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Authorized for distribution by Jonathan D. Ostry

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Abstract

While the COVID-19 pandemic is affecting all countries, output losses vary considerably across countries. We provide a first analysis of robust determinants of observed initial output losses using model-averaging techniques—Weighted Average Least Squares and Bayesian Model Averaging. The results suggest that countries that experienced larger output losses are those with lower GDP per capita, more stringent containment measures, higher deaths per capita, higher tourism dependence, more liberalized financial markets, higher pre-crisis growth, lower fiscal stimulus, higher ethnic and religious fractionalization and more democratic regimes. With respect to the first factor, lower resilience of poorer countries reflects the higher economic costs of containment measures and deaths in such countries and less effective fiscal and monetary policy stimulus.

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Author's E-Mail Address: DFurceri@imf.org; michael.ganslmeier@spi.ox.ac.uk; JOstry@imf.org; NYang@imf.org

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I. INTRODUCTION

The magnitude of the COVID-19 recession is unprecedented, and easily dwarfs the blow from the Global Financial Crisis (IMF, 2020). Initial output losses, however, vary considerably across countries. Figure 1a shows, for a sample of 60 advanced, emerging and developing economies, a density plot of growth in the first semester of 2020 minus the IMF pre-pandemic growth forecast. While all countries had a negative surprise, there is considerable variation. Unexpected growth is but a few percentage points in Korea but ranges to more than 30 percentage points in Peru. Such heterogeneity is also evident when comparing first semester growth in 2020 versus 2019 (Figure 1b).

What drives this heterogeneity? Because the pandemic is foremost a health crisis, a natural candidate is the severity of health-related factors measured for example by: deaths per capita; degree of health preparedness; and stringency of containment. These factors, however, explain only a small fraction of observed output performance (Figure 2), suggesting the researcher need look elsewhere for a fuller explanation.

Assessing which factors drive the heterogeneous outcomes is not an easy task, for three interrelated reasons. First, the number of observations is relatively small and limited by the number of countries with available quarterly data. Second, the number of potential factors affecting economic resilience is large. Third, many of the country characteristics are correlated with one other: the level of regulation in product and financial markets is likely to be correlated with the level of development, for example (Alesina et al., 2020).

We address these issues by considering a large set of explanatory variables and analyzing all the regressors jointly by averaging outcomes for all possible combinations of regressors (more than 1.07 billion regressions) using model-averaging techniques: Weighted Average Linear Squared (WALS) developed by Magnus, Powell, and Prüfer (2010); and Bayesian Model Averaging (BMA) developed by Fernandez, Ley and Steel (2001a). WALS and BMA share similar foundations. There are two main differences. First, WALS relies on a preliminary orthogonal transformation of the auxiliary regressors and their parameters, whose advantage is to increase speed of computation. Second, while WALS uses a Laplace distribution to reduce the risk of excessive influence of the prior on final estimates, BMA uses a Gaussian distribution prior for the auxiliary parameters. Reflecting these tradeoffs, we use WALS as our baseline technique, and adopt the BMA as a robustness check.

We focus on the acute phase of the crisis because most countries are already recording positive growth in the third quarter of 2020 and the factors affecting recovery are different from those driving the downturn.[1] We consider two measures of output performance: (i) actual growth in the first semester of 2020 minus the January 2020 IMF growth forecast for this period; and (ii) growth in the first semester of 2020 minus the growth rate for the first semester of 2019.

We find that larger output losses are experienced by countries with lower GDP per capita, more stringent containment, higher deaths per capita, a larger tourism share, more liberalized credit markets, higher pre-crisis growth, and more democratic regimes. We also find that lower fiscal stimulus and higher social fractionalization are positively correlated with one measure of output loss. GDP per capita is particularly important: a country at the 75th percentile of the per capita GDP distribution (such as Portugal) has a 7-percentage-point smaller growth surprise than a country at the 25th percentile (such as Bangladesh). This result reflects higher economic costs of containment and deaths in poorer countries and less effective macro policy stimulus.

Our paper contributes to two strands of the literature. The first is on resilience following major crises such as the GFC: Rose (2011); Rose and Spiegel (2010, 2011, 2012); Giannone, Lenza and Reichlin (2011); Obstfeld et al. (2009); Blanchard et al. (2010); Devereux and Dwyer (2016). In contrast to these studies, we do not find that trade and financial openness have been important drivers of output surprises in our study. The second is on use of Bayesian model-averaging techniques in the macroeconomic literature, including studies focusing on robust drivers of growth (e.g., Fernandez et al., 2001b; Brock and Durlauf, 2001; and Sala-i-Martin et al., 2004), inequality (Furceri and Ostry, 2019) and reforms (Duval, Furceri and Mieithe, 2020).

The rest of the paper is structured as followed. In Section II, we provide an overview of our empirical approach. In Section III, we introduce potential determinants of COVID-19 output losses. In Section IV, we summarize these results and provide an overall assessment of the statistical robustness of the determinants. Sections V concludes, highlighting policy implications and issues for future research.

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[1] While for many countries the peak of the economic crisis was observed in the second quarter, the pandemic had inflicted significant human losses already in the first quarter of 2020 for most countries in our sample. In addition, most countries had already introduced travel restrictions—one important factor behind output losses for countries relying on tourism—in response to the initial outbreak in China and Asia (Deb et al. 2020a). Finally, by including the first quarter, we also take into account potential growth spillovers from the downturn in China in the first quarter. As we show in the robustness checks, the results are similar when restricting the analysis to the second quarter of 2020.

II. Empirical Framework

Although there is a voluminous literature on the determinants of economic recessions, cross-sectional information has not been fully exploited to study the drivers of the COVID-19 recession, and theory provides little guidance on appropriate model specification. Therefore, we start from a simple linear reduced from specification:

$$Y_i = \alpha + \beta X_i + \mu_i \quad (1)$$

where X is a vector of k covariates reflecting characteristics of economy i along different dimensions, and Y is a measure of output performance. Such an approach needs to confront two econometric challenges: (i) the large number of potential explanatory factors and correlation among them; and (ii) lack of an a priori "true" statistical model to test. With an unknown true model, the number of possible independent variables is very large. Depending on the model selection procedure, conclusions could vary significantly.

To meet these concerns, the literature has turned to model-averaging techniques.[2] Model-averaging addresses the challenges by: (i) running the maximum combination of models; and (ii) providing estimates that take into account the performance of each potential driver not only in the final "reported" model but over the whole set of possible specifications. Formally, assuming that we are faced with M different models and that β_x is the coefficient related to variable X in each model, a final estimate of β_x is computed as $\beta_x = \sum_1^M \omega_i \beta_{x,i}$, where the weights ω_i denote a measure of goodness of fit of each model.

In this paper, we rely on two model-averaging techniques: Weighted Average Linear Squares (WALS) developed by Magnus, Powell, and Prüfer (2010), and Bayesian Model Averaging (BMA) developed by Fernandez, Ley and Steel (2001a). WALS and BMA share similar foundations. There are, however, two main differences. First, WALS relies on a preliminary orthogonal transformation of the auxiliary regressors and their parameters. The key

[2] Fernandez et al. (2001b), Brock and Durlauf (2001) and Sala-i-Martin et al. (2004) used BMA to investigate robustness of growth determinants in cross-country regressions. Furceri and Ostry (2019) used BMA to identify robust determinants of income inequality across and within-countries. Duval, Furceri and Mieithe (2020) used Bayesian averaging of maximum likelihood estimates (BAMLE) to identify robust drivers of structural reforms.

advantage of this transformation is that the space over which model selection is performed rises linearly rather than exponentially with model size as in BMA (2^{K2} where $K2$ is the number of "auxiliary" regressors to be tested). Second, while WALS uses a Laplace distribution to reduce risks of excessive influence of the prior on final estimates, BMA uses a Gaussian prior for the auxiliary parameters (see Annex B). Reflecting these considerations, we use WALS as our baseline technique, and adopt BMA as a robustness check.

To decide which regressors are robust determinants of output loss, we follow the literature. For WALS, Magnus, Powell, and Prüfer (2010) suggest using a threshold value of the t-statistic—greater than 1 (in absolute value)—to determine that a regressor is robust. Using such a threshold means including regressors which improve the model fit (measured by the adjusted R^2) and the precision of the estimators measured by the MSE. For BMA, the procedure involves estimating the posterior probability that a given variable belongs in the "true" model and selecting variables with high posterior probabilities as the robust determinants.

While model averaging addresses model uncertainty and omitted variable bias, it does not address reverse-causality issues—where event studies may be appropriate. While reverse causality is not an issue for many of the more structural characteristics used in our analysis, it may be a valid concern for policies implemented in response to the pandemic.

III. Potential Determinants

Variable selection is driven to an important extent by data availability. Given the small number of quarterly GDP growth observations (96), we constrain the choice and number of variables so that we are left with enough degrees of freedom for estimation. The set of regressors in the baseline includes 30 variables grouped into six categories: (i) Public health; (ii) Sectoral composition; (iii) Fiscal and monetary response; (iv) Macroeconomic characteristics; (v) Regulation; and (vi) Development level, Demographics and Institutions. In the robustness section, where we extend the set of regressors to 34, the results based on the more limited (full-model) sample of 48 observations are qualitatively similar but less precise. Data sources and key descriptive statistics are reported in Table A1 of Annex A.

A. Public Health Indicators

Countries with higher per capita deaths should experience greater output losses through reduced labor supply and greater demand-reducing social distancing (Maloney and Taskin, 2020). Hasell (2020) finds a negative relationship between deaths per capita and year-over-year growth in the second quarter of 2020, supporting this prior. Stringency of non-pharmaceutical (containment) measures, designed to avoid overwhelming the medical system while effective treatments and vaccines are developed, is associated with short-term output loss. Main measures include: (i) school closures; (ii) workplace closures; (iii) cancellation of public events; (iv) restrictions on size of gatherings; (v) closures of public transport; (vi) stay-at-home orders; (vii) restrictions on internal movement; (viii) restrictions on international travel.[3] Likewise, countries with better health systems in terms of epidemic management and prevention are expected to suffer smaller economic losses (Deb et al. 2020b).

To test the empirical relevance of these factors, we use the following three variables: (i) log of deaths per capita—cumulative deaths as of June 30 relative to population; (ii) the containment stringency index from the Oxford Coronavirus Government Response Tracker, normalized from 0 to 1;[4] and (iii) the Global Health Security Index from Johns Hopkins University.[5] Figure 2 presents scatter plots between these measures and our first measure of output loss (the second measure is shown in the Appendix). Output loss is larger for countries with higher mortality and containment, while no relation is found with the Health Security Index, or any of its sub-indicators. OLS and WALS regressions confirm these findings (Table 1).

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[3] A growing economic literature has looked at the economic impact of containment measures using high-frequency indicators: Carvalho et al. (2020); Chronopoulos, Lukas, and Wilson (2020); Deb et al. (2020a); Demirgüç -Kunt, Lokshin, and Torre (2020); Baek et al. (2020); Baker et al. (2020); Béland, Brodeur, and Wright (2020); Chernozhukov, Kasahara, and Schrimpf (2020); Coibion, Gorodnichenko and Weber (2020); Gupta et al. (2020).

[4] The Oxford Coronavirus Government Response Tracker collects information on government policy responses across the eight dimensions given above. The database scores the stringency of each measure ordinally, for example, depending on whether the measure is a recommendation or a requirement and whether it is targeted or nationwide. We normalize each measure to range between 0 and 1 to make them comparable.

[5] Index based on health scores for the following six categories: (i) prevention of the emergence or release of pathogens; (ii) early detection and reporting for epidemics of potential international concern; (iii) rapid response to and mitigation of the spread of an epidemic; (iv) sufficient and robust health system to treat the sick and protect health workers; (v) commitments to improving national capacity, financing plans to address gaps, and adhering to global norms; and (vi) overall risk environment and country vulnerability to biological threats.

B. Industry Shares

Recessions tend to have heterogenous effects across industries. Evidence from past recessions and financial crises in advanced economies suggests that finance and manufacturing tend to contract more than other sectors during downturns (Aaronson, Rissman, and Sullivan, 2004; Furceri et al., 2020), while services tend to be more resilient (Kopelman and Rosen, 2016). However, because this crisis is foremost a health crisis and has been met with strong containment measures, high-contact sectors (such as tourism and retail) and non-teleworkable industries (mining, manufacturing, and construction) have been the ones to experience relatively large drops in activity (Stephany et al., 2020).

To test the role of sectoral composition, we consider three indicators (for 2019) from the World Development Indicators: shares of services, manufacturing, and tourism in value added (we exclude agriculture to avoid perfect collinearity). The scatter plot in Figure 3, as well as the OLS and WALS results reported in Table 2, confirm that services, and particularly tourism, have been hit the hardest during this crisis.

C. Fiscal and Monetary Policies

Governments and central banks have implemented unprecedented support measures in response to the pandemic. As of June 30, 2020, more than 90 countries had announced fiscal packages ranging in size from 1 to 23 percent of GDP (IMF's Covid-19 Policy Tracker). In addition, monetary policy rates have been cut in 97 countries from December 2019 to-June 2020 and many central banks have deployed unconventional tools. Preliminary evidence suggest that these measures have been effective in reducing the depth of the recession, especially in advanced economies where fiscal multipliers are higher and monetary policy transmission is more effective (Faria-e-Castro, 2020; Jinjarak et al., 2020; Fornaro and Wolf; Bayer et al., 2020).

To test the role of policy stimulus, we use the IMF's Covid-19 Policy Tracker measures of: (i) total fiscal stimulus (above and below the line) deployed (or announced); (ii) the cumulative change in the policy interest rate from December 2019 to June 2020; (iii) the amount of liquidity (in percent of GDP) injected by central banks from December 2019 to June 2020. Figure 4 shows that only policy rate cuts seem to be associated with lower output loss. Moreover, none of the variables is statistically significant when performing OLS and WALS regressions (Table 3). While lack of significance could be due omitted variable bias or reverse causality—as

countries may provide more support in response to weak activity, it could also reflect the lack of a causal impact for two reasons: first, some of the fiscal measures have been announced but not yet implemented; and second, it may take time for policy stimulus to affect activity. In addition, it is likely that impacts are heterogeneous across countries, an issue explored below.

D. Regulation

Labor and product market regulations can affect realized output losses given the shifts of labor across industries in response to the pandemic. Evidence from past recessions and financial crises suggest that countries with more flexible product and labor market regulations are more resilient (Eichhorst et al., 2010; Artha and de Haan, 2011; Bernal-Verdugo et al., 2012; Bluedorn et al., 2019).[6] The relationship between resilience and credit market regulation is less settled. While liberalized markets contribute to financial depending and lower volatility (Beck and Demirguc-Kunt, 2009), in the short term they may amplify volatility: Caprio and Honohan (2002) find that banking systems less subject to monitoring exhibit more procyclicality; Giannone et al. (2011) find a negative correlation between credit market liberalization and output growth during the GFC.

