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The depth, length and shape of the covid-19 recession conveyed in 2020 growth forecasts

By: Javier G. Gómez-Pineda

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Javier G. Gómez-Pineda[1]

jgomezpi@banrep.gov.co

Banco de la República

Abstract

With the help of growth forecasts and a simple structural model, we build a likely forward-looking account of the depth, length and shape of the recession as well as of the demand and supply shocks that may be driving it. The results point to an approximately –8 percent deep, V-shaped recession with partial recovery in advanced economies and an approximately –9 percent deep, L-shaped recession in emerging and developing economies. In addition, the projected shapes likely involve, in advanced economies, an output level shock and in emerging and developing economies, an output growth shock. In light of the forecast performance during the 2008 global financial crisis, growth forecasts might be informative about the depth of the recession as soon as 6 months after the beginning of the recession and, in advanced economies, might be informative about the shape of the recession about 12 months after the beginning of the recession. The depth and shape of the recession are important for monetary and fiscal policy analysis. The simple structural model does not have the problem of univariate filters that can misleadingly attribute to demand shocks a large part of output variability that is actually originated in supply shocks.

Key words: Covid-19 recession; L-shaped recession; V-shaped recession; scarring effects; forecast performance
JEL clasificación: E17; E37; E32; E58; E47

[1] The author thanks Victor Orantes from Focus Economics for providing historical forecast data and Sofía Salamanca and David López for excellent research assistance.

La profundidad, duración y forma de la recesión del covid-19 contenida en los pronósticos de crecimiento de 2020

Javier G. Gómez-Pineda[2]

jgomezpi@banrep.gov.co

Banco de la República

Resumen

Con la ayuda de pronósticos de crecimiento y de un modelo estructural sencillo, construimos un probable recuento prospectivo de los choques de demanda y oferta que explican la recesión del covid-19, en desarrollo, así como de la profundidad, duración y forma de la recesión. Los resultados indican que en las economías avanzadas la recesión tiene una profundidad aproximadamente de –8 porciento y es en forma de V con recuperación parcial mientras que en las economías emergentes y en desarrollo la recesión es aproximadamente–9 por ciento de profunda y en forma de L. Adicionalmente, la forma proyectada de la recesión probablemente supone en las economías avanzadas un choque al nivel de producto y en las economías emergentes y en desarrollo un choque al crecimiento del producto. A la luz del desempeño de los pronósticos durante la crisis financiera global de 2008, los pronósticos de crecimiento pueden informar sobre la profundidad de la recesión tan pronto como 6 meses después de su comienzo y, en las economías avanzadas, pueden informar sobre la forma de la recesión cerca de 12 meses después de su comienzo. La profundidad y la duración de la recesión en la brecha del producto son importantes en el análisis de las políticas monetaria y fiscal. Los filtros univariados pueden equivocadamente atribuir a choques de demanda una gran parte de la variabilidad del producto que en realidad es originada en choques de oferta.

Palabras clave: recesión del covid-19; recesión en forma de L; recesión en forma de V; secuelas de la recesión; desempeño de los pronósticos
Clasificación JEL: E17; E37; E32; E58; E47

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1. Introduction

Growth forecasts can help articulate a forward-looking account or story of the depth, length, shape of the covid-19 recession as well as of the demand and supply shocks likely driving it—with the help of a structural model. Using a simple structural model of the decomposition of output between potential output and the output gap, as well as between supply and demand shocks, the purpose of the paper is to try to uncover a forward-looking story of the unfolding covid-9 recession that is conveyed in growth forecasts.

The structural model is a simple decomposition of output between the output gap and potential output. The former explained by demand shocks; the later, by supply shocks. More elaborated versions of the model may include a set of Phillips curves and policy rules to close a standard new-Keynesian model. In this light, the simple structural model in the paper is the real block of a standard model in the tradition of the New Neoclassical Synthesis (NNS).

A standard approach is to use a structural model and the demand and supply shocks in order to forecast a projected path of output. Examples are Mckibbin and Fernando (2020) and Stannard et al. (2020). Counter to this method, we use the structural model and the growth forecasts to build backwards from the forecasts to the underlying demand and supply shocks, a sort of backward engineer methodology. The outcome is a likely story of the projected covid-19 recession in terms of the depth, length and shape as well as of the size, type and mix of the underlying demand and supply shocks.

The paper has six sections including this introduction. Section 2 explains the structural model and, for expositional purposes, applies the backward engineer methodology to the global financial recession. Section 4 describes the data. Section 5 presents the calibration and estimation of the model parameters as well as the estimation of the output gap. Section 6 describes the forward looking story of the projected depth, shape and length of the covid-19 recession contained in growth forecasts and the underlying supply and demand shock decomposition of the recession. Section 7 discusses the robustness of the results to different assumptions and calibrations of the model. Section 8 presents some conclusions and policy implications.

2. The model

The model is a decomposition of output into the output gap and potential output, with processes for the output gap and potential output driven by demand and supply shocks.

Output Y_t is split between the output gap $\hat{Y}_t$ and potential output $\bar{Y}_t$ as follows:

$$Y_t = \hat{Y}_t + \bar{Y}_t. \text{ (1)}$$

The output gap is a stationary, autoregressive process driven by a demand, or output gap shock $\varepsilon_t^{\hat{Y}}$. The output gap shock aggregