude than in the US and very similar across LMIC and HICs at around 4.3. Without time fixed effects, UMICs are of similar magnitude, and LICs is a third to a half below that found in the other groups. However, with them, the UMIC falls by more than half and becomes insignificant and the LIC coefficient disappears completely. A monotonic story in income is thus not clean, but it is consistent with the argument that in very poor countries, people cannot afford not to work and hence they will continue to do so.

Figures 3a-c: Mobility, COVID Cases and NPIs, Global Sample



Notes: Workplace mobility is Google measure of work-related mobility index. LIC, LMIC, UMIC, and HIC stand for Low Income Countries, Lower Middle-Income Countries, Upper Middle-Income Countries, and High Income Countries, respectively. See Table AIII for income group classification.

The impact of NPIs themselves is mixed. Workplace closures are most clearly significant in LMICs accounting for almost 9 points of reduced mobility which in UMIC and HIC, the point estimate is roughly half that and becomes insignificant with the inclusion of time fixed effects. School closures are robustly significant and account for 10 points in HIC suggesting that having to school children at home is a limitation on job related mobility. For UMICs, the coefficient is similar without time fixed effects, but falls to 6.6 pts and becomes insignificant with their inclusion. For LICs and LMICs, the point estimates are negative significant, and they

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are positive. This monotonic increase with lower incomes is consistent with children playing a different role, perhaps helping in a business with less regard to human capital accumulation foregone.

Again, the sampling for the LIC and LMIC samples for sure are not representative and what we may be finding is simply that people who can afford smart phones behave similarly around the world. Still, either LMIC governments have the capability to, at least, coral the elites, or, again, are simply providing a coordination mechanism.

Cancelling public events never enters significantly with full time fixed effects although the point estimates are often in the -6 to -10 range. The restriction that most robustly reduces mobility among the LICs is closing of public transport, accounting for a massive 16.5 points. In UMICs, and arguably in HICs, the value is a third of that. This would seem the most potent tool of control in the poorest countries.

Public information campaigns curiously enter positively and significantly in LMICs and almost in UMICs with coefficients of roughly 7-10. The intuition is not clear, but it may be the case that guidance on washing hands and wearing masks makes individuals feel more in control and protected and hence, net the impact is to increase mobility.

Restrictions on internal movement have large and significant effects (12, 14.3) in LMICs and UMICs, with much less impact in HIC and virtually none in LICs. In the latter case, this may testify to difficulty in enforcing such shelter in place ordinances relative too, for instance, shutting down public transport.

In sum, in HICs, and LMICs, the voluntary component is still as or more important as NPIs. UMICs look quite similar to HICs with the exception of anomalous lack of impact of case incidence, and the large impact of restrictions on internal movement which it shares with LMICs. It may be that in fact, LMIC and UMIC are more effective in enforcing such measures. Overall, for LICS the voluntary component is absent and the only NPI that appears to have any effect is closing public transportation. Again, with the caveat that cell phone coverage in such countries is around or under 20% of the population, this is consistent, again, with limited state capability and more resistance from the population to stop working.

Again, Annex IV presents the complementary regressions on residential mobility and finds patterns that mirror those presented above.

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Table 3: Workplace Mobility, COVID Cases, and NPIs, Global Sample

	(1) LIC	(2) LIC	(3) LMIC	(4) LMIC	(5) UMIC	(6) UMIC	(7) HIC	(8) HIC
K-12 closure	3.13	0.04	1.24	0.64	-6.62	-10.60**	-10.20***	-13.32***
	(4.83)	(3.03)	(4.61)	(5.11)	(4.80)	(3.90)	(3.16)	(3.85)
Close N.E. business	1.00	-0.80	-8.83*	-9.30	-3.96	-8.59**	-4.73	-8.75***
	(7.40)	(4.45)	(5.01)	(5.61)	(3.37)	(4.09)	(2.84)	(2.90)
Cancel public events	-9.77	-6.37	-5.26	-6.66*	-1.49	-5.66	-2.32	-6.35*
	(5.27)	(4.46)	(3.88)	(3.75)	(5.96)	(4.45)	(3.04)	(3.16)
Close public transp.	-16.51*	-16.17*	-2.20	-5.35	-5.37*	-4.93	-5.06	-6.44**
	(8.37)	(7.18)	(4.93)	(5.02)	(2.86)	(3.64)	(3.03)	(2.71)
Public info. camp.	0.77	-0.40	9.90***	10.47***	7.32	8.99**	4.71*	5.59**
	(3.23)	(3.35)	(2.89)	(2.31)	(4.91)	(4.07)	(2.62)	(2.70)
Restr. on internal mov.	-1.21	-1.85	-12.03***	-10.52**	-14.32***	-16.81***	-2.72	-5.53**
	(3.57)	(3.13)	(2.98)	(3.81)	(3.78)	(4.46)	(2.04)	(2.18)
Log cases	-0.03	-2.43*	-4.30***	-5.57***	-1.50	-3.85***	-4.61***	-3.42***
	(1.89)	(1.17)	(1.13)	(0.56)	(1.63)	(0.80)	(0.97)	(0.75)
Constant	3.76	14.08**	-5.82	6.46	-0.50	8.68*	-1.73	10.41***
	(3.41)	(5.84)	(4.46)	(4.02)	(5.05)	(4.75)	(2.58)	(2.49)
Time FE	Yes	No	Yes	No	Yes	No	Yes	No
Day of the week FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Countries	8	8	24	24	29	29	40	40
Obs.	193	193	720	720	945	945	1777	1777
R-squared	0.69	0.62	0.77	0.73	0.85	0.80	0.86	0.80

Notes: Regression of Google measure of work-related mobility on NPIs, the log of national cases, country, and days of the week/time fixed effects. Robust clustered errors are in parenthesis. *** p<0.01, ** p<0.05, *<0.1. LIC, LMIC, UMIC, and HIC stand for Low Income Countries, Lower Middle Income Countries, Upper Middle Income Countries, and High Income Countries, respectively. See Table AIII for income group classification.

V. Mapping to Economic Activity

Do these voluntary declines in Google mobility in fact map to economic activity? Preliminary evidence from the U.S. and Sweden suggests they do. Figure 4 presents restaurant reservations by state against COVID incidence for the U.S. What is immediately clear is that the fall in reservations predated the closing of non-essential businesses. This is confirmed by Table 4 which suggests a combined elasticity of over 10 and virtually no impact of business closing measures. That is, the entire fall can be accounted for with the increase in cases. The results suggest that what slowed economic activity was not the NPIs, but rather voluntary de-mobliization as evidence of the magnitude of the threat accumulated.

In the same vein, Figure 5 presents preliminary national data from movie theater releases and revenues in Sweden, again, a country with no restrictions on non-essential businesses. Consistent with this, releases continue more or less unchanged while revenues drop off entirely. Supply remains unaffected, but, consistent with the declines in overall mobility, demand evaporates. Since the data are at the national level, we cannot pursue these trends more formally.

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Figure 4: Decline in Restaurant Reservations vs. COVID Cases

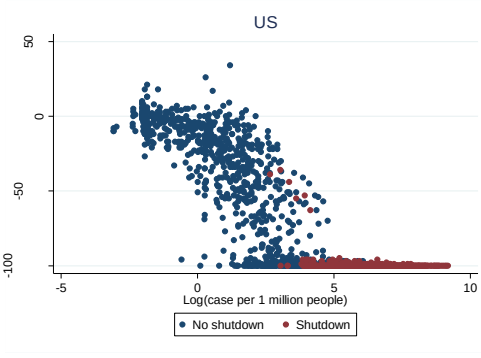
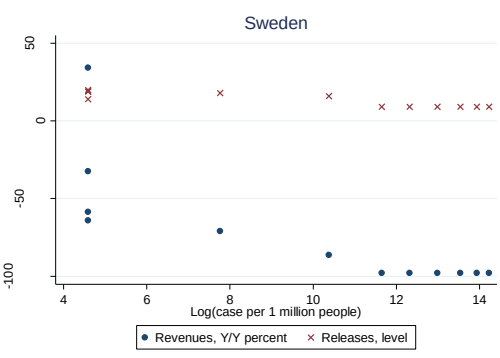


Figure 5: Decline in Movie Theater Revenues and Releases vs. COVID Cases



Notes: U.S. Restaurant reservations against COVID incidence. Sweden: Movie releases and theater revenues against COVID incidence. See text for sources.

In both the cases of restaurant reservations in the U.S. and theater demand in Sweden, demand has fallen sharply and independent of NPIs. This suggests that, as in Wuhan, it is likely that release of NPIs will have little effect unless individuals are confident that the risk has diminished.

VI. Conclusion

Several key findings thus emerge. First, clearly, the pattern of demobilization varies across countries with the political choices made. The US and Japan have radically different degrees of demobilization.

Second, decreased mobility seems more driven by "voluntary" individual response to increased local and national COVID-19 case incidence, proxying for awareness or fear or social responsibility, rather than formal measures. For all except the poorest countries (LICs) the response of mobility with respect to cases is of similar orders of magnitude and can explain most of the reduction in mobility, dwarfing the effect of NPIs.

Third, that said, there is evidence that less affluent countries were also able to implement NPIs. LMICs and UMICs appear to have been able to engineer as much or more of a fall in mobility through NPIs as some High-Income Countries.

Fourth, our global data suggest that other measures beyond closing non-essential workplaces have important impacts-school closures, restrictions on internal mobility/shut-down of public transportation. Counterintuitively, public information campaigns appear to raise mobility- information on protective measures may make individuals feel more confident moving about.

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Table 4: Restaurant Reservations, COVID Cases, and NPIs, United States

	(1) Restaurant reservations
Close N.E. business	0.818
	(1.381)
Close K-12	2.349
	(1.720)
Stay home/SIP	0.952
	(1.139)
Log cases	-0.678
	(1.125)
Log national cases	-9.775***
	(0.884)
Constant	31.251***
	(6.388)
Time FE	Yes
State FE	Yes
# of States	49
Obs.	1877
R-squared	0.958

Notes: Regression of restaurant reservations (Y/Y percent change) from OpenTable, on NPIs, the log of cases, the log of national cases, state, time fixed effects. Robust clustered errors are in parenthesis. *** p<0.01, ** p<0.05, *<0.1

Fifth, the dominant contribution of voluntary self-restraint along with historical and anecdotal evidence suggests that formal NPIs may be as much coordination mechanisms as repressive measures. For instance, no parent may want to send his/her child to school, but only when schools force all students on line can continued safe learning at a distance be realized. As in Japan, no one may want to be seen as the slacker by not showing up at work, but if the government signals that this is the safe thing to do, then all can work from home without stigma.

Sixth, these findings offer both good and bad news. First, they imply that for many countries in the world, self-enforcing dynamics and NPIs can reduce mobility and business activity substantially. That mobility fell almost as much in Sweden, with no NPIs, as the U.S. dramatically illustrates this point and suggests that the focus on government NPI policy in explaining Sweden's mortality rate may not be justified. The finding that only shutting down public transport has any effect in LICs is consistent with arguments that government capacity may be generally low, and resistance to demobilizing is high where it implies lost livelihoods.

Seventh, the potentially bad news is that releasing constraints may not, as appears to be the case in Wuhan have the economically rejuvenating effect that was expected if people are not convinced that, in fact, the coast is

clear. Given this, we are more likely to be facing a U-shaped recovery rather than a V propelled by the release of constraints.

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Annex I. Smartphone Coverage

Country	Smartphone penetration	
United Kingdom	82.20%	1
Netherlands	79.30%	2
Sweden	78.80%	3
Germany	78.80%	4
United States	77.00%	5
Belgium	76.60%	6
France	76.00%	7
Spain	72.50%	8
Canada	72.10%	9
Australia	68.60%	10
South Korea	68.00%	11
Kazakhstan	64.90%	12
Poland	64.00%	13
Russian Federation	63.80%	14
Taiwan	60.00%	15
Italy	58.00%	16
Malaysia	57.50%	17
Japan	55.30%	18
China	55.30%	19
Romania	53.80%	20
Ukraine	48.30%	21
Argentina	46.90%	22
Saudi Arabia	46.00%	23
Mexico	45.60%	24
Philippines	44.90%	25
Chile	44.20%	26
Thailand	43.70%	27
Brazil	41.30%	28
Venezuela	40.80%	29
Colombia	39.80%	30
Morocco	37.90%	31
Turkey	37.90%	32
Vietnam	37.70%	33
South Africa	35.50%	34
Iran (Islamic Republic of)	64.60%	35
Peru	32.10%	36
Uzbekistan	31.30%	37
Algeria	29.10%	38
Egypt	28.00%	39
India	27.70%	40

Indonesia	27.40%	41
Ghana	24.00%	42
Myanmar	21.80%	43
Kenya	20.90%	44
Sudan	19.70%	45
Bangladesh	16.10%	46
Uganda	15.60%	47
Pakistan	13.80%	48
Nigeria	13.00%	49
Ethiopia	11.20%	50

Source: *Newzoo's Global Mobile Market Report* (2018) as cited at https://en.wikipedia.org/wiki/List_of_countries_by_smartphone_penetration

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Annex II. Subnational Data Sources

Brazil: Official state websites, Platforma COVID Brazil by the Government of Brazil: https://covid19br.wcota.me/

Italy: Dipartimento della Protezione Civile: https://github.com/pcm-dpc/COVID-19

Japan: Japan COVID-19 Data Repository: https://github.com/sanpei3/covid19jp

South Africa: Department of Health: https://github.com/dsfsi/covid19za

Sweden: https://www.boxofficemojo.com/weekend/by-year/2020/?area=SE

UK: Department of Health and Social Care: https://github.com/tomwhite/covid-19-uk-data