To test the role of regulatory variables, we consider the most recent observation (typically, 2019) for the following indicators from the Fraser Institute Index of Economic Freedom: (i) credit market deregulation, which includes ownership of banks, competition, and extension of credit; (ii) labor market deregulation, a composite index of hiring and firing practices; (iii) business deregulation, which assesses difficulty in starting a new business, including administrative rules and government bureaucracy.[7] The indicators range from 0 to 10, with higher values indicating less regulation.[8] The scatter plots in Figure 5, as well as the WALS

[6] Another channel through which more flexible labor market can reduce the depth of the COVID-19 recession is by amplifying the effectiveness of fiscal stimulus (Cacciatore et al., 2020).

[7] We use the Fraser Institute dataset as it provides a greater country and time coverage than alternatives. The results are similar when using the indicators in Alesina et al. (2020)—see Table 10.

[8] The indicator of credit market regulation covers private ownership of banks, exposure to foreign competition, depth of private credit, and interest rate controls. The labor market indicator covers minimum wage regulation, hiring and firing practices, centralization of collective bargaining, unemployment benefits, and use of military conscription. Business regulation includes price controls, regulations for starting new businesses, government bureaucracy, import and export permits and exchange controls, tax assessments, and police protection.

results in Table 4, confirm that countries with freer financial markets are less resilient. In contrast, we do not find robust significant relationship between other regulatory measures and both measures of output performance.

E. Macroeconomic characteristics

Macroeconomic fundamentals can play a substantial role in mitigating output losses during a crisis. One reason is that crises usually come with excess volatility and increases in uncertainty (Ahir et al., 2018) which can lead to significant outflows of capital in countries with large imbalances (McQuade and Schmitz, 2017; Aizenman and Pasricha, 2010). Domestic imbalances, such as a high debt-to-GDP ratios, can also affect resilience by reducing fiscal space, and constraining counter-cyclical policies (Ostry et al., 2010; Kim and Ostry, 2018).

Financial markets can also affect resilience. On the one hand, financial depth can foster risk-sharing across economic agents, enhance consumption smoothing and dampen the effect of cyclical shocks (Beck et al. 2009; Ostry et al., 2009). On the other, excess leverage can lead to larger output losses during periods of financial stress (Feldkircher, 2014; Berkmen et al., 2012; Devereux and Dwyer, 2016; Frankel and Saravelos, 2010; Cecchetti et al., 2011; Babecký, 2012, Babecký, 2013; Caprio et al., 2014).

Trade and financial linkages have also played an amplification role in past crises. Blanchard et al. (2010) find that the economic performance in trading partners was a strong predictor of output loss during the GFC, while Claessens et al. (2012) find that the GFC exerted a larger impact on trade-dependent firms; Groot et al. (2011), Ho (2010), Levchenko et al. (2010) and Demir and Javorchik (2020) also stress the role of the trade channel. In a similar vein, Rodrik (1998), Bhagwati (1998) and Stiglitz (2002) argue that financial integration induces volatility in times of recession and endangers financial stability (see Kose et al., 2009), while Rose (2011) and Rose and Spiegel (2012) show that greater financial exposure to the United States was not associated with larger output losses in the GFC. Exchange rate flexibility may also affect resilience in the face of external shocks (Ghosh, Ostry and Wolf, 1997; Ghosh, Ostry and Tsangarides, 2011; Ghosh, Ostry and Qureshi, 2015).

To test the role of these factors, we consider the most recent pre-crisis value of the following variables: (i) current account balance as a share of GDP; (ii) general government debt-to-GDP ratio; (iii) financial system deposits as a percent of GDP; (iv) bank concentration; (v)

domestic credit as a percent of GDP; (vi) and (vii) trade and financial globalization indices developed by the KOF Swiss Economic Institute; and (viii) an exchange rate regime variable—which assumes 1 for fixed; 2 for intermediate and 3 for flexible—from the IMF. We also consider the three-year average GDP growth preceding the COVID-19 crisis to control for cross-country heterogeneity in pre-crisis growth. Figure 6 presents scatter plots between output loss and each of these variables. Output performance seems weaker for countries with higher pre-crisis growth, greater financial development and openness, higher pre-crisis debt-to-GDP ratios and current account deficits. Among these variables, however, only the debt-to-GDP ratio and pre-crisis growth appear to be robust determinants of output performance (Table 5).

F. Development level, Demographics and Institutions

Development level (per capita GDP) may influence resilience, as containment measures may be costlier in poorer countries because of limited social safety nets and larger shares of financially-constrained households and firms. In addition, there is evidence that fiscal and monetary policy are more effective in advanced economies (Ilzetki et al., 2013 on fiscal policy; Brandao-Marques et al., 2020 on monetary policy). On the other hand, resilience could be enhanced in poorer economies as larger informal sectors reduce nominal rigidities (Mithra, 2013).

Income distribution may affect resilience: Wright et al. (2020) find that shelter-in-place policies are more effective in reducing virus spread in richer countries. Weill et al. (2020) show that social distancing measures reduce mobility more in wealthier areas. In addition to its effects through compliance with social distancing, inequality can affect resilience if more inequal societies have larger shares of vulnerable workers.

Turning to demographic characteristics, the pandemic is more serious in terms of symptoms and death for the elderly: Ioannidis et al. (2020) finds that 88-96% of people dying with or because of COVID-19 are 65 or above. In addition, the effect of the crisis on labor force dropouts is larger for older workers. Thus, countries with older populations are likely to suffer more from job loss due to injury, death or labor force dropout. Country size may also play a role: smaller economies are typically more volatile (Furceri and Karras 2007) while larger economies may find it more difficult and costly to manage public health services (Alesina et al. 2005).

Finally, virus spread runs through social proximity, which is why high population density is associated with high case numbers.

Other factors we consider include: remittances; social fractionalization; and the nature of the political regime. The effect of remittances on resilience during a crisis is unclear as they tend to be countercyclical in the worker's country of origin and procyclical in the migrant's host country (Frankel 2011). Ethnic and religious fractionalizations can also affect output performance during a crisis by impairing the quality of the government and its policy response (Alesina et al., 2003). Finally, the type of political regime may shape both pandemic management and readiness of the public health system: democratic countries tend to have better public health systems (Ruger, 2005; Sen, 1999) which can give them an edge in fighting the disease (Kavanagh and Singh, 2020), but authoritarian governments may react faster and adopt drastic policy measures without fearing popular resistance. Cepaluni et al. (2020) show that more democratic countries face higher per capita deaths than less democratic countries do.

To assess the role of these factors, we consider the most recent pre-crisis value of: (i) the (log) of GDP per capita from the World Development Indicators (WDI); (ii) the Gini coefficient of after-tax income from the Standardized World Income Inequality Database; (iii) the share of population over 65; (iv) and (v) (log of) population and population density from the World Development Indicators; (vi) the share of remittances to GDP from the World Bank Financial Structure Database; (vii) a composite indicator of ethnic and religious fractionalization from Alesina et al. (2003); (viii) an indicator of informality from WDI; (vii) the level of democracy from Polity IV. Figure 7 suggests larger output losses in countries with lower GDP per capita, higher inequality, larger informal sectors, higher remittances and more democratic regimes. The evidence for inequality and informality are confirmed by the WALS results (Table 6).

IV. Robust Drivers

Scatter plots and estimates based on a few covariates suggest that several factors are associated with output losses. But which factors are robust? To answer this question, we report WALS estimates of the most robust drivers for the two alternative measures of output loss mentioned earlier. To remind, a regressor is considered robust if the *t*-statistic in absolute value is larger than 1—broadly speaking, this corresponds to a statistically significant increase in the adjusted R^2 due to the inclusion of that variable.

The results confirm the associations highlighted earlier. Output performance is negatively related to: more stringent containment measures; higher deaths rates; a larger tourism share; less stringent credit market regulation; higher pre-crisis growth; and more democratic political regimes. Lower fiscal stimulus and higher social fractionalization are negatively correlated with at least one measure of output performance (Table 7).

In Figure 8, we present the effect on output performance from moving from the 25th to the 75th percentile of each variable's distribution—that is, we multiply the WALS coefficient by the inter-quartile range. The results show that GDP per capita is quantitatively the largest player in driving output loss: a country at the 25th percentile of the GDP per capita distribution (such as Bangladesh) has, on average, a 7 percentage point lower-than-expected output growth than a country at the 75th percentile (such as Portugal). The next two positions in the ranking are containment measures and deaths, with similar magnitudes: an increase from the 25th to the 75th percentile of their distributions is associated with an increase in output losses of 4½-5 percentage points. While these results confirm the large economic cost associated with containment, they also highlight the close relation between "saving lives" and "saving the economy."

Two other economically important drivers of resilience are tourism dependence and the democracy score. Countries with a large share of tourism—notably Caribbean and Pacific islands—experience a 3½ percentage point smaller than expected output growth along the inter-quartile range. In contrast, countries that score low in the Polity IV democracy index (such as China and Vietnam) are associated with significantly higher resilience (reductions of about 4 percentage points in output growth losses) than more democratic countries. As suggested by Cepaluni et al. (2020), this may reflect better enforcement of containment measures and compliance with social distancing as well as faster interventions to pandemic outbreaks.

A. Robustness checks

Outliers

Do outlier observations influence the results? To check, we winsorize the upper and lower 5 percentiles of the distribution of the dependent variables, and show in Table 8 (Figure

A7) results to be broadly in line with the baseline in Table 7.[9] For the first measure of output performance (column I), we confirm the same robust drivers, but higher fiscal stimulus becomes a robust driver of output performance. The results are also similar for the second output performance measure (column II), except that higher government debt is also robustly associated with lower output performance.

BMA

As discussed earlier, WALS is theoretically superior to BMA because, while BMA uses a Gaussian prior for the auxiliary parameters, WALS uses a Laplace distribution which reduces the risk of the prior overly influencing the final estimates. WALS is also practically superior because the space over which model selection is performed increases linearly rather than exponentially with size. At the same time, a key advantage of BMA is the larger number of models considered. To check robustness of our results, we repeat the analysis using BMA and consider the entire model space (2^{30} models). In Table 9 we report the posterior inclusion probability of each regressor—that is, the probability that a variable belongs to the true model. Similar to the baseline, the variables with the highest posterior probabilities are containment stringency, tourism and deaths per capita. Other variables that would enter in at least 10 percent of the 2^{30} (1,073,741,824) models are typically those found to be robust in WALS such as, pre-crisis growth, credit market regulation, the level of GDP per capita and democracy. In addition, we find that the share of the elderly seems to be robust in BMA—with a 35 percent posterior probability to enter in all models for the second output loss measure.

Additional determinants

As mentioned earlier, the selection of the variables is partly dictated by data availability. To check robustness to the inclusion of additional factors, we expanded the set of controls to include: additional measures of regulation pertaining to trade, the current and capital accounts, and indicators of rule of law; the share of non-performing loans (NPL); a measure of poverty and the amount of central bank reserves in percent of imports. The results with this larger set of (36)

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[9] To avoid further reducing sample size, winsorizing seems preferable to dropping observations. If we choose instead to drop outlying data, results are similar but effects are less precisely estimated.

controls, based on a more limited sample of observations (and 11 degrees of freedom), confirm the baseline findings that GDP per capita, containment measures, deaths, and tourism are the most robust determinants of output performance (Table 9 and Figure A8). Additionally, we also find that countries with higher rule of law, higher debt-to-GDP ratios and smaller fiscal stimulus suffer higher output losses. In contrast, democracy is no longer significant, reflecting that in this restricted sample most countries have a similar democracy score and the democracy variable has a high negatively correlation with the rule of law indicator.

Alternative period

For many countries the peak of the economic crisis has been observed in the second quarter of 2020. It is useful to check, therefore, the validity of our results when considering only economic performance in the second quarter alone. Results reported in Table 11 (Figure A9) confirm our previous findings, and also suggest that countries with higher debt-to-GDP ratio, larger current account surpluses and more flexible exchange rates tend to experience weaker economic performance.

B. Cross-Country Heterogeneity: Mediating Channels

The results suggest that differences in GDP per capita are the most robust and important drivers of cross-country differences in output loss. What drives this result? Potential mediating channels could be the higher economic costs of health crises and less effective macroeconomic stimulus in poorer countries. To shed light on this, we extend the specification to include interaction terms between three alternative measures of economic development and deaths per capita, the stringency of containment measures, and the monetary and fiscal policy response variables. The measures of economic development we consider are: (i) the level of GDP per capita; (ii) a dummy which takes value 1 for countries with a level of GDP per capita above the sample average; (iii) a dummy which takes value 1 for advanced economies (IMF definition).

The WALS results in Table 12 (Figure A10) highlight mediating channels consistent with our priors. First, output costs associated with containment measures and deaths are larger in lower-income countries, probably because of more limited social safety nets and larger shares of financially-constrained households and firms. Second, monetary stimulus—specially liquidity provisions—has been less effective in poorer countries, consistent with the literature on the more

limited transmission of monetary policy in emerging market and developing economies. Third, there is some evidence that effectiveness of fiscal stimulus is lower in poorer countries.

V. Conclusion

This paper has explored the factors that drive heterogeneity of output losses across countries in the first phase of the Covid-19 recession. Using model-averaging techniques to address model uncertainty, we find that countries experiencing smaller output losses are those with: higher GDP per capita; less stringent containment measures; smaller number of deaths per capita; smaller tourism sectors; less flexible credit markets; lower pre-crisis growth; higher fiscal stimulus; less social (ethnic and religious) fractionalization; and less democratic regimes. Among these factors, the level of GDP per capita has the largest quantitative effect on resilience among the robust factors: a country at the 75th percentile of the GDP per capita distribution (such as Portugal) has, on average, a 7 percentage point smaller output loss than a country at the 25th percentile (such as Bangladesh). Our analysis suggests two key reasons why less-developed economies may be less resilient: the higher economic costs of containment measures—probably because of more limited social safety nets—and less effective fiscal and monetary policy stimulus.

We also find that death rates and containment stringency have similar effects on resilience, which suggests that rollback of containment should be implemented in a way that minimizes health risks. This implies relaxing containment only when new infections are declining and implementing strong testing and contact tracing policies. Second, fiscal stimulus has helped to reduce economic losses, underscoring that premature withdrawal of such stimulus is self-defeating. Our results indicate that monetary stimulus enhanced resilience more in advanced than non-advanced economies, underscoring the criticality of improving transmission in the latter. Third, reflecting that this is foremost a health crisis, the economic fallout has been particularly acute in high-contact sectors such as tourism and retail. This underscores the need for targeted rather than generalized support, particularly in the later stages of the crisis.

Our findings also speak to the more general literature on resilience. In contrast to studies on the GFC, we do not find that trade and financial openness have been important drivers of output loss during the pandemic. Whether such factors will play a key role going forward, including during the recovery, is an important question for future research.

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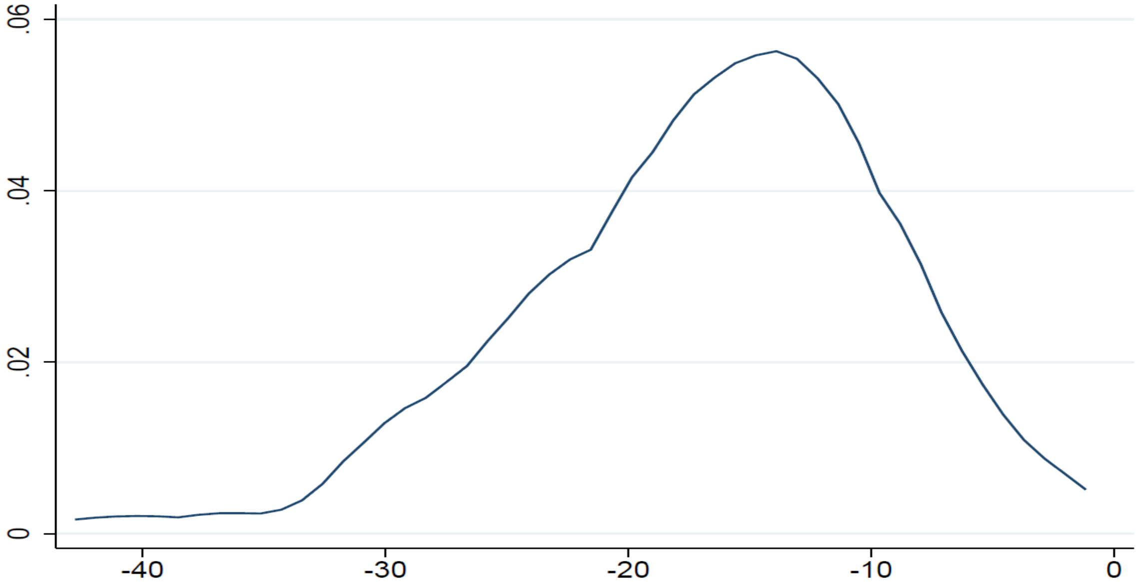
FIGURE 1. DISTRIBUTION OF OUTPUT PERFORMANCES (%)—DENSITY PLOTS

Panel A. Growth rate for the first semester of 2020 minus the January 2020 IMF Growth Forecast over the corresponding period



Panel B. Growth rate for the first semester of 2020 minus growth rate for the first semester of 2019

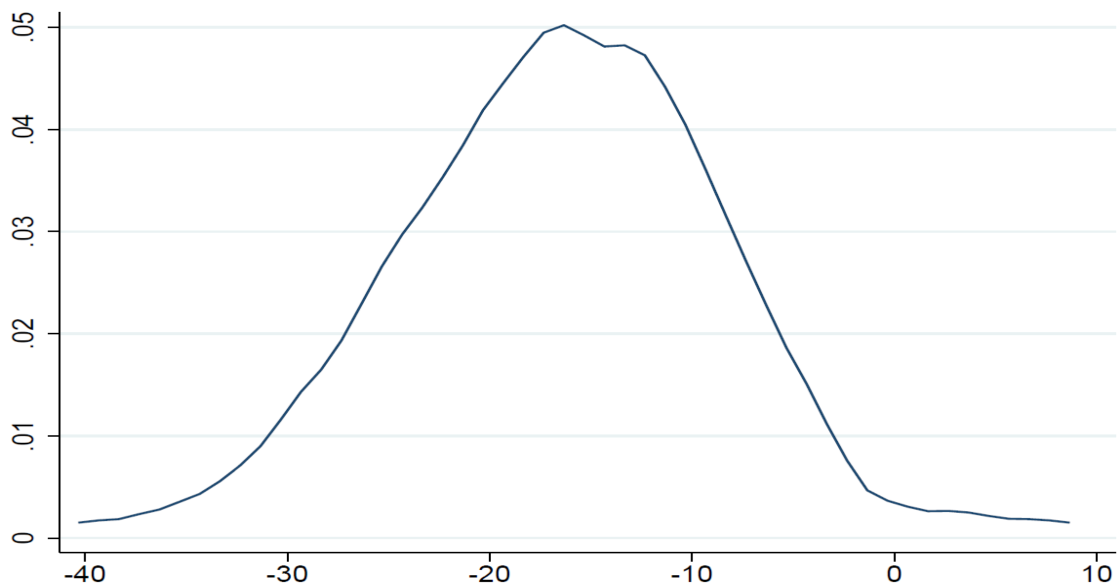
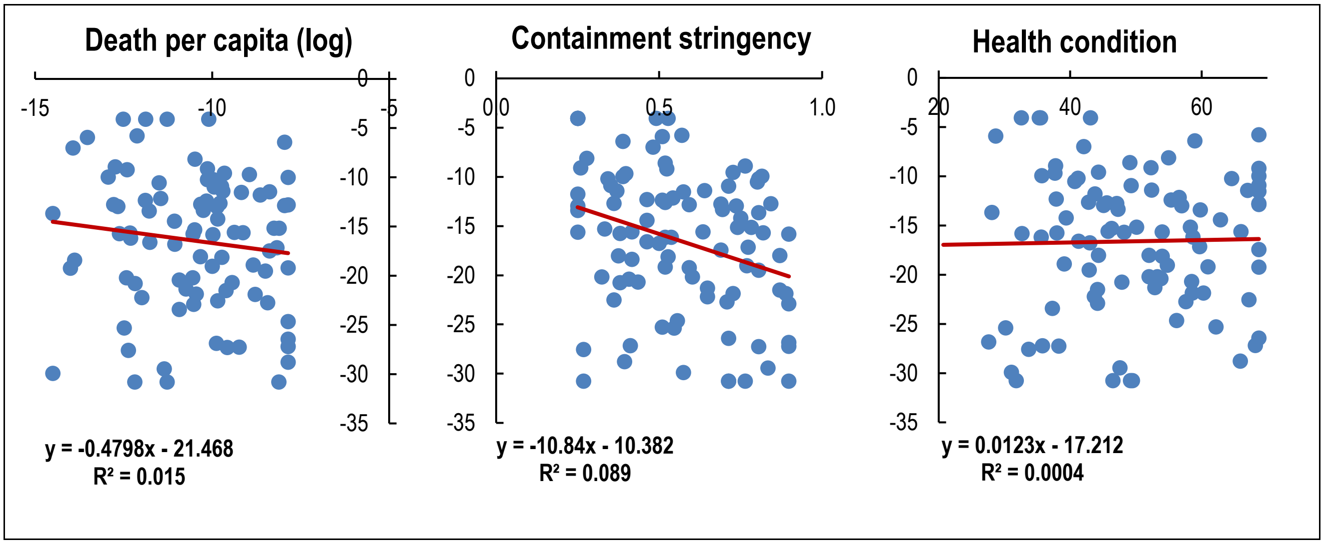
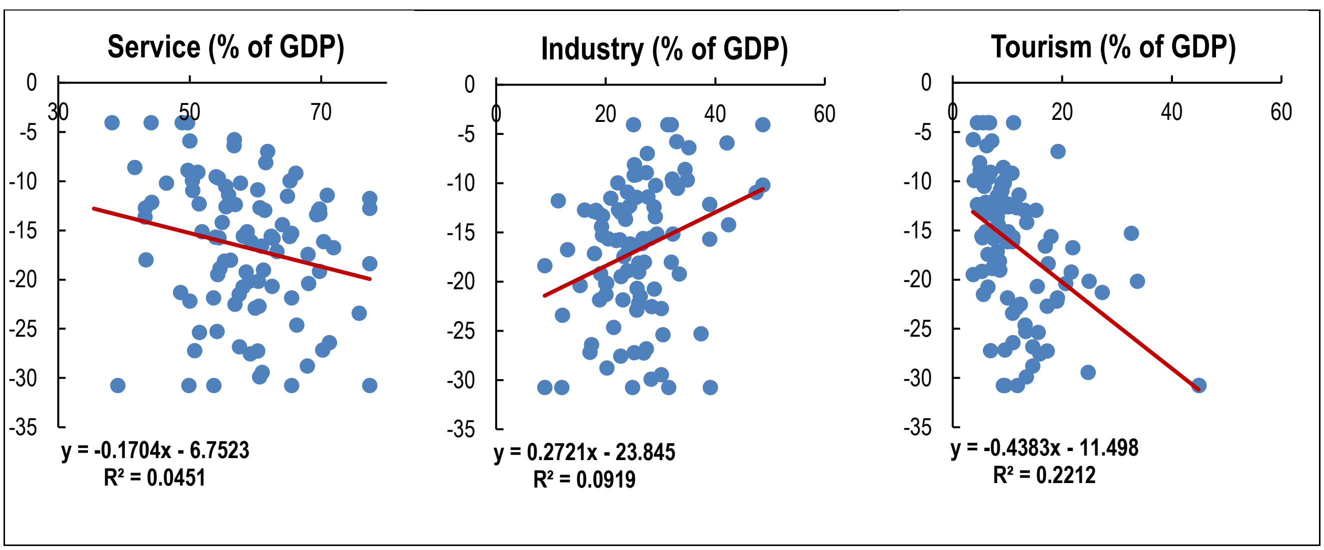


FIGURE 2. OUTPUT PERFORMANCES (%) AND PUBLIC HEALTH



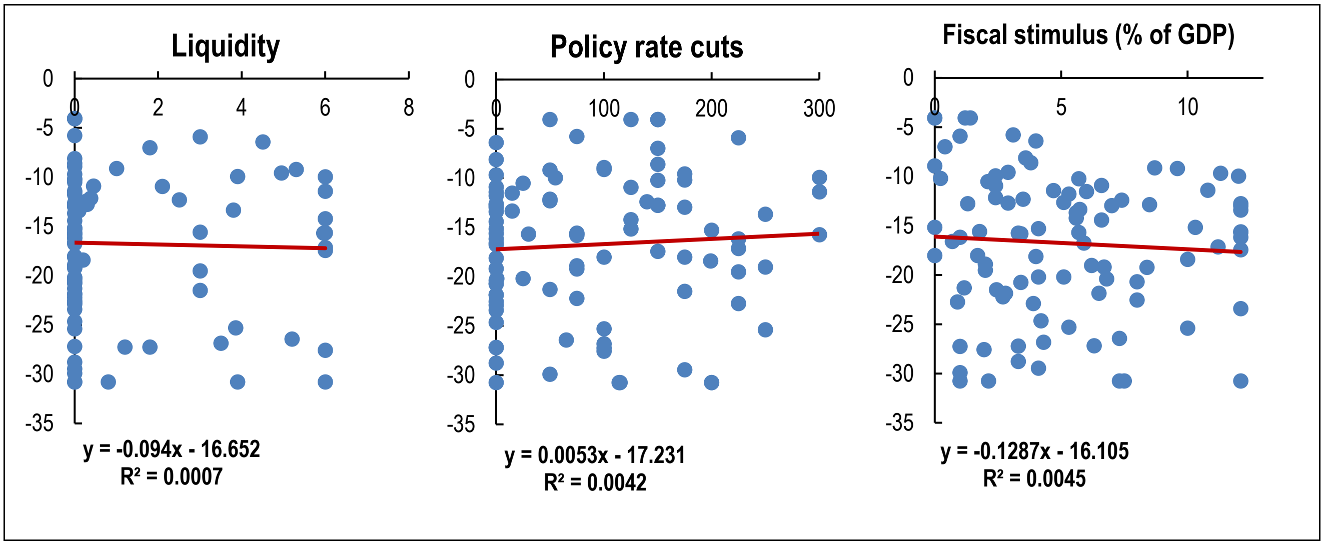
Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 3. OUTPUT PERFORMANCES (%) AND SECTORAL COMPOSITION



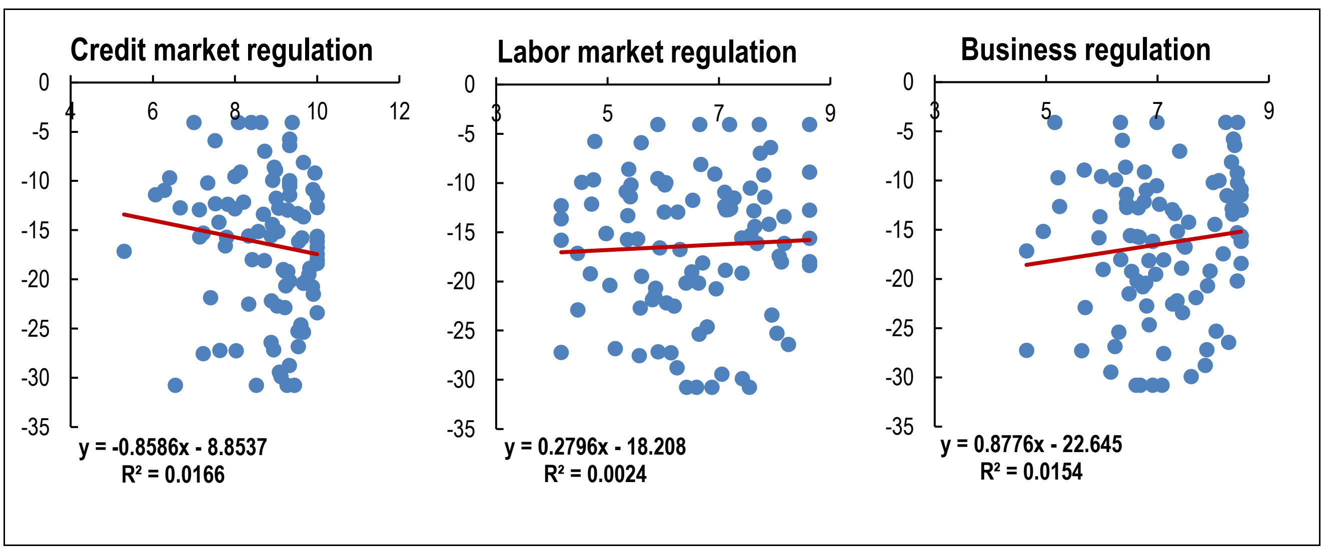
Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 4. OUTPUT PERFORMANCES (%) AND FISCAL AND MONETARY RESPONSE



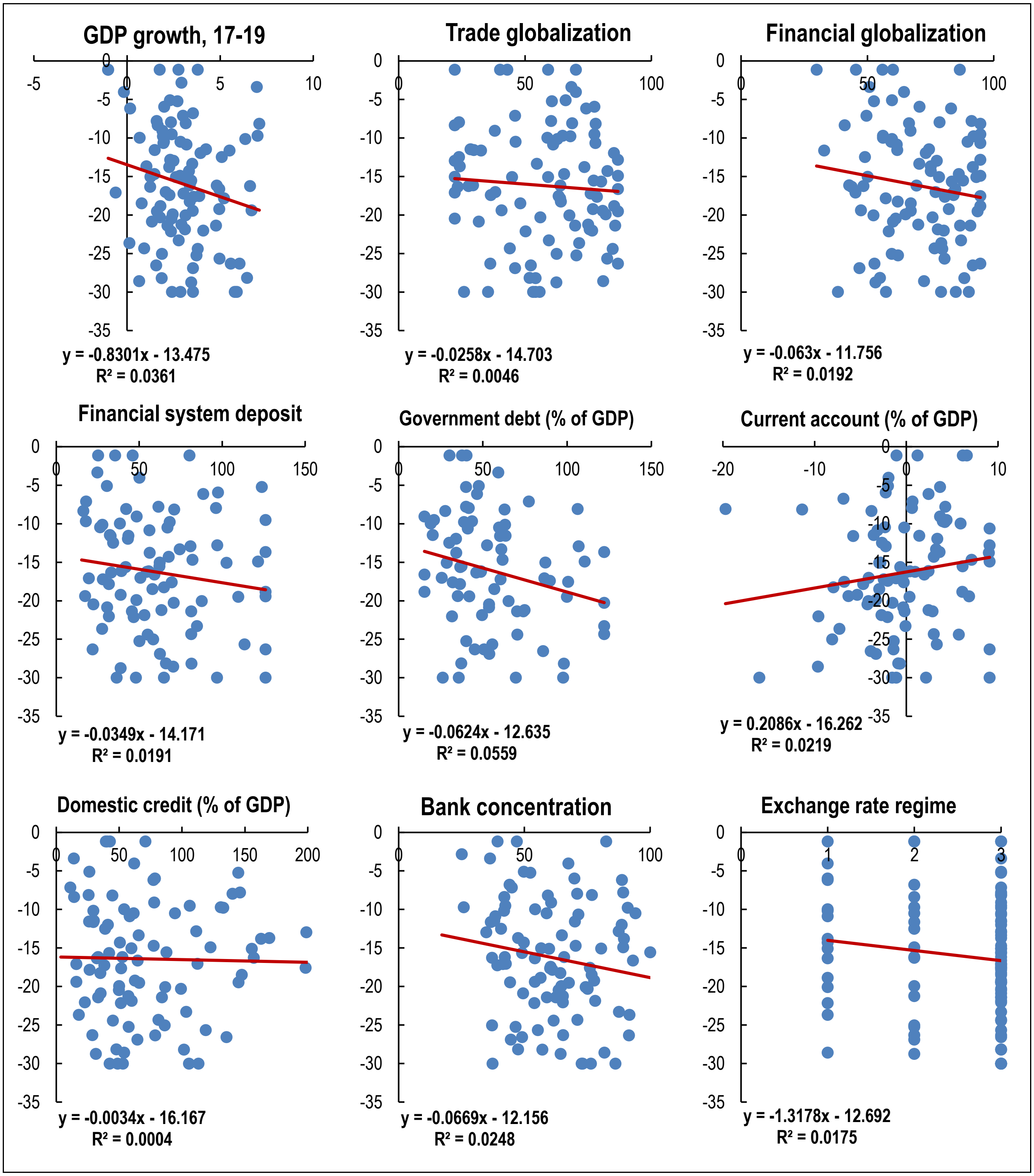
Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 5. OUTPUT PERFORMANCES (%) AND REGULATION



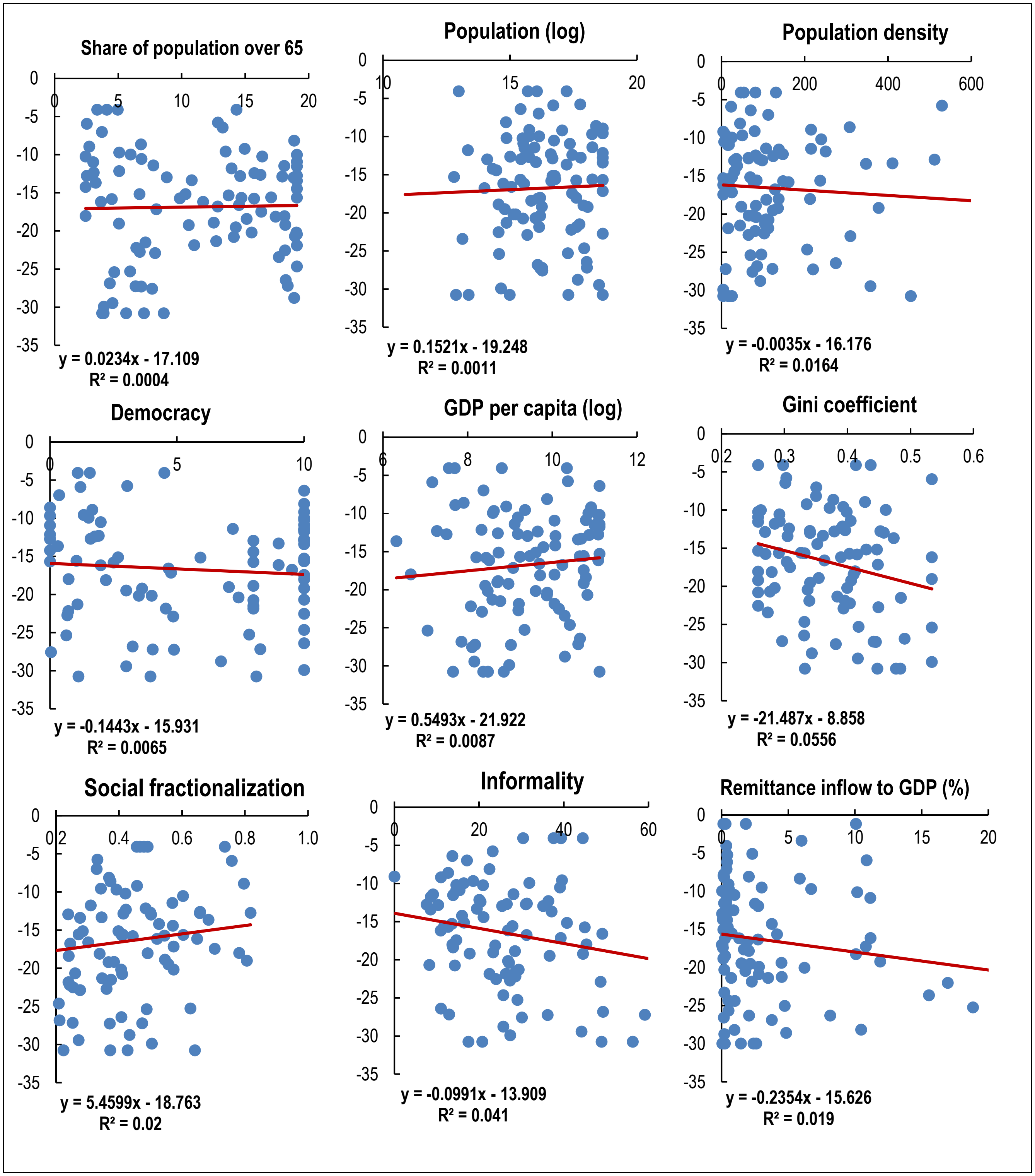
Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 6. OUTPUT PERFORMANCES (%) AND MACROECONOMICS CHARACTERISTICS



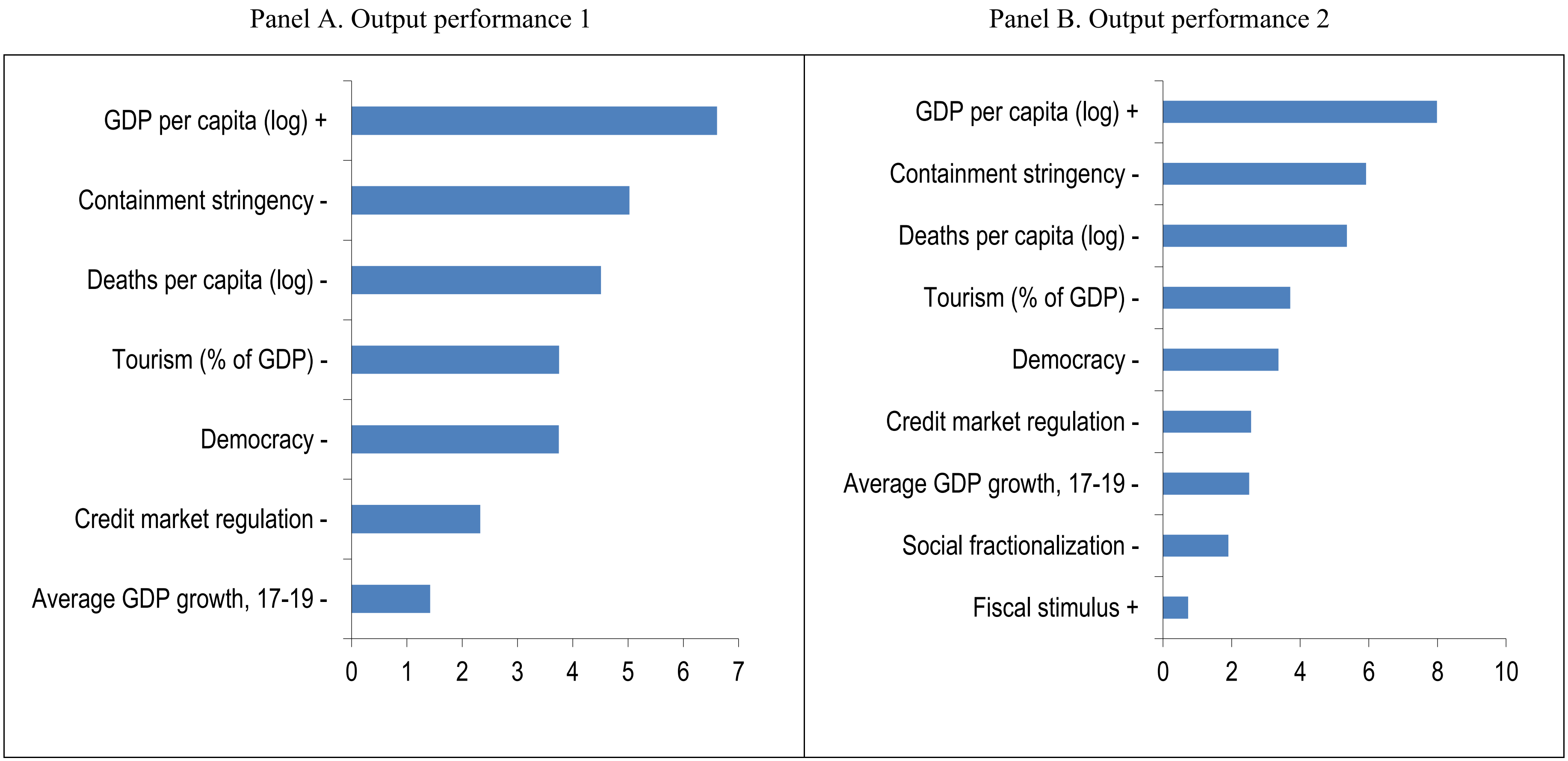
Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 7. OUTPUT PERFORMANCES (%) AND DEVELOPMENT, DEMOGRAPHIC AND INSTITUTIONS



Note: Output performance is defined the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1.

FIGURE 8. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES, MAGNITUDE OF THE EFFECTS



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1).

TABLE 1. REGRESSION RESULTS OF PUBLIC HEALTH, OLS AND WALS

	Output performance 1		Output performance 2	
	OLS	**WALS**	**OLS**	**WALS**
Deaths per capita (log)	-0.434	-0.380	-0.655	**-0.496**
	(-0.895)	(-0.974)	(-1.076)	(-1.075)
Containment stringency	**-11.110****	**-8.428***	-10.041	**-7.460**
	(-2.756)	(-2.319)	(-1.891)	(-1.734)
Health condition	-1.011	-0.602	-1.080	-0.639
	(-0.834)	(-0.578)	(-0.817)	(-0.518)
N	85	85	85	85

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 2. REGRESSION RESULTS OF SECTORIAL COMPOSITION, OLS AND WALS

	Output performance 1		Output performance 2	
	OLS	**WALS**	**OLS**	**WALS**
Service	-0.126	**-0.111**	-0.168	**-0.148**
	(-0.900)	(-1.064)	(-1.081)	(-1.257)
Industry	0.052	0.064	0.074	0.091
	(0.481)	(0.561)	(0.607)	(0.710)
Tourism	**-0.889****	**-0.798*****	**-0.825****	**-0.723*****
	(-3.083)	(-7.632)	(-2.912)	(-6.133)
N	96	96	96	96

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 3. REGRESSION RESULTS OF FISCAL AND MONETARY RESPONSE, OLS AND WALS

	Output performance 1		Output performance 2	
	OLS	**WALS**	**OLS**	**WALS**
Fiscal stimulus	-0.079	-0.047	-0.094	-0.057
	(-0.486)	(-0.364)	(-0.586)	(-0.416)
Liquidity	0.071	0.042	0.034	0.020
	(0.369)	(0.173)	(0.175)	(0.078)
Policy rate cut	0.002	0.001	0.008	0.005
	(0.322)	(0.122)	(0.896)	(0.492)
N	96	96	96	96

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 4. REGRESSION RESULTS OF REGULATION, OLS AND WALS

	Output performance 1		Output performance 2	
	OLS	**WALS**	**OLS**	**WALS**
Credit market regulation	-1.207	**-0.798**	-1.840	**-1.200**
	(-1.707)	(-1.186)	(-1.922)	(-1.509)
Labor market regulation	-0.057	-0.025	-0.307	-0.162
	(-0.093)	(-0.043)	(-0.422)	(-0.245)
Business regulation	1.297	**0.820**	0.632	0.398
	(1.457)	(1.141)	(0.583)	(0.483)
N	94	94	94	94

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 5. REGRESSION RESULTS OF MACROECONOMICS CHARACTERISTICS, OLS AND WALS

	Output performance 1		Output performance 2	
	OLS	**WALS**	**OLS**	**WALS**
Financial globalization	0.0266	0.0209	-0.0695	-0.0430
	(0.238)	(0.278)	(-0.552)	(-0.511)
Trade globalization	0.0601	0.0396	0.0707	0.0430
	(0.875)	(0.798)	(0.963)	(0.780)
Current account (% of GDP)	0.0481	0.0248	0.0570	0.0410
	(0.253)	(0.158)	(0.216)	(0.243)
Financial system deposit (% GDP)	-0.0235	-0.0164	-0.0154	-0.0104
	(-1.385)	(-0.995)	(-0.800)	(-0.599)
Government debt (% of GDP)	-0.0362	**-0.0232**	-0.0384	**-0.0248**
	(-1.404)	(-1.115)	(-1.471)	(-1.092)
Domestic credit (% of GDP)	0.0224	0.0151	0.0243	0.0160
	(1.042)	(0.737)	(1.028)	(0.708)
Bank concentration	-0.0873	**-0.0601**	-0.0744	-0.0489
	(-1.369)	(-1.092)	(-1.113)	(-0.838)
Exchange rate regime	-0.231	-0.157	0.262	0.192
	(-0.160)	(-0.117)	(0.172)	(0.129)
Average GDP growth (17-19)	**-1.055***	**-0.677**	**-1.740****	**-1.124****
	(-1.682)	(-1.444)	(-2.369)	(-2.172)
N	70	70	70	70

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 6. REGRESSION RESULTS OF DEVELOPMENT, DEMOGRAPHIC AND INSTITUTIONS, OLS AND WALS

	Output performance 1		**Output performance 2**	
	OLS	**WALS**	**OLS**	**WALS**
Share of population over 65	-0.182 (-0.847)	-0.107 (-0.511)	-0.333 (-1.213)	-0.218 (-0.887)
Population (log)	-0.0445 (-0.0668)	-0.0472 (-0.0862)	-0.107 (-0.129)	-0.126 (-0.193)
GDP per capita (log)	-0.381 (-0.185)	-0.290 (-0.235)	-0.479 (-0.222)	-0.330 (-0.222)
Democracy	-0.254 (-0.567)	-0.228 (-0.771)	-0.283 (-0.578)	-0.198 (-0.569)
Population density	-0.00463 (-0.619)	-0.00361 (-0.567)	-0.00626 (-0.748)	-0.00382 (-0.494)
Gini coefficient	**-41.40**** (-2.569)	**-29.44**** (-2.113)	-28.36 (-1.354)	**-18.08** (-1.127)
Social fractionalization	**10.45**** (2.114)	**7.895*** (1.792)	6.586 (1.082)	4.540 (0.873)
Informality	-0.158 (-1.388)	**-0.117** (-1.599)	-0.166 (-1.355)	**-0.118** (-1.369)
Remittance to GDP (%)	0.0132 (0.0590)	0.0302 (0.144)	-0.126 (-0.472)	-0.0624 (-0.244)
	85	85	85	85

Note: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1). t-statistic reported in parentheses. In bold those regressors that can be considered "robust"—that is, with a t-value in absolute value greater than 1. * p<0.05, ** p<0.01, *** p<0.001.

TABLE 7. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—WALS

	Output performance 1	**Output performance 2**
Health condition	0.41	0.27
Containment stringency	**-2.23**	**-2.38**
Deaths per capita (log)	**-2.44**	**-2.65**
Liquidity	-0.81	-0.84
Policy rate cut	0.37	0.48
Fiscal stimulus	0.85	**1.20**
Labor market regulation	-0.07	-0.02
Credit market regulation	**-1.59**	**-1.63**
Business regulation	-0.28	-0.40
Financial globalization	0.75	0.66
Trade globalization	-0.28	-0.36
Current account (% of GDP)	-0.88	-0.78
Financial system deposit (% of GDP)	-0.83	-0.47
Government debt (% of GDP)	-0.92	-0.95
Domestic credit (% of GDP)	-0.05	-0.29
Bank concentration	0.19	0.46
Exchange rate regime	-0.93	-0.60
Average GDP growth, 17-19	**-1.05**	**-1.71**
Tourism (% of GDP)	**-3.01**	**-2.75**
Service (% of GDP)	-0.10	-0.40
Industry (% of GDP)	-0.28	-0.55
Share of population over 65	-0.29	-0.79
Population (log)	-0.20	0.03
GDP per capita (log)	**1.14**	**1.24**
Democracy	**-1.67**	**-1.38**
Population density	0.50	0.54
Gini coefficient	0.65	0.86
Social fractionalization	-0.71	**-1.25**
Informality	0.23	0.32
Remittance inflow to GDP (%)	0.31	0.5
N	60	60

Note: t-statistic reported in the table. In bold those regressors that can be considered "robust". Estimates based on equation (1).

TABLE 8. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—CONTROLLING FOR OUTLIERS

	Output performance 1	**Output performance 2**
Health condition	0.42	0.22
Containment stringency	**-2.11**	**-1.89**
Deaths per capita (log)	**-2.45**	**-2.74**
Liquidity	-0.56	-0.62
Policy rate cut	0.83	0.98
Fiscal stimulus	**1.05**	**1.20**
Labor market regulation	0.38	0.24
Credit market regulation	**-1.72**	**-1.87**
Business regulation	0.03	0.04
Financial globalization	0.67	0.42
Trade globalization	-0.47	-0.33
Current account (% of GDP)	-0.76	-0.96
Financial system deposit (% of GDP)	-0.63	-0.20
Government debt (% of GDP)	-0.97	**-1.10**
Domestic credit (% of GDP)	-0.07	-0.37
Bank concentration	0.42	0.67
Exchange rate regime	-0.92	-0.70
Average GDP growth, 17-19	**-1.24**	**-1.90**
Tourism (% of GDP)	**-3.24**	**-2.73**
Service (% of GDP)	-0.19	-0.38
Industry (% of GDP)	-0.13	-0.38
Share of population over 65	-0.34	-0.78
Population (log)	-0.59	-0.16
GDP per capita (log)	**1.08**	**1.31**
Democracy	**-1.95**	**-1.37**
Population density	0.63	0.56
Gini coefficient	0.55	0.67
Social fractionalization	-0.86	**-1.29**
Informality	0.30	0.44
Remittance inflow to GDP (%)	0.05	0.20
N	60	60

Note: t-statistic reported in the table. In bold those regressors that can be considered “robust”. Estimates based on equation (1).

TABLE 9. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—BMA

	Output performance 1	**Output performance 2**
Tourism (% of GDP) (-)	**0.99**	**0.85**
Containment stringency (-)	**0.97**	**0.88**
Deaths per capita (log) (-)	**0.56**	**0.54**
Government debt (% of GDP) (-)	*0.17*	*0.17*
Democracy (-)	*0.14*	0.08
GDP per capita (log) (+)	*0.11*	*0.1*
Share of population over 65 (-)	*0.1*	*0.35*
Fiscal stimulus (+)	0.08	0.08
Credit market regulation (-)	0.07	*0.11*
Trade globalization (-)	0.07	0.09
Domestic credit (% of GDP) (+)	0.07	0.09
Exchange rate regime (-)	0.07	0.05
Average GDP growth, 17-19 (-)	0.07	*0.32*
Population (log) (-)	0.07	0.06
Business regulation (+)	0.06	0.06
Financial system deposit (% of GDP) (-)	0.06	0.04
Remittance inflow to GDP (%) (-)	0.06	0.06
Informality (-)	0.06	0.05
Health condition (-)	0.05	0.05
Policy rate cut (+)	0.05	0.06
Financial globalization (-)	0.05	0.06
Service (% of GDP) (-)	0.05	0.06
Industry (% of GDP) (+)	0.05	0.05
Population density (-)	0.05	0.04
Gini coefficient (-)	0.05	0.06
Social fractionalization (-)	0.05	0.05
Liquidity (+)	0.04	0.04
Labor market regulation (+)	0.04	0.05
Current account (% of GDP) (-)	0.04	0.05
Bank concentration (+)	0.04	0.05
N	60	60

Note: posterior-inclusion-probability reported in the table. In bold those regressors with a posterior inclusion probability above 0.50; in italic those with a posterior inclusion probability above 0.1. Estimates based on equation (1). – (+) denotes a negative (positive) effect on output.

TABLE 10. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—ADDITIONAL COVARIATES

	Output performance 1	Output performance 2
Health condition	0.11	0.10
Containment stringency	**-1.59**	**-1.90**
Deaths per capita (log)	**-2.56**	**-2.65**
Liquidity	0.10	-0.12
Policy rate cut	-0.02	-0.17
Fiscal stimulus	**2.18**	**1.79**
Labor market regulation	-0.75	-0.39
Credit market regulation	**-1.88**	**-2.09**
Business regulation	0.42	0.09
Financial globalization	**1.08**	0.87
Trade globalization	-0.49	-0.33
Current account (% of GDP)	-0.96	**-1.16**
Financial system deposit (% of GDP)	0.88	0.41
Government debt (% of GDP)	**-1.96**	**-2.10**
Domestic credit (% of GDP)	-0.02	0.37
Bank concentration	0.44	0.58
Exchange rate regime	-0.72	-0.32
Average GDP growth, 17-19	**-1.92**	**-2.49**
Tourism (% of GDP)	**-1.45**	-0.75
Service (% of GDP)	0.53	0.15
Industry (% of GDP)	0.41	0.00
Share of population over 65	0.04	-0.75
Population (log)	-0.94	-0.50
GDP per capita (log)	**1.49**	**1.64**
Democracy	0.03	0.55
Population density	0.50	0.69
Gini coefficient	-0.61	-0.58
Social fractionalization	**-1.28**	**-1.28**
Informality	**-1.94**	**-1.47**
Remittance inflow to GDP (%)	-0.24	-0.13
Rule of law	**-2.01**	**-1.82**
Average tariff rates	**-1.73**	**-1.18**
Normalized current account index	0.25	0.63
Non-performing loan	0.04	0.15
Poverty rate	0.99	0.59
Reserve (% of imports)	-0.72	0.63
N	48	48

Note: t-statistic reported in the table. In bold those regressors that can be considered “robust”. Estimates based on equation (1).

TABLE 11. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—USING ONLY Q2 DATA

	Output performance 1	**Output performance 2**
Health condition	-0.07	-0.19
Containment stringency	**-1.80**	**-1.71**
Deaths per capita (log)	**-2.89**	**-3.20**
Liquidity	-0.69	-0.63
Policy rate cut	0.00	0.08
Fiscal stimulus	0.68	**1.01**
Labor market regulation	-0.79	-0.85
Credit market regulation	**-1.98**	**-2.04**
Business regulation	-0.05	0.01
Financial globalization	0.69	0.46
Trade globalization	-0.11	-0.06
Current account (% of GDP)	**-1.01**	**-1.04**
Financial system deposit (% of GDP)	-0.97	-0.90
Government debt (% of GDP)	**-1.08**	**-1.20**
Domestic credit (% of GDP)	-0.02	-0.21
Bank concentration	0.56	0.71
Exchange rate regime	**-1.19**	**-1.14**
Average GDP growth, 17-19	**-1.00**	**-1.49**
Tourism (% of GDP)	**-2.69**	**-2.48**
Service (% of GDP)	0.53	0.54
Industry (% of GDP)	0.40	0.40
Share of population over 65	-0.09	-0.24
Population (log)	0.26	0.35
GDP per capita (log)	**1.17**	**1.18**
Democracy	**-1.61**	**-1.40**
Population density	0.26	0.30
Gini coefficient	0.00	-0.03
Social fractionalization	-0.02	-0.30
Informality	-0.10	-0.06
Remittance inflow to GDP (%)	0.58	0.54
N	60	60

Note: t-statistic reported in the table. In bold those regressors that can be considered “robust”. Estimates based on equation (1).

TABLE 12. ROBUST DRIVERS OF OUTPUT PERFORMANCE ACROSS COUNTRIES—INTERACTION WITH INCOME LEVEL

	Continuous		**Dummy 1**		**Dummy 2**	
	OP1	**OP2**	**OP1**	**OP2**	**OP1**	**OP2**
Covariates						
Health condition	0.15	-0.06	0.07	0.00	0.30	0.15
Containment stringency	**-1.66**	**-1.22**	**-1.00**	**-1.60**	**-1.62**	**-1.93**
Deaths per capita (log)	**-1.78**	**-2.54**	**-2.71**	**-2.63**	**-2.26**	**-2.49**
Liquidity	**-1.88**	**-2.06**	-0.46	-0.59	**-1.25**	**-1.31**
Policy rate cut	-0.72	-0.73	0.22	-0.23	0.53	0.65
Fiscal stimulus	0.29	0.91	**-1.19**	-0.56	0.31	0.66
Labor market regulation	-0.30	-0.03	-0.46	-0.47	-0.23	-0.23
Credit market regulation	**-1.94**	**-1.97**	**-1.25**	**-1.18**	**-1.97**	**-1.97**
Business regulation	0.13	0.09	-0.51	-0.47	-0.15	-0.19
Financial globalization	-0.01	-0.58	0.65	0.55	0.39	0.24
Trade globalization	-0.59	**-1.00**	0.25	-0.18	-0.13	-0.35
Current account (% of GDP)	-0.08	0.13	-0.20	-0.21	-0.62	-0.54
Financial system deposit (% of GDP)	-0.45	0.00	**-1.15**	-0.71	-0.30	0.19
Government debt (% of GDP)	-0.42	-0.42	-0.49	-0.59	-0.53	-0.59
Domestic credit (% of GDP)	-0.05	-0.05	0.15	0.05	-0.34	-0.55
Bank concentration	0.18	0.51	-0.06	0.11	0.53	0.88
Exchange rate regime	-0.49	0.12	-0.22	-0.07	-0.94	-0.59
Average GDP growth, 17-19	-0.95	**-1.49**	-0.37	-0.83	-0.98	**-1.54**
Tourism (% of GDP)	**-3.21**	**-3.21**	**-3.24**	**-2.94**	**-3.02**	**-2.84**
Service (% of GDP)	0.09	-0.46	0.80	0.15	0.23	-0.09
Industry (% of GDP)	0.31	0.02	0.57	-0.13	0.28	0.03
Share of population over 65	0.24	-0.38	0.44	-0.01	-0.20	-0.75
Population (log)	-0.67	-0.62	-0.95	-0.58	-0.38	-0.19
GDP per capita (log)	**1.54**	**2.27**	**1.64**	**1.57**	**1.05**	**1.20**
Democracy	**-1.08**	-0.64	**-1.76**	-0.93	**-1.52**	**-1.31**
Population density	-0.02	-0.31	0.08	0.32	0.04	0.02
Gini coefficient	0.63	0.68	**1.26**	**1.23**	0.64	0.77
Social fractionalization	0.13	-0.19	-0.35	-0.74	-0.21	-0.55
Informality	-0.06	-0.12	-0.12	0.12	-0.07	-0.03
Remittance inflow to GDP (%)	**1.15**	**1.95**	0.10	0.63	0.42	0.74
Containment*Income level	**1.01**	**1.00**	0.21	0.57	0.42	0.75
Deaths per capita*Income level	**1.44**	**2.18**	**1.53**	**1.39**	0.39	0.57
Liquidity*Income level	**1.84**	**2.01**	0.43	0.52	**1.40**	**1.47**
Policy rate cut*Income level	0.77	0.79	0.73	**1.10**	0.35	0.30
Fiscal stimulus*Income level	-0.29	-0.90	**1.22**	0.60	-0.15	-0.45
N	60	60	60	60	60	60

Note: t-statistic reported in the table. In bold those regressors that can be considered robust". Estimates bases on equation (1). Dummy 1 uses the average of GDP per capita as reference, 1 denotes above average, otherwise 0; Dummy 2 uses the definition of income level in the World Economic Outlook, 1 is advanced economies, otherwise 0; OP stands for output performance.

