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A Vicious Cycle: How Pandemics Lead to Economic Despair and Social Unrest

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A Vicious Cycle: How Pandemics Lead to Economic Despair and Social Unrest[1]

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Abstract

In this paper we analyze the dynamics among past major pandemics, economic growth, inequality, and social unrest. We provide evidence that past major pandemics, even though much smaller in scale than COVID-19, have led to a significant increase in social unrest by reducing output and increasing inequality. We also find that higher social unrest, in turn, is associated with lower ourput and higher inequality, pointing to a vicious cycle. Our results suggest that without policy measures, the COVID-19 pandemic will likely increase inequality, trigger social unrest, and lower future output in the years to come.

JEL Classification Numbers: D63; D74

Keywords: Covid-19, Pandemics, Inequality, Social Unrest

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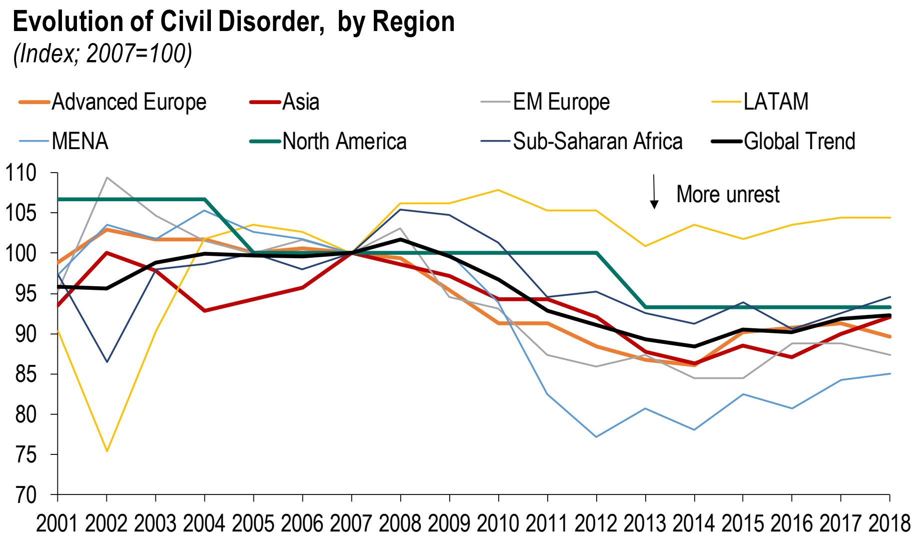
I. Introduction

Social unrest has become more widespread and more frequent over the past decade. Social unrest, measured by the civil disorder score from International Country Risk Guide (ICRG), increased by about 10 percent (or one standard deviation) since 2009 (Figure 1).[2] The aftermath of the Global Financial Crisis (GFC), with the slow recovery and rising inequality, left tens of millions of people behind with fading hope of climbing up the social ladder. Many took their frustration to the street, contributing to an elevated level of citizen activism 10 years after the crisis. In 2019, popular protests erupted in France and Greece in Europe, Hong Kong and India in Asia, Chile, Colombia and Bolivia in Latin America to Iran and Iraq in the Middle East. Though triggered by different events, ranging from rising transport costs to higher fuel prices, and specific demands vary by country, a common theme underlying the social discontent is reported to be stagnating living standards and inequality.

Figure 1. Social Unrest, 2001-2018



Source: ICRG

The COVID-19 pandemic is worsening existing socio-economic inequalities. The virus pushed economies into a Great Lockdown, which triggered the worst recession since the Great Depression (IMF, 2020a; Deb et al. 2020). The lockdown measures have taken a huge toll on the labor market, with surging unemployment and plunging labor force participation. Job losses are concentrated in industries with lower wages and among women and youth, indicating early signs of worsening distributional outcomes. At the same time, social unrest has decreased in recent months as mobility has declined. The recent widespread protests in the United States and across the world against police brutality and systemic racism, and in Lebanon are notable exceptions (IMF 2020d).

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[2] In this paper, we have changed the sign of the Civil Disorder, so an increase means higher social unrest.

Against this background, this paper explores the dynamics among past major pandemics, economic growth, inequality, and social unrest. It answers two main questions. Do pandemics lead to more social unrest? If so, what are the key channels?
To answer these questions, we apply two complementary econometric approaches to a sample of 133 countries from 2001 to 2018. First, using monthly data we estimate the impulse response of social unrest to pandemics with the local projection method (Jordà, 2005). We leverage the availability of both social unrest and pandemic data at high frequency and establish a direct link between exogenous pandemic events and civil disorder score at a monthly frequency. Second, using annual data we apply panel vector autoregressions (VAR) to explore the channels through which past major pandemics lead to social unrest in the medium term. In particular, we focus on inequality and economic growth as the two key channels.

The results from local projections show that social unrest increases about 14 months after pandemics on average. The direct effect peaks in about 24 months post-pandemic. The results from the panel VAR using annual data confirm that social unrest increases a year after pandemics. In addition, the panel VAR results suggest that pandemics contribute to social unrest by lowering economic growth and increasing inequality, measured by the Gini coefficient. The effect of pandemics on social unrest is also more persistent in the panel VAR model than in the local projections model. This is because lower growth, higher inequality and elevated social unrest reinforce each other, forming a vicious cycle. These results are consistent with earlier literature establishing that external shocks—such as deteriorations in the terms of trade—can lead to social instability and lower economic growth (Rodrik, 1999).

To the best of our knowledge, our finding that pandemics lead to social unrest by lowering growth and raising inequality is novel and contributes to two strands of literature. The first is the recent literature on the socio-economic effects of pandemics (for recent contributions, see Atkeson 2020; Barro et al. 2020; Deb et al. 2020; Eichenbaum et al. 2020; Gonzalez-Torres and Esposito, 2020; IMF 2020c; Jordà et al. 2020; Ma et al. 2020, Furceri et al. 2020). This literature points to large and persistent effects of pandemics on economic activities. In particular, Ma et al. (2020) examined the same set of episodes considered in our paper and found that real GDP is significantly lower on average across 210 countries in the year the outbreak is officially declared and remains below pre-shock level five years later. Furceri et al. (2020) provide evidence that major epidemics over the past two decades, even though much smaller in scale than COVID-19, have led to persistent increases in the Gini coefficient, raised the income share of higher-income deciles, and lowered the employment-to-population ratio for those with basic education compared to those with higher education. Gonzalez-Torres and Esposito (2020), focusing on Western Africa, document that Ebola outbreak has led to an increase in civil violence by more than 40 percent one year later and its effects on social unrest persist several years after the outbreak ended. While IMF (2020d) finds no significant short-term effects of pandemics on social unrest, Li and Coppo (2020) find that severe epidemics, that causes mortality rate above the 75 percentile of the world distribution of disaster mortality, increases the risks of riots and anti-government demonstration in the medium term.

The second strand of the literature is on the economic drivers of social unrest. Crises and economic shocks can lead to social unrest as shown in Miguel, Satyanath, and Sergenti (2004), and Vassallo (2019). The link between inequality and social unrest is less clear with competing theories. First, the grievance theory predicts that inequality should be associated with more social unrest among those with lower incomes, because relative deprivation can motivate people to engage in protest activities (e.g. Lipsky, 1968; Gurr, 1970; Boix, 2008). Second, the relative power theory has the opposite prediction: the poor are less likely to participate in non-violent protests when inequality rises (e.g. Solt, 2008). This is because the rich have more political resources that can be used to prevail in open debates on issues that divide primarily along income lines, and also to successfully prevent these issues from reaching the political agenda at all, and even to influence, persuade and convince poorer individuals to abandon their preferences on these issues entirely. Therefore, the impact of inequality on social unrest is ultimately an empirical question. The results in this paper suggest that greater inequality is associated with more social unrest on average. In another paper, Saadi Sedik and Xu (forthcoming) show that the effect of inequality on social unrest is nonlinear, being stronger when initial income inequality is high.

The remainder of the paper is structured as follows. Section II describes our data and econometric methods. Section III presents the key results. Section IV discusses the robustness checks. Section V concludes and provides policy implications.

II. Data and Econometric Methods

A. Data

Our measure of social unrest is the civil disorder score from the International Country Risk Guide (ICRG). This measure has three features that are essential for the analysis. First, the score is available on a monthly basis, which enables us to estimate the impact of pandemics on a high frequency basis. Second, the ICRG data are comparable across countries, well established and have been used widely in the empirical literature (e.g., Alesina, Tabellini, Trebbi, 2017; Cubeddu et al., 2019). Third, we take advantage of the availability of civil disorder on a monthly frequency to identify shocks in the panel VAR analysis and use the December score in the Cholesky decomposition. The original civil disorder score ranges from 0 to 4, with a higher score indicating less disorder. In all the analysis, we flip the sign of the variable so that an increase in the score indicates higher social unrest, which is more intuitive. Civil disorder variable is available for 133 countries from 2001 to the present.

We measure inequality by Gini coefficient from the Standardized World Income Inequality Database (SWIID 8.2), which combines information from the United Nations World Income Database (UNWIDER) and the Luxembourg Income Study (LIS). SWIID provides comparable estimates of income inequality for 175 countries from 1961 to the present. Other macro variables, including real GDP growth, come from World Development Indicators and the IMF's World Economic Outlook database (see Annex I for the definition and sources of the variables).

Following Ma et al. 2020 and Furceri et al. 2020, we focus on five major past pandemics: SARS in 2003, H1N1 in 2009, MERS in 2012, Ebola in 2014, and Zika in 2016. The most widespread one was H1N1 (Swine Flu Influenza), with more than 6,000,000 confirmed cases across 148 countries and about 19,000 fatalities. Excluding H1N1—which spread across all regions—the other four events are mostly confined to specific regions: (i) SARS and MERS in Asia; (ii) Ebola in Africa and (iii) Zika in the Americas (Table A1). In terms of average mortality rates (deaths/confirmed cases), Ebola and MERS were the most fatal, followed by SARS, Zika, and H1N1. The list of countries in our sample that are affected by each event is given in Table A2 in the Appendix. We construct a dummy variable, the pandemic event, which takes the value 1 when WHO declares a pandemic for the country and 0 otherwise. The pandemic events are constructed both on a monthly basis and on a yearly basis.

B. Local Projection Model

To leverage the monthly data on civil disorder and pandemics, we follow the method proposed by Jordà (2005) and estimate impulse response functions directly from local projections:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i^k + \beta^k D_{i,t} + \theta^k X_{i,t} + \varepsilon_{i,t+k} \quad (1)$$

where $y_{i,t}$ is our measure of social unrest (the negative of civil disorder rating from ICRG) for country *i* at time (month) *t;* α_i are country fixed effects, which take into account country characteristics that do not vary over the period of the study and that may affect both pandemics and social unrest. For example, they control for geography, climate, institutional history, ethnicity, culture, type of the government, and system of law; $D_{i,t}$ is a dummy variable indicating a pandemic event that affects country *i* at time *t*; $X_{i,t}$ is a vector that includes 1 to 24-month lags of the dependent variable. In the baseline specification, we do not control for other factors affecting social unrest as the occurrence of the pandemic events are unpredictable and exogenous to the economy. In other words, without the controls the coefficient β^k would still be unbiased (Jordà et al, 2020). Also, high-frequency data reduces the risks of omitted variable bias due to the exclusion of time (monthly)-varying confounding factors.

Equation (1) is estimated for an unbalanced panel of 133 countries over the period 2001-2018. We estimate the model for each horizon *k*=0,…,60 with monthly data. The database comprises of monthly civil disorder scores from ICRG and pandemic events identified on a monthly basis. Impulse response functions are computed using the estimated coefficients β^k, and the confidence bands associated with the estimated impulse-response functions are obtained using the estimated standard errors of the coefficients β^k, based on robust standard errors clustered at the country level.

The local projection model estimates the direct effect of pandemics on social unrest. However, it does not speak to the channels or potential feedback effects. To explore the channels through which pandemics lead to more social unrest, we estimate a panel VAR model using annual data. Since Gini and economic growth are not available on a monthly basis, exploring the channels by using a panel VAR is not feasible using monthly data.

C. Panel VAR Model

In addition to civil disorder and pandemics, we include economic growth and inequality and estimate a panel VAR model using annual data:

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + Y_{it-3}A_3 + D_{it}B + u_i + e_{it},\ i \in \{1,2,\dots,N\}, t \in \{1,2,\dots,T_i\} \quad (2)$$

where Y_{it} is a (1×3) vector of dependent variables, namely real GDP growth, change in inequality and civil disorder score. All three dependent variables pass the unit-root test for stationarity. The panel has 133 countries and annual data from 2001-2018. D_{it} is the dummy variable for pandemic events. u_i denotes country fixed effect. We plot cumulative orthogonalized impulse responses to show dynamics responses to a shock in each variable. Confidence bands (90 percent) are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. In the baseline, we assume the following ordering of the Cholesky decomposition among the endogenous variables to identify shocks (from the most to the least exogenous): real GDP growth, disposable income Gini and civil disorder. We take advantage of the availability of civil disorder on a monthly frequency and use the December score to reduce the likelihood that civil disorder contemporaneously impacts growth and inequality. We gauge robustness of the results to different ordering of the variables in Section IV. The dummy variable for pandemic events is assumed to be exogeneous.

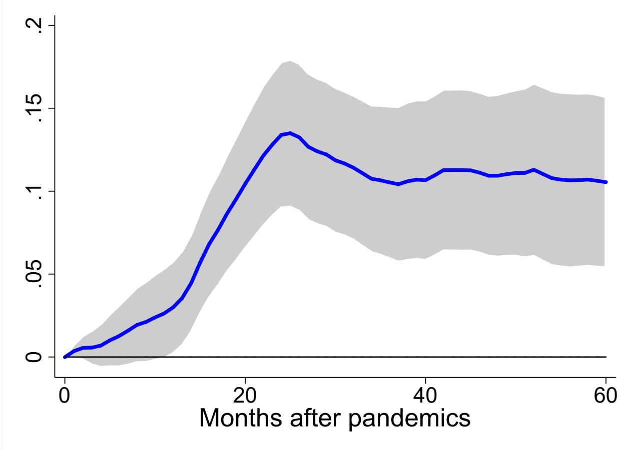
III. Effect of Pandemics on Social Unrest

A. Social Unrest Increases after Pandemics

Figure 2 shows the estimated response of civil disorder score to a pandemic event over a five-year period following the event, with the 90 percent confidence interval around the point estimate. Pandemic events lead to significantly higher risk of civil disorder after 14 months. Five years after the pandemic, civil disorder is about 0.1 point higher than the pre-shock level. Given that civil disorder scores are between 0 and 4, the effect is quantitatively important. It corresponds to approximately ¼ standard deviation of the average change of civil disorder score in the sample. Putting it differently, the impact represents a seven percent increase from the mean of the sample.[3]

[3] Even though pandemic events are exogenous, as robustness check we tried a bivariate panel VAR using monthly data. The impulse response of social unrest to pandemic events is broadly consistent with the results from local projections.

Figure 2. Impact of Pandemic on Civil Disorder



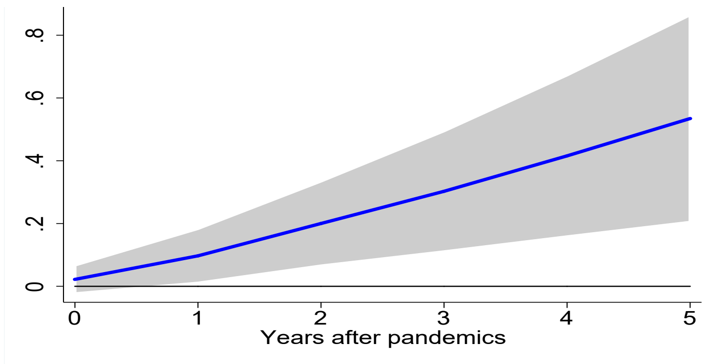
Note: The impulse response functions are estimated using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands. The x-axis shows months after pandemic events: t=0 is the start of the pandemic event. Estimates are based on $y_{i,t+k} - y_{i,t-1} = \alpha_i^k + \beta^k D_{i,t} + \theta^k X_{i,t} + \varepsilon_{i,t+k}$. $y_{i,t}$ is the civil disorder rating for country *i* in month *t*, where a high score indicates more civil disorder; α_i are country fixed effects; $D_{i,t}$ is a dummy variable indicating a pandemic event that affects country *i* in month *t*. $X_{i,t}$ is a vector that includes 1 to 24-month lags of the dependent variable. Standard errors are clustered at the country level. See Table A2 for the full list of pandemic events.

B. Transmission Channels: Growth and Inequality

Estimates from the panel VAR model shed light on the channels through which pandemics lead to social unrest. We present the cumulative impulse response functions with 90 percent confidence bands. First, we confirm the results of the local projection model that uses monthly data. Risk of civil disorder increases significantly one year after the pandemic event, as shown in Figure 3. The effect is also persistent over time. Five years after the pandemic, civil disorder score goes up by 0.5 (out of 4), which is about one standard deviation of the average change of the civil disorder score. In other words, the impact represents 18 percent increase from the mean of the sample.

In the short run, the impact estimated from the panel VAR using annual data has similar magnitude to that estimated using monthly data. Beyond two years, the direct impact of pandemics flattens out in the local projections model, whereas the estimated impact in the panel VAR model is persistent. This reflects the long-lasting impact of higher inequality and depressed growth in triggering social unrest and the feedback loop captured by the VAR model.

Figure 3. Impact of Pandemic Events on Civil Disorder

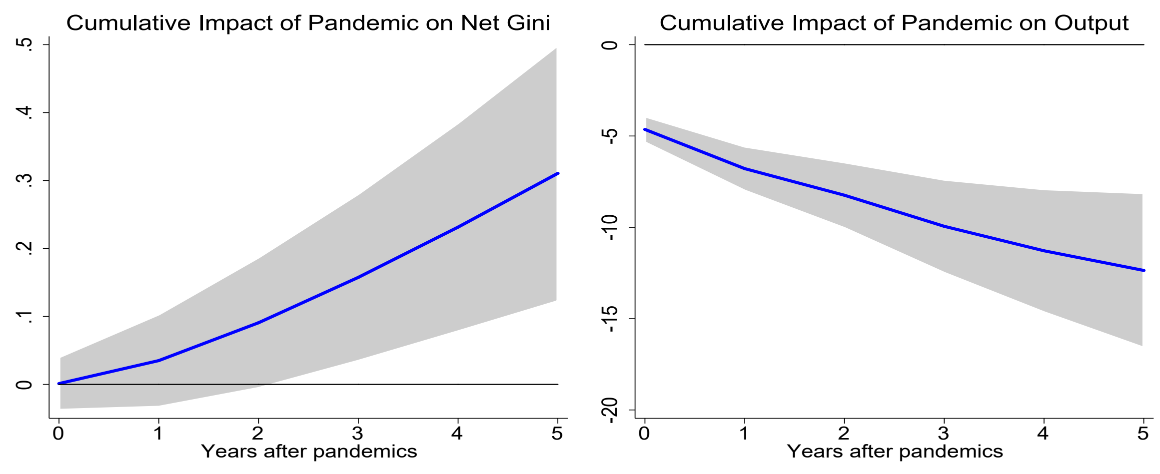


Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables (from most to least exogenous) are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Second, inequality increases and output is significantly lower following pandemic events, as shown in Figure 4. In particular, net Gini increases significantly two years after the pandemic events, and the effect is persistent. Five years after the pandemic, net Gini goes up by 0.3, which is about one standard deviation of the average change of net Gini in the sample. The marginal impact of pandemics on net Gini is still significant after five years, suggestion even higher impact over the long term. Our results are similar to those in Furceri et al (2020) that finds that net Gini increases by about 1.2 percent after pandemics over the medium term.[4] The effect of pandemic on output is immediate, with output lowering by 4.6 percent in the pandemic year. Five years after the pandemic, while the marginal impact fades, cumulative output loss is still about 10 percent.

[4] The average of net Gini in our sample is 38. A 1.2 percent increase is roughly 0.45 increase in net Gini, which is similar to the 0.3 increase we estimated.

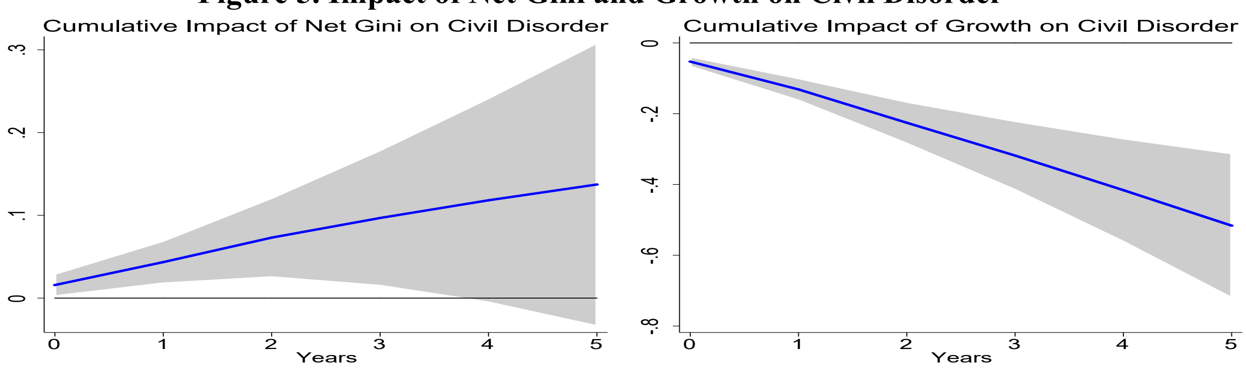
Figure 4. Impact of Pandemics on Net Gini and Output



Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Output is in percentage, and net Gini ranges from 0-100. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables (from most to least exogenous) are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Third, Figure 5 shows that risk of civil disorder increases with greater inequality and lower economic growth. The risk of civil disorder increases significantly after a one standard deviation increase in net Gini (left). Civil disorder also increases substantially after a negative growth shock and the effect is persistent (right). Figure 4 and Figure 5 together suggest that greater inequality and lower growth are two channels through which pandemics lead to more social unrest.