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Annex III. Income Groups

LIC	LMIC	UMIC	HIC
Afghanistan	Angola	Argentina	Australia
Burk. Faso	Bangladesh	Belize	Austria
Mali	Bolivia	Bos. and Herz.	Belgium
Mozambique	Cameroon	Botswana	Canada
Niger	Cape Verde	Brazil	Chile
Rwanda	Egypt	Bulgaria	Croatia
Tanzania	El Salvador	Colombia	Czechia
Uganda	Ghana	Costa Rica	Denmark
	Honduras	Dominican Republic	Estonia
	India	Ecuador	Finland
	Indonesia	Guatemala	France
	Kenya	Iraq	Germany
	Kyrgyzstan	Jamaica	Greece
	Laos	Jordan	Hong Kong
	Mongolia	Kazakhstan	Hungary
	Myanmar (Burma)	Lebanon	Ireland
	Nicaragua	Libya	Israel
	Nigeria	Malaysia	Italy
	Pakistan	Mauritius	Japan
	Papua New Guinea	Mexico	Luxembourg
	Philippines	Namibia	Netherlands
	Vietnam	Paraguay	New Zealand
	Zambia	Peru	Norway
	Zimbabwe	Romania	Panama
		South Africa	Poland
		Sri Lanka	Portugal
		Thailand	Puerto Rico
		Turkey	Saudi Arabia
		Venezuela	Singapore
			Slovakia
			Slovenia
			South Korea
			Spain
			Sweden
			Switzerland
			Trinidad and Tobago
			United Arab Emirates
			United Kingdom
			United States
			Uruguay

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Annex IV.

Table A4: Residential mobility, global sample

	(1) LIC	(2) LIC	(3) LMIC	(4) LMIC	(5) UMIC	(6) UMIC	(7) HIC	(8) HIC
K-12 closure	-1.59	-1.81	1.78	1.86	4.34**	5.67***	3.71**	5.18***
	(3.57)	(2.00)	(2.33)	(2.57)	(2.04)	(1.74)	(1.39)	(1.57)
Close N.E. business	0.84	0.49	4.37**	4.63*	2.69*	4.68***	1.65	3.10**
	(1.75)	(2.16)	(2.06)	(2.35)	(1.31)	(1.46)	(1.39)	(1.34)
Cancel public events	7.34***	4.03	0.67	1.39	1.39	2.71	0.87	2.83**
	(1.61)	(2.58)	(1.71)	(1.82)	(2.54)	(1.98)	(1.38)	(1.31)
Close public transp.	2.74	4.78	-0.07	1.25	0.42	0.30	3.25**	3.19**
	(2.26)	(2.93)	(2.07)	(2.07)	(1.61)	(1.77)	(1.38)	(1.21)
Public info. camp.	-2.71**	-2.34	-5.94***	-6.16***	-5.27**	-5.22***	-2.32	-2.41*
	(0.96)	(2.37)	(1.89)	(1.45)	(2.28)	(1.72)	(1.43)	(1.34)
Restr. on internal mov.	2.46	3.06	6.35***	5.83***	7.90***	9.26***	0.69	1.34
	(1.68)	(1.63)	(1.23)	(1.67)	(1.74)	(1.77)	(1.01)	(0.98)
Log cases	0.84	1.37*	1.68***	2.20***	0.12	1.25***	1.99***	1.55***
	(0.83)	(0.60)	(0.42)	(0.27)	(0.74)	(0.38)	(0.55)	(0.36)
Constant	7.28***	1.43	5.60**	2.52	1.35	-1.25	1.01	-4.48***
	(1.22)	(3.99)	(2.28)	(2.18)	(2.52)	(1.88)	(1.35)	(1.18)
Time FE	Yes	No	Yes	No	Yes	No	Yes	No
Day of the week FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Countries	8	8	24	24	29	29	40	40
Obs.	193	193	711	711	942	942	1775	1775
R-squared	0.78	0.71	0.80	0.77	0.83	0.80	0.85	0.79

Notes: Regression of Google measure of residential mobility on NPIs, the log of national cases, country, and days of the week/time fixed effects. Robust clustered errors are in parenthesis. *** p<0.01, ** p<0.05, *<0.1. LIC, LMIC, UMIC, and HIC stand for Low Income Countries, Lower Middle Income Countries, Upper Middle Income Countries, and High Income Countries, respectively. See Table AIII for income group classification

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