ANNEX A

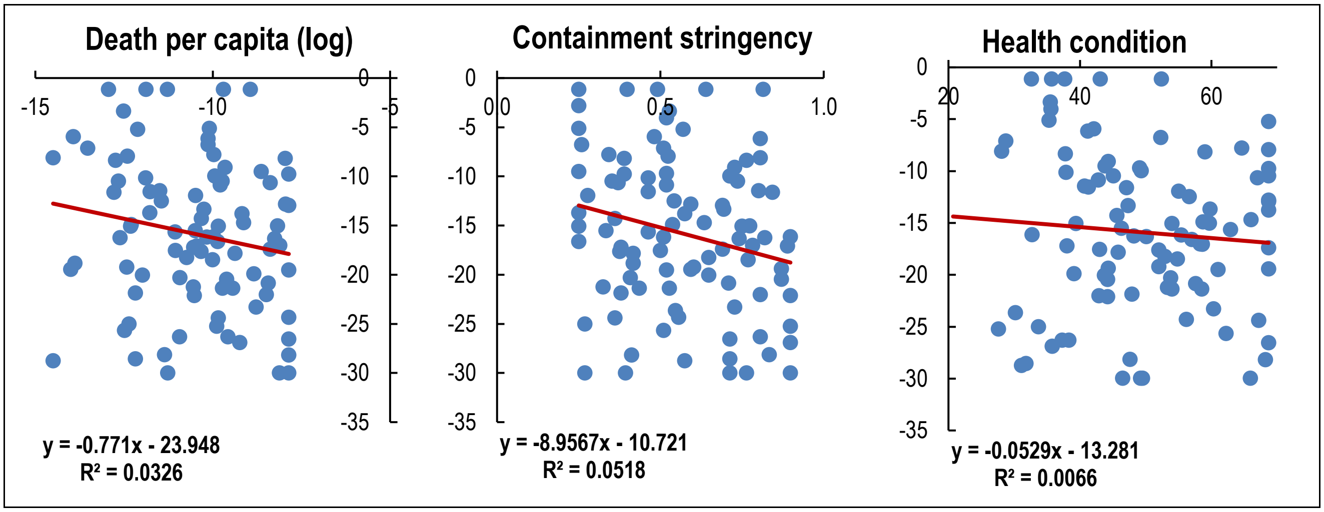
Table A1. Sources and descriptive statistics of the variables used in the analysis

Category	Description	Source	Obs	Mean	Std. dev
Measure of output performance	Output performance 1	IMF	97	-17.60	12.44
	Output performance 2	IMF	97	-16.67	13.15
Health factors	Health condition	JHU	191	40.58	14.41
	Containment stringency	OxCGRT	183	0.59	0.20
	Deaths per capita (log)	JHU	175	-11.02	1.95
Policy Support	Liquidity	IMF	194	1.25	3.50
	Policy rate cut	IMF	194	87.29	134.04
	Fiscal stimulus	IMF	194	4.26	6.09
Regulation	Labor market regulation	FI	157	6.46	1.36
	Credit market regulation	FI	157	8.18	1.55
	Business regulation	FI	157	6.75	1.27
Macroeconomics factors	Financial globalization	KOF	180	63.19	19.67
	Trade globalization	KOF	183	56.41	20.37
	Current account (% of GDP)	IMF	132	-1.72	8.36
	Financial system deposit (% of GDP)	FSD	163	59.93	50.73
	Government debt (% of GDP)	FSD	115	56.34	37.13
	Domestic credit (% of GDP)	FSD	165	57.31	43.31

	Bank concentration	FSD	160	65.69	19.30
	Exchange rate regime	IMF	192	2.07	0.87
	Average GDP growth, 17-19	IMF	199	2.97	3.60
Sectorial composition	Tourism (% of GDP)	WTTC	174	13.96	13.07
	Service (% of GDP)	WDI	193	56.60	13.36
	Industry (% of GDP)	WDI	202	25.43	12.45
Development and others	Share of population over 65	WDI	190	8.34	5.88
	Population (log)	WDI	211	15.29	2.41
	GDP per capita (log)	WDI	208	8.83	1.50
	Democratization	Polity IV	152	3.87	3.92
	Population density	WDI	209	454.25	2085
	Gini coefficient	SWIID 7.1	165	0.39	0.08
	Social fractionalization	Alesina et al. (2003)	179	0.44	0.19
	Informality	WDI	143	29.30	14.25
	Remittance inflow to GDP (%)	FSD	180	4.68	6.61

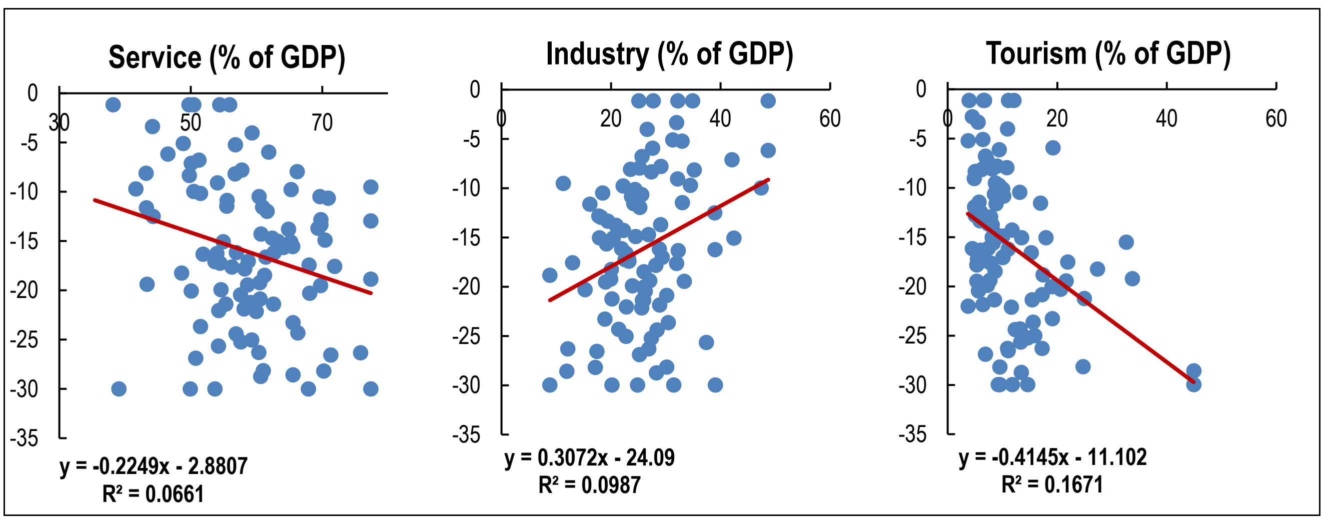
Notes: Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. IMF is International Monetary Fund; JHU is Johns Hopkins University Coronavirus Resource Center; OxCGRT is Oxford COVID-19 Government Response Tracker; FI is Fraser Institute Economic Freedom Network; KOF is Swiss Economic Institute; FSD is World Bank Financial Structure Database; WDI is World Development Indicators; WTTC is World Tourist & Tourism Council.

Figure A1. Output performances (%) and public health



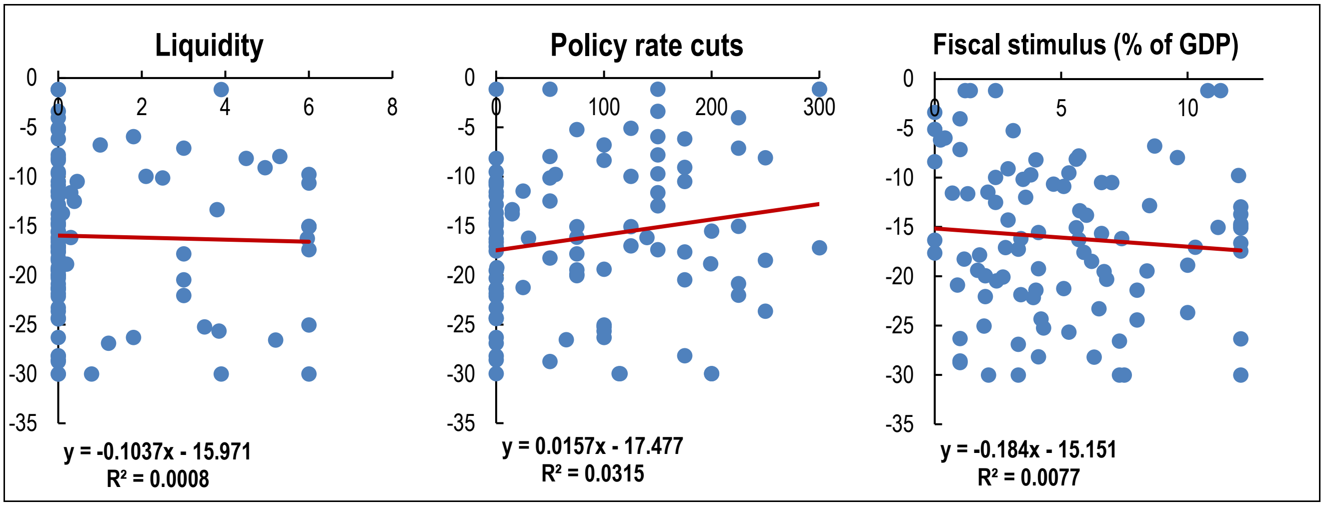
Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

Figure A2. Output performances (%) and sectoral composition



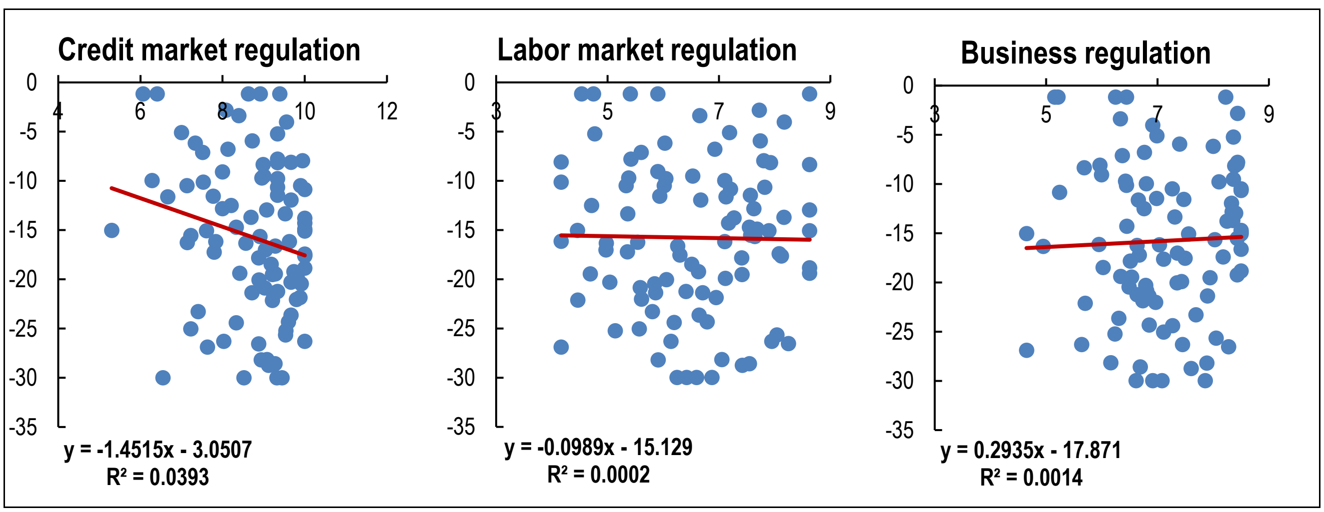
Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

Figure A3. Output performances (%) and fiscal and monetary response



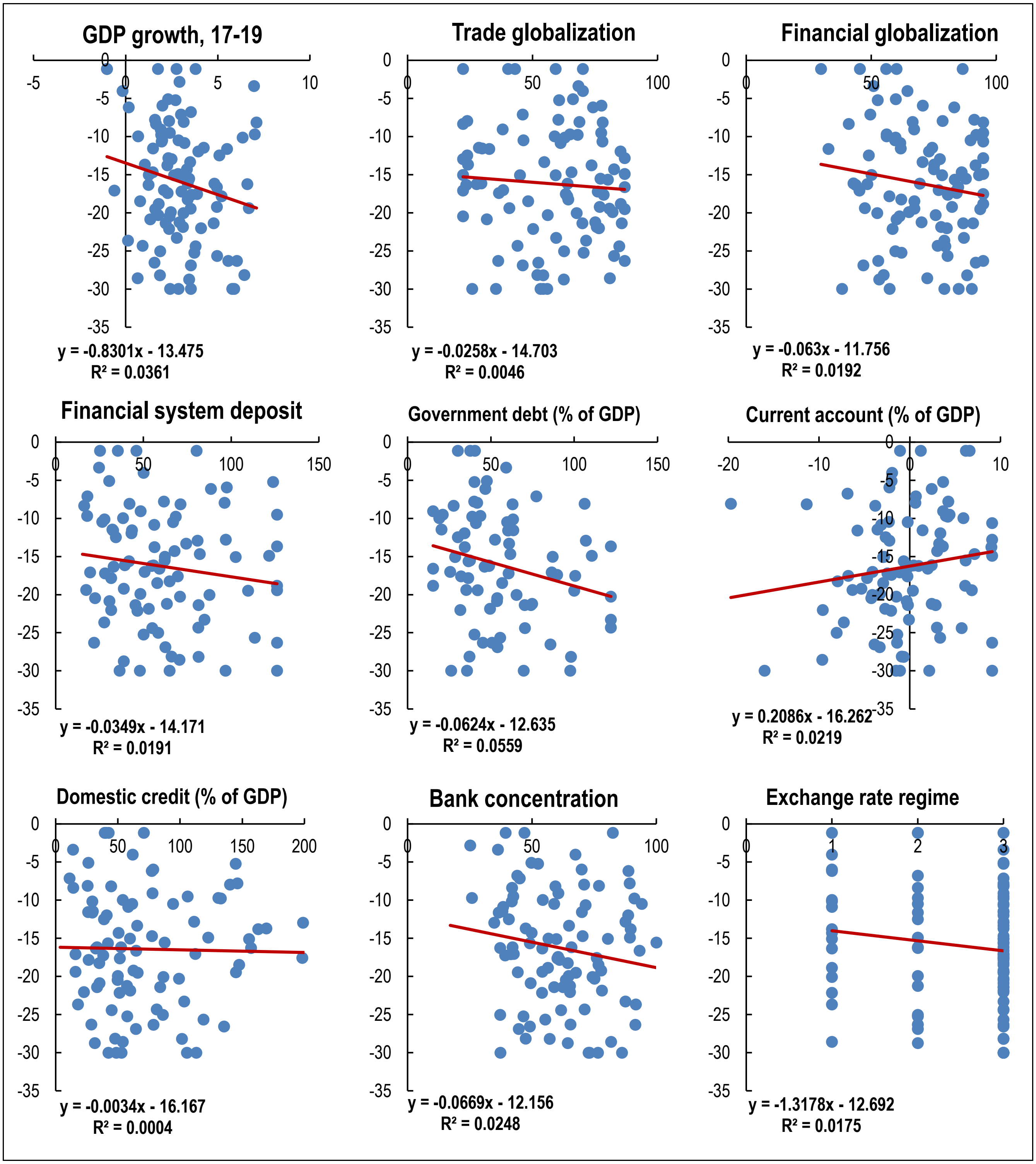
Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