Figure 5. Impact of Net Gini and Growth on Civil Disorder

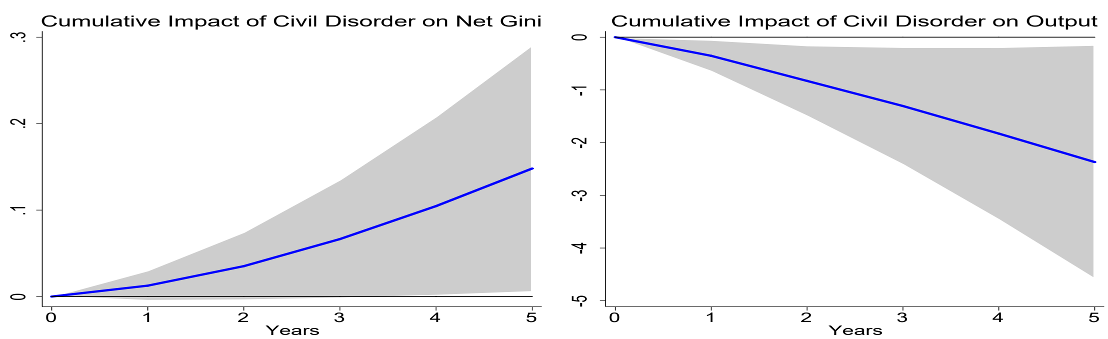


Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after the shock. Growth is in percentage, and net Gini ranges from 0-100. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables (from the most to least exogenous) are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

C. The Specter of a Vicious Cycle

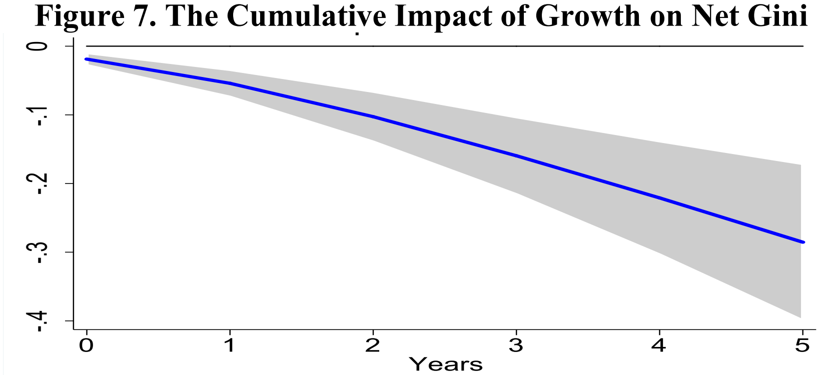
Our results from the panel VAR point to a potential vicious cycle that can be triggered by a pandemic event. Figure 6 shows that an increase in social unrest is followed by higher inequality and lower output. Figure 7 shows that higher growth is associated with lower net Gini and the impact is persistent. Therefore, weaker growth and higher inequality can be associated with more social unrest, creating a vicious cycle. These results are consistent with earlier literature establishing that external shocks—such as deteriorations in the terms of trade—can lead to social instability and lower economic growth (Rodrik, 1999). More recently, Hadzi-Vaskov, Pienknagura Loor, and Ricci (forthcoming) show that economic activity declines following spikes in social unrest, with GDP remaining on average ¼ percentage point below the pre-shock baseline after 6 quarters, as social unrest lowers confidence and raises uncertainty.

Figure 6. Impact of Civil Disorder on Net Gini and Output



Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after the shock. Output is in percentage, and net Gini ranges from 0-100. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables (from the most to least exogenous) are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure 7. The Cumulative Impact of Growth on Net Gini



Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after the shock. Growth is in percentage, and net Gini ranges from 0-100. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables (from the most to least exogenous) are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

IV. Robustness Checks

We use a battery of robustness checks. First, we gauge robustness of different orderings for the Cholesky decomposition. Since pandemic dummy is exogeneous in the panel VAR, its impact is not affected by the ordering of endogenous variables. The impulse response functions of net Gini and growth on civil disorder are robust to alternative orderings, as shown in Figure A1.

Second, we control for year fixed effects. Given that the pandemic variable is a dummy, we do not include time-fixed effect in the baseline regressions because it will absorb the effect of pandemic events that are more widely spread. For instance, if we had COVID-19 data, a year dummy for 2020 would be perfectly correlated with the COVID pandemic event. This is the case for H1N1 pandemic where most countries in our sample were impacted. The results with time fixed effects are broadly similar to the baseline scenario, although the estimates are less precise (see Figure A2 in the Appendix).

Third, the results are robust when we control for time trend, global conditions proxied by US growth rate and oil prices, or exclude H1N1 pandemic (Figures A3-A5). The results for other variables are also qualitatively similar. We also included unemployment as an additional channel in the panel VAR model and the results are consistent (Figure A6).

Fourth, we proxy the intensity of pandemics using the number of deaths in each country at each pandemic event as in Furceri et al. (2020). This is not included in the baseline analysis because the number of deaths and infections could be endogenous to inequality and economic conditions. Figure A7 shows that a one unit increase in the log(deaths) is associated with a 0.2 (or about ½ standard deviation) increase in civil disorder five years after a pandemic. Note that the magnitude of the effect is not directly comparable to the baseline results, where the impulse response function is based on the pandemic dummy variable.

V. Conclusions

The COVID-19 pandemic has devastated the global economy and is likely to increase inequality in the years to come. We established that past pandemics, even though much smaller in scale than COVID-19, have significantly contributed to social unrest through their impact on economic growth and inequality. Specifically, we provide evidence that pandemics tend to depress economic growth and increase inequality, and both lower growth and greater inequality are important drivers of social unrest. Furthermore, social unrest, in turn, is associated with output loss and with higher inequality, suggesting a vicious cycle. Our results would imply a heightened risk of social unrest post COVID-19 unless swift and bold policies are implemented to protect the most vulnerable group in the society.

Policymakers need to pay special attention to preventing scarring effects on the livelihoods of the least advantaged in society. Absent strenuous and targeted attempts, we are again likely to see an increase in inequality, which was already "one of the most complex and vexing challenges in the global economy" (Georgieva 2020). Unemployment benefits and improved health benefits, such as sick leaves, are useful for all in dealing with the effects of the pandemic but particularly so for the poorer segments of society who lack a stock of savings and are thus living hand-to-mouth (Furceri, Loungani, and Ostry, 2020). Where informality is pervasive, cash transfers may be the best response. These extraordinary circumstances also provide an opportunity to address longstanding inequalities—in access to health and basic services, finance, and the digital economy—and to enhance social protection for informal workers (Dabla-Norris and Rhee, 2020).

Our results motivate future research in several aspects. First, the effect of pandemic events on social unrest is likely to vary across countries, depending on country-specific characteristics such as the level of development and the quality of institutions, as well as the capacity to respond to pandemics. The effects also likely depend on policy responses and how pandemics are managed. Second, beyond the averages, the dynamics among pandemic events, economic growth, inequality, and social unrest could be more complex. For example, some of these relationships could be nonlinear. Indeed, Saadi Sedik and Xu (forthcoming) show that the effect of inequality on social unrest is nonlinear, being stronger when initial income inequality is high. Furthermore, the impact of inequality on social unrest could depend on the extent of redistribution: an increase in inequality is associated with more unrest when redistributive transfers are low.

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APPENDIX

Table A1. Data Sources and Descriptive Statistics.

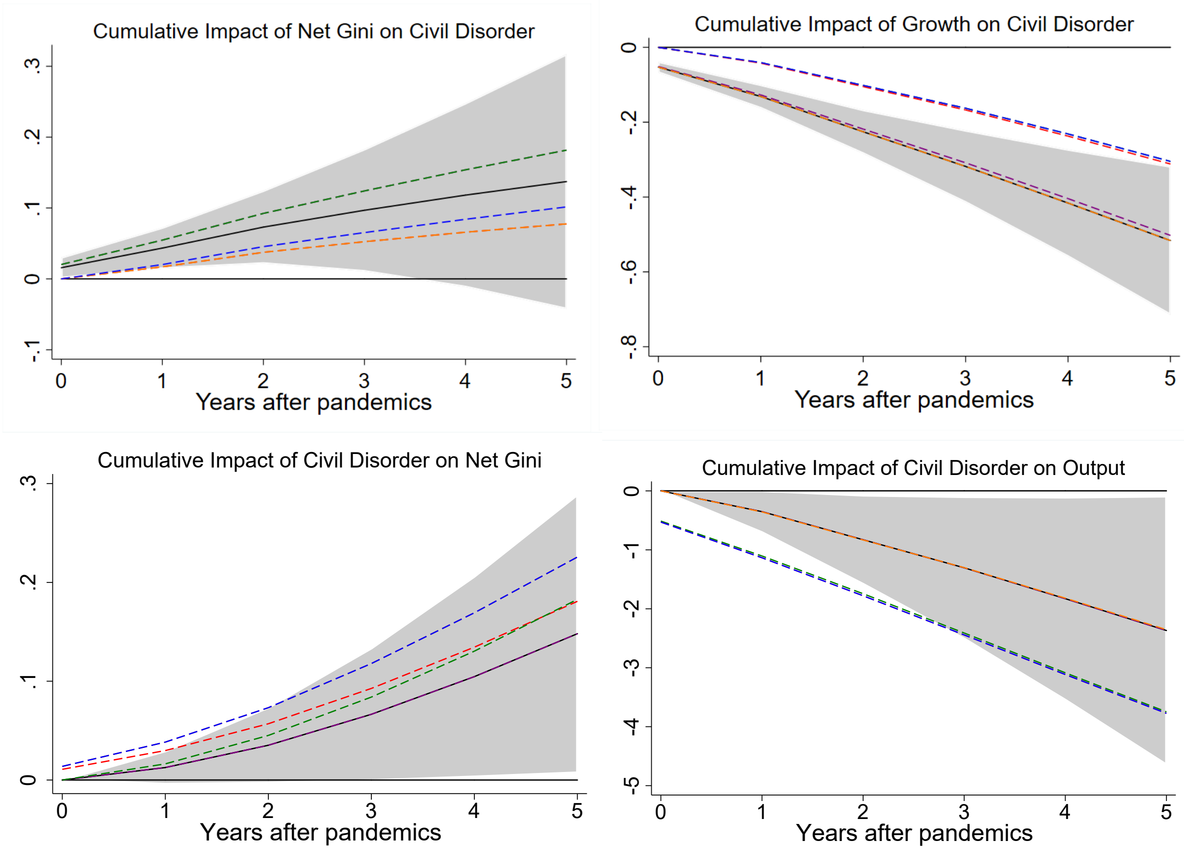
Variable	Source	Obs	Mean	Std. Dev.
Main sample: 133 countries, 2001-2018				
Civil (Dis)order	ICRG	2030	2.71	0.59
Real GDP growth	WEO (2020)	2030	3.90	4.10
Net gini	SWIID 8.2	1904	38.04	8.47
Number of Confirmed Cases	Furceri et al. (2020)	1971	3412	82638
Number of deaths	Furceri et al. (2020)	1971	13	157

Table A2. List of Pandemic and Epidemic Episodes

Starting year	Event Name	Affected Countries	Number of countries
2003	SARS	AUS, CAN, CHE, CHN, DEU, ESP, FRA, GBR, HKG, IDN, IND, IRL, ITA, KOR, MNG, MYS, NZL, PHL, ROU, RUS, SGP, SWE, THA, TWN, USA, VNM, ZAF	27
2009	H1N1	AFG, AGO, ALB, ARG, ARM, AUS, AUT, BDI, BEL, BGD, BGR, BHS, BIH, BLR, BLZ, BOL, BRA, BRB, BTN, BWA, CAN, CHE, CHL, CHN,CIV, CMR, COD, COG, COL, CPV, CRI, CYP, CZE, DEU, DJI, DMA, DNK, DOM, DZA, ECU, EGY, ESP, EST, ETH, FIN, FJI, FRA, FSM, GAB, GBR, GEO, GHA, GRC, GTM, HND, HRV, HTI, HUN, IDN, IND, IRL, IRN, IRQ, ISL, ISR, ITA, JAM, JOR, JPN, KAZ, KEN, KHM, KNA, KOR, LAO, LBN, LCA, LKA, LSO, LTU, LUX, LVA, MAR, MDA,MDG, MDV, MEX, MKD, MLI, MLT, MNE, MNG, MOZ, MUS, MWI, MYS, NAM, NGA, NIC, NLD, NOR, NPL, NZL, PAK,PAN, PER, PHL, PLW, PNG, POL, PRI, PRT, PRY, QAT, ROU, RUS, RWA, SAU, SDN, SGP, SLB, SLV, STP, SVK, SVN, SWE, SWZ, SYC, TCD, THA, TJK, TON, TUN, TUR, TUV, TZA, UGA, UKR, URY, USA, VEN, VNM, VUT, WSM, YEM, ZAF, ZMB, ZWE	148
2012	MERS	AUT, CHN, DEU, EGY, FRA, GBR, GRC, IRN, ITA, JOR, KOR, LBN, MYS, NLD, PHL, QAT, SAU, THA, TUN, TUR, USA, YEM	22
2014	Ebola	ESP, GBR, ITA, LBR, USA	5
2016	Zika	ARG, BOL, BRA, CAN, CHL, COL, CRI, DOM, ECU, HND, LCA, PAN, PER, PRI, PRY, SLV, URY, USA	18
		Total Pandemic and Epidemic Events	**220**

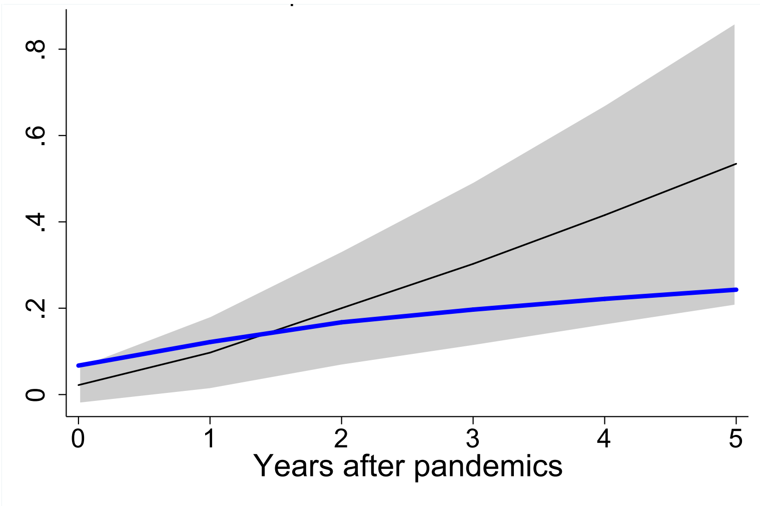
Source: Based on Ma and others (2020).

Figure A1. Impulse Response Functions with Different Ordering of Variables



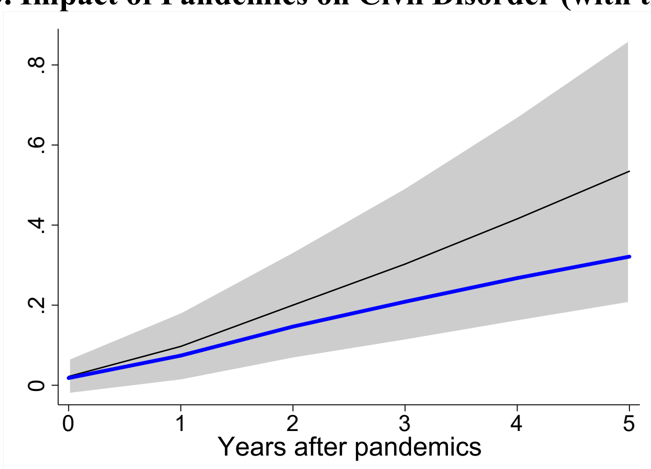
Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The dashed lines show the impulse response of the panel VAR model with the other five alternative orderings in Cholesky decomposition. The dashed lines lie within the confidence bands of the baseline effect. For growth, while the impulse responses are outside the confidence band when civil disorder is ordered first, they are statistically significant with 90 percent confidence bands. The different size of the impulse responses could be explained by the fact that we use the December rating of civil disorder, which should not affect growth contemporaneously. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure A2. Impact of Pandemics on Civil Disorder (with year FE)



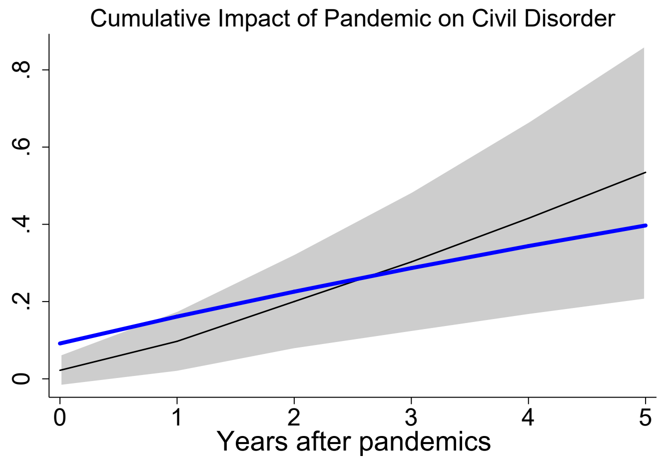
Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The blue line shows the impulse response of the panel VAR model with year fixed effects. The blue line lies within the confidence bands. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects and year fixed effects are controlled for and standard errors are clustered at the country level.

Figure A3. Impact of Pandemics on Civil Disorder (with time trend)



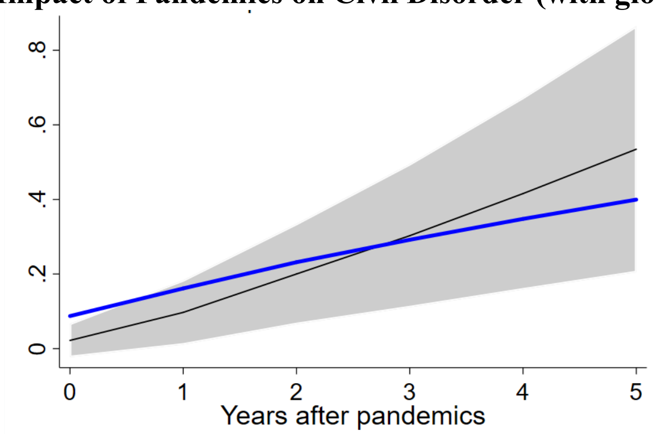
Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The blue line shows the impulse response of the panel VAR model with time trend. The blue line lies within the confidence bands. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure A4. Impact of Pandemics on Civil Disorder (without H1N1)



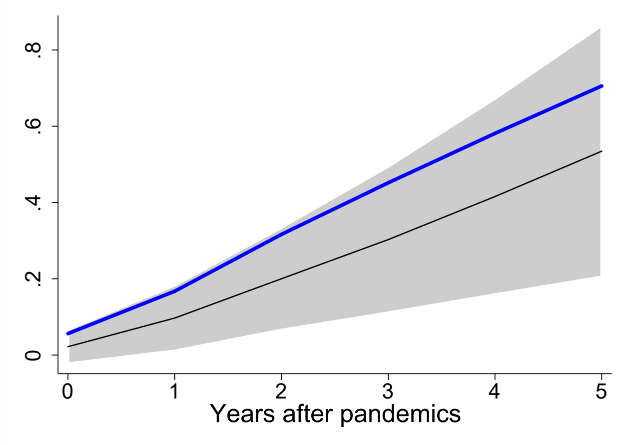
Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The blue line shows the impulse response of the panel VAR model excluding H1N1 from pandemic episodes. The blue line lies within the confidence bands. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure A5. Impact of Pandemics on Civil Disorder (with global controls)



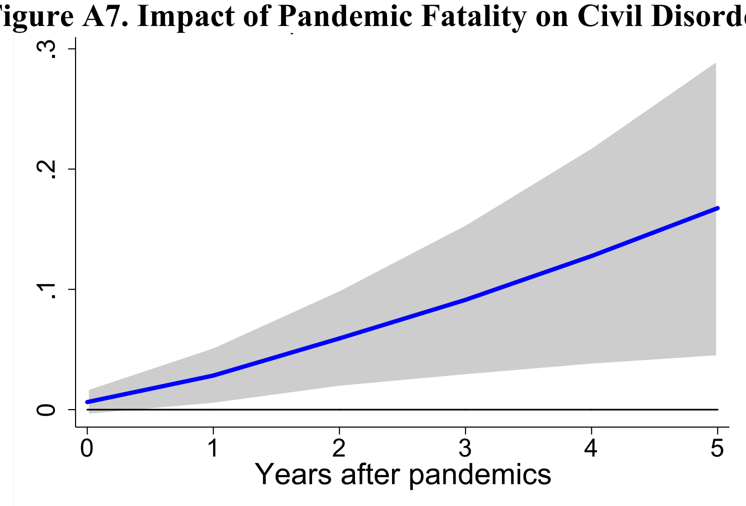
Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The blue line shows the impulse response of the panel VAR model with global controls, i.e. the US growth rate and oil prices. The blue line lies within the confidence bands. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure A6. Impact of Pandemics on Civil Disorder (with unemployment)



Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The black line and shaded area show the responses and 90 percent confidence bands of the baseline panel VAR model, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The blue line shows the impulse response of the panel VAR model with changes in unemployment rate as an additional endogenous variable. The blue line lies within the confidence bands. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The four endogenous variables are real growth, change in unemployment rate, change in net Gini, and civil disorder. The pandemic dummy is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.

Figure A7. Impact of Pandemic Fatality on Civil Disorder



Note: The impulse response functions are estimated from Equation (2) using a sample of 133 countries over the period of 2001-2018. The graph shows the responses and 90 percent confidence bands, which are estimated using Gaussian approximation based on 200 Monte Carlo draws from the fitted panel VAR model. The x-axis shows years after pandemic events: t=0 is the year of the pandemic event. Estimates are based on the orthogonalized impulse response functions of the panel VAR model. The three endogenous variables are real growth, change in net Gini, and civil disorder. The logarithm of pandemic-related deaths is an exogenous covariate in the panel VAR. Country fixed effects are controlled for and standard errors are clustered at the country level.