Figure A4. Output performances (%) and regulation



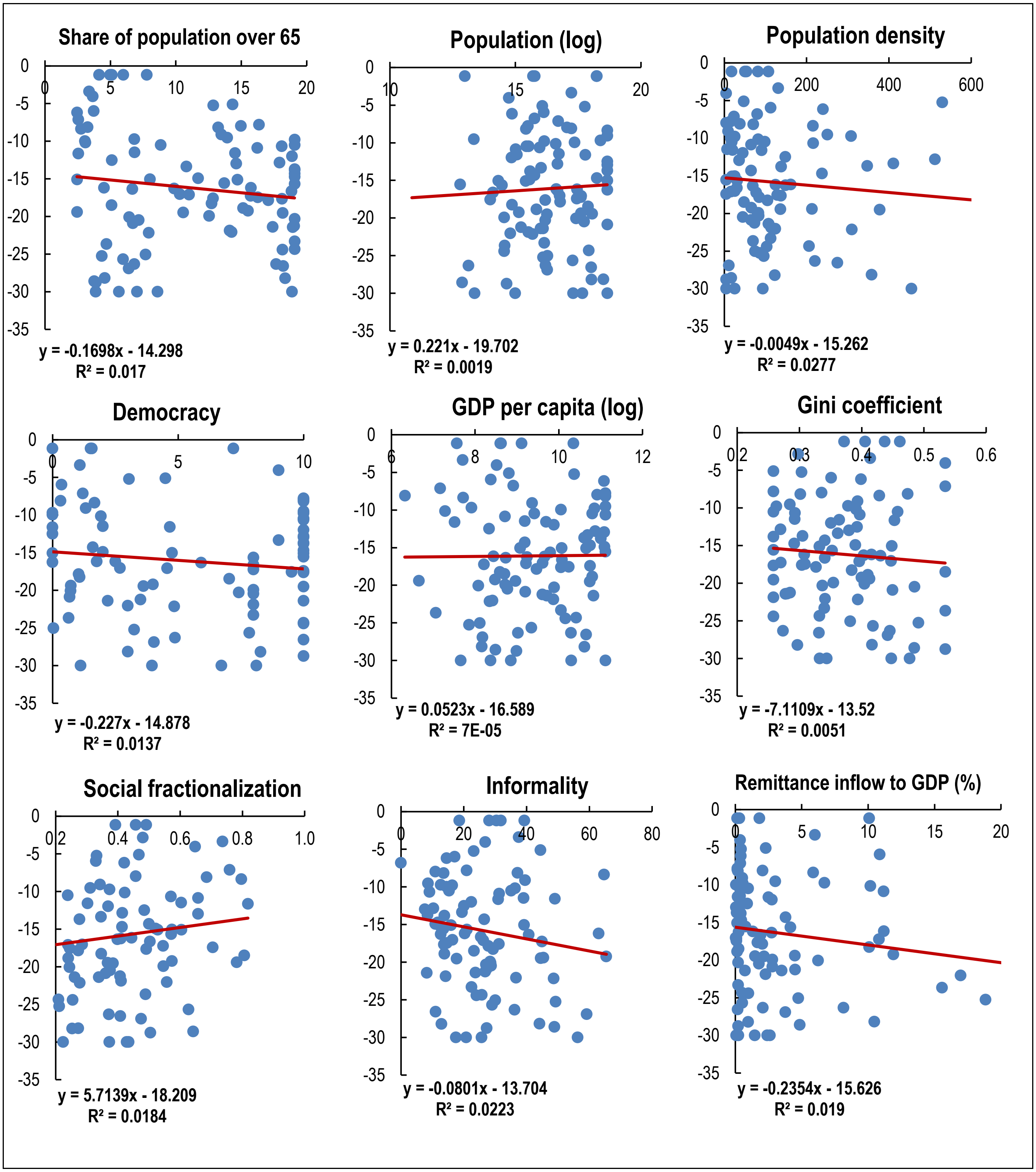
Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

Figure A5. Output performances (%) and macroeconomics characteristics



Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

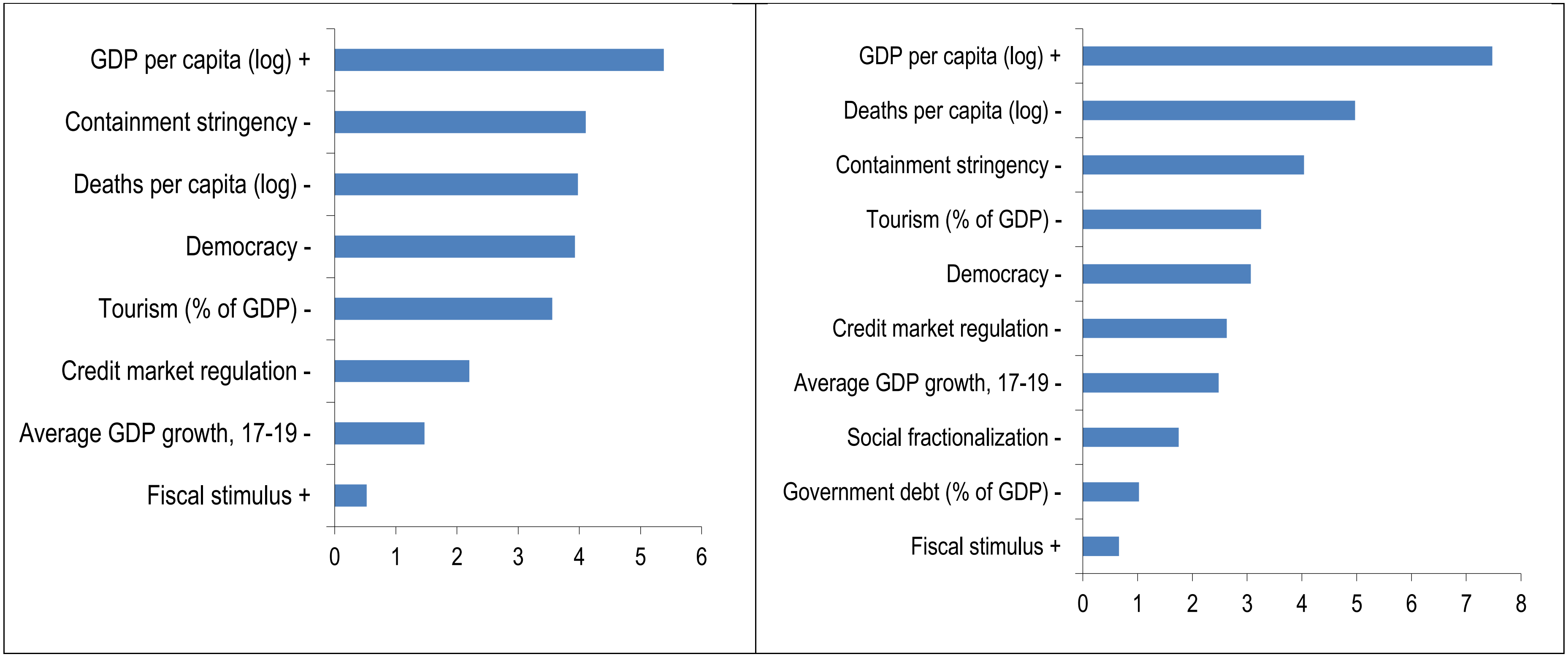
Figure A6. Output performances (%) and development, demographic and institutions



Note: Output performance is defined as the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1).

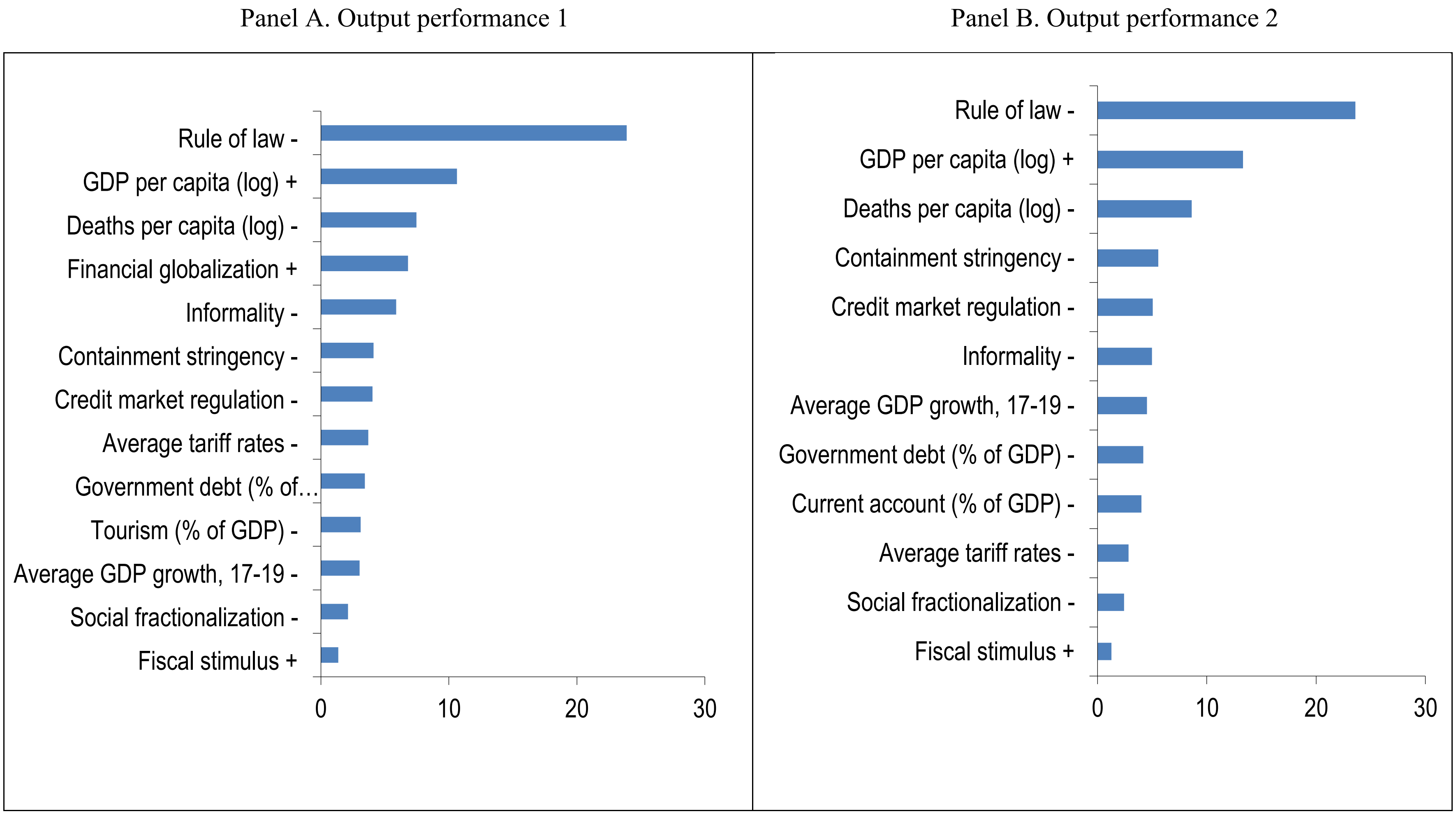
Figure A7. Robust drivers of output performance across countries—controlling for outliers, magnitude of the effects

Panel A. Output performance 1 Panel B. Output performance 2



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1).

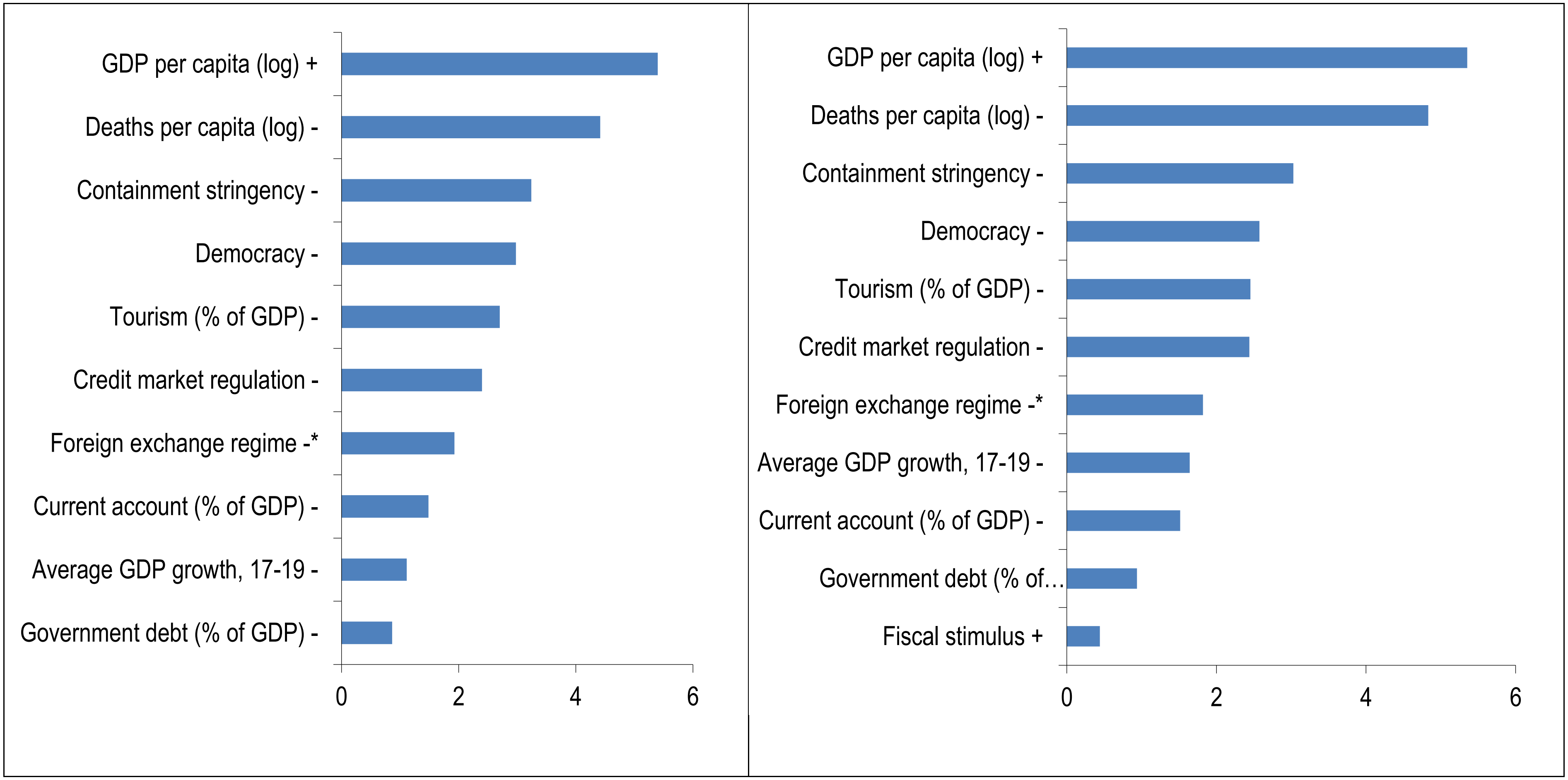
Figure A8. Robust drivers of output performance across countries—additional covariates, magnitude of the effects



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1).

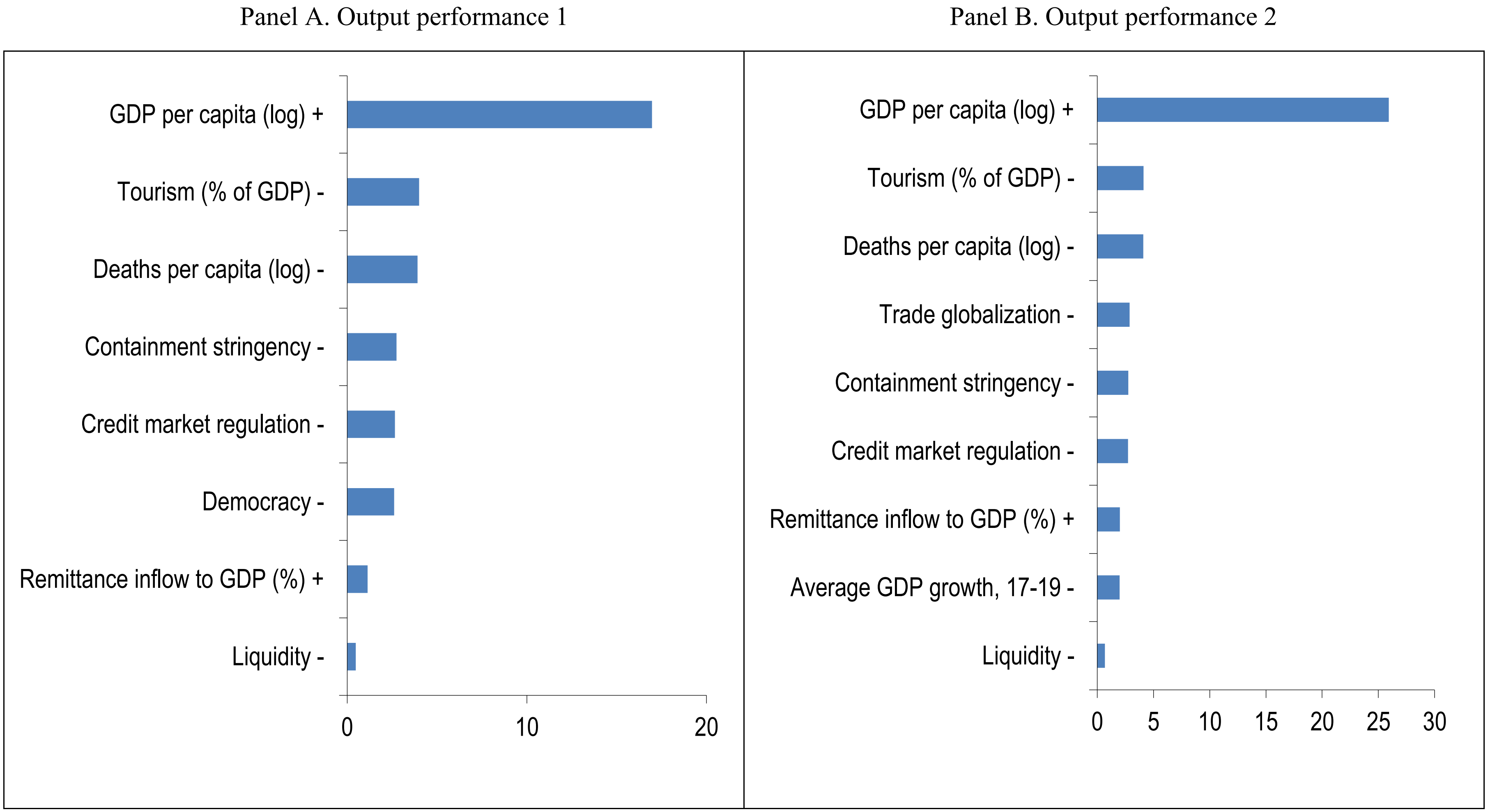
Figure A9. Robust drivers of output performance across countries—using Q2 deviation as dependent variable

Panel A. Output performance 1 Panel B. Output performance 2



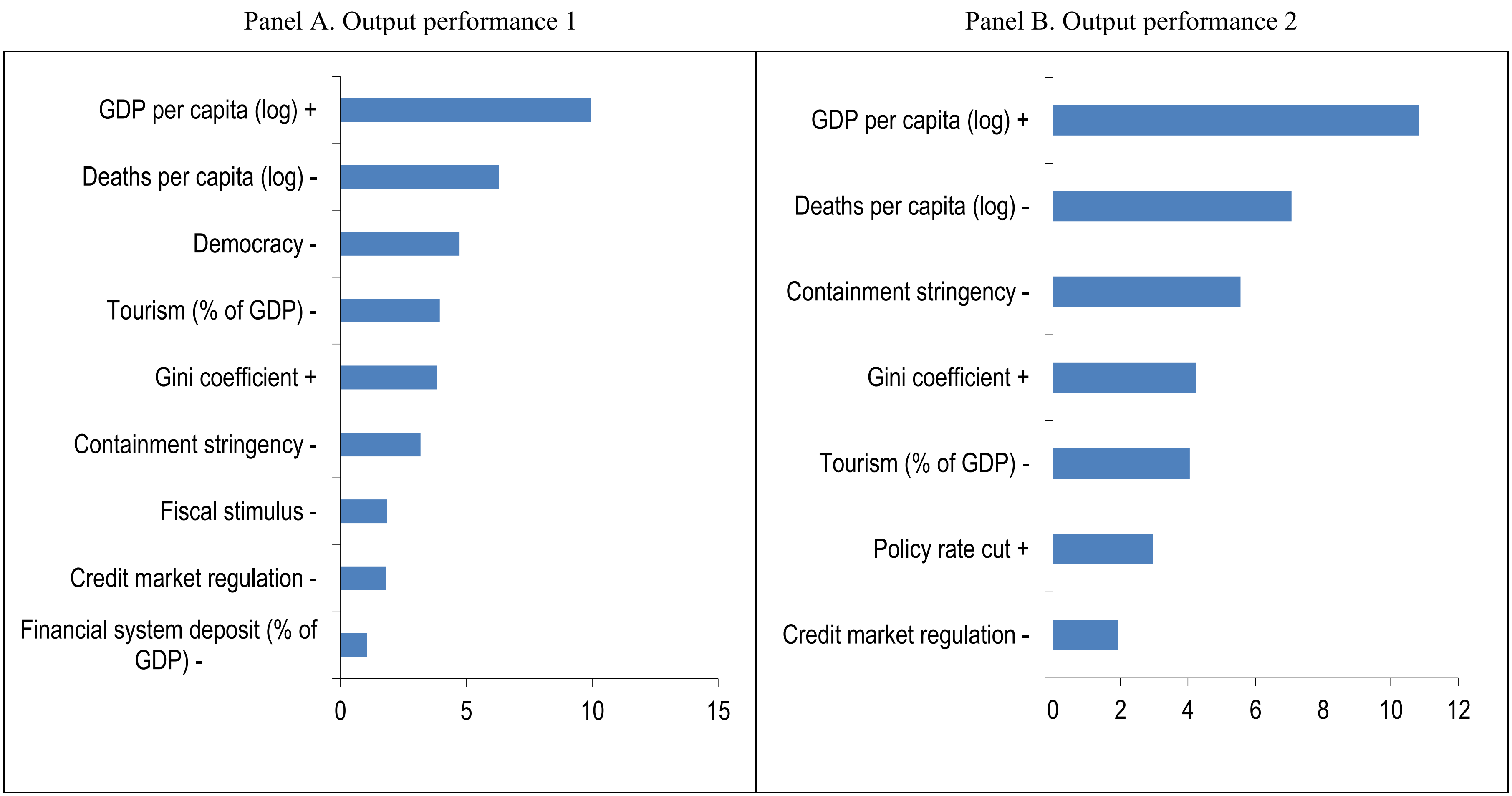
Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1). For foreign exchange regime, its interquartile value is 0, instead we use the variation from the 10th percentile to the 90th percentile of its distribution.

Figure A10. Robust drivers of output performance across countries— interaction with income level (continuous), magnitude of the effects



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25^{th} percentile to the 75^{th} percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1).

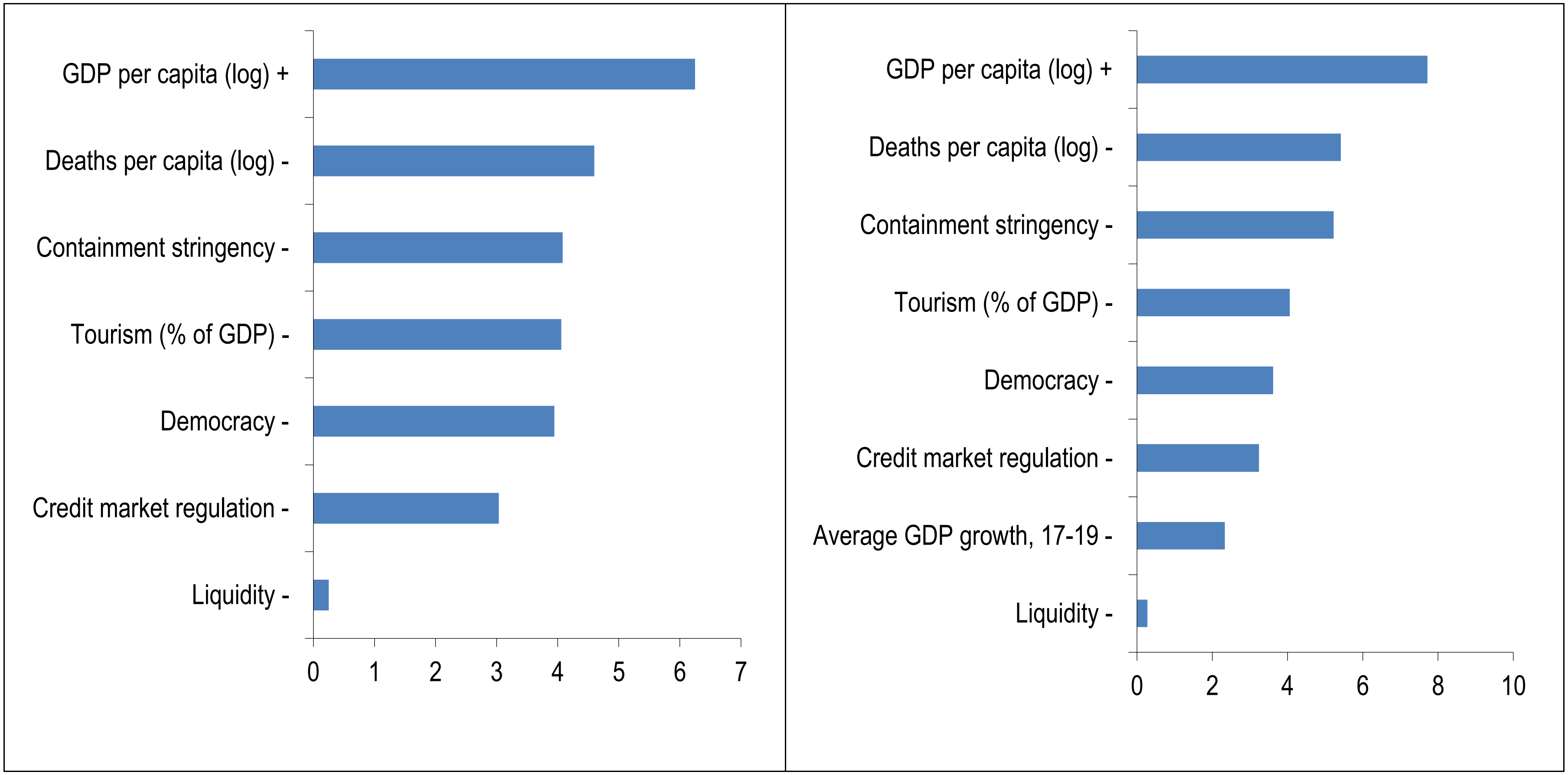
Figure A11. Robust drivers of output performance across countries— interaction with income level (dummy 1), magnitude of the effects



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1). Dummy 1 uses the average of GDP per capita as reference, 1 denotes above average, otherwise 0.

Figure A12. Robust drivers of output performance across countries— interaction with income level (dummy 2), magnitude of the effects

Panel A. Output performance 1 | Panel B. Output performance 2



Note. Output performance 1 is the difference between the observed cumulative real GDP growth in 2020H1 and the cumulative growth that was expected before the onset of the pandemic for the same period—based on the IMF World Economic Outlook 2020 January forecast for 2020H1; Output performance 2 is the difference in cumulative real GDP growth between the first half of 2020 (2020H1) and the first half of 2019 (2019H1);. The chart shows the differential effect on output performance moving the level of the variable from the 25th percentile to the 75th percentile of its distribution, based on the coefficients of the variables that are robust in column (I-II) of Table 7. – (+) denotes a negative (positive) effect on output. Estimates based on equation (1). Dummy 2 uses the definition of income level in the World Economic Outlook, 1 is advanced economies, otherwise 0.

ANNEX B

The objective of Model Averaging is to address model uncertainty by (i) running the maximum combination of possible models and (ii) providing estimates and inference results that take into account the performance of the variable not only in the final "reported" model but over the whole set of possible specifications. In practice, these two steps consist in estimating a parameter of interest conditional on each model in the model space and computing the unconditional estimate as a weighted average of conditional estimates. Formally, assuming that we are faced with *M* different models and that β^x is the coefficient related to the variable *X*, the final estimate of this coefficient is computed as:

$$\hat{\beta}^x = \sum_{i=i}^{M} \omega_i \hat{\beta}_i^x \qquad \text{(B1)}$$

where the weights ω_i denote a measure of goodness of fit of each model.

The Moving Averaging technique used in this paper is the Weighted Average Least Squares (WALS) proposed by Magnus, Powell, and Prüfer (2010) and generalized by De Luca and Magnus (2011) to introduce the distinction between focus and auxiliary regressors. Focus regressors are those that are forced to enter in each model based on priors guided by theory, while auxiliary regressors are those whose significance and model inclusion is tested. Given the lack of strong theoretical foundations on the drivers of COVID-19 output losses, we only consider the constant to be a focus regressor in the analysis.

Let's assume that the general statistical framework is a linear regression model of the form:

$$y = X_1\beta_1 + X_2\beta_2 + \varepsilon \qquad \text{(B2)}$$

where y is vector of observations on the outcome of interest (output performance), X_1 is a matrix of observations and k_1 focus regressors, X_2 is a matrix of observations and k_2 auxiliary regressors, β_1 and β_2 their respective coefficients. Conditional on model M_i being the true model, the sample likelihood function implied by B2 is $p(y|\beta_1, \beta_2, \sigma^2, M_i)$. Compared to the Bayesian Model Averaging (BMA) which uses a Gaussian distribution prior

for the auxiliary parameters, the WALS uses a Laplace distribution which reduces the risk of the prior influencing heavily the final estimates (Magnus, Powell, and Prüfer 2010). The WALS relies on preliminary orthogonal transformation of the auxiliary regressors and their parameters. This consists of computing an orthogonal $k_2 \times k_2$ matrix P and a diagonal $k_2 \times k_2$ matrix Δ such that $P^T X_2^T M_1 X_2 P = \Delta$. The key advantage of this transformation is that the space over which model selection is performed increases linearly rather than exponentially in size (as in the BMA).

Denoting $\bar{t}$ the Laplace estimator of the vector of theoretical t-ratios of the auxiliary regressors ($t = [t_1, t_2, .. t_{k2}]$), the WALS estimators of the coefficients β_1 and β_2, are given respectively by:

$$\widehat{\beta_1} = (X_1^T X_1)^{-1} X_1^T (y - X_2 \widehat{\beta_2}) \quad \text{(B3)}$$

$$\hat{\beta}_2 = sP\Delta^{-1/2}\bar{t} \quad \text{(B4)}$$

To decide whether a given auxiliary regressor is a robust determinant of the outcome of interest, Magnus, Powell, and Prüfer (2010) suggest an absolute value of the t-ratio greater than 1 for a variable to qualify as robust. This choice is motivated by the fact that including a given auxiliary regressor variable increases the model fit (as measured by the adjusted R^2) and the precision of the estimators of focus regressors (measured by a lower MSE) if and only if the *t-ratio* of the additional auxiliary regressor is in absolute value greater than 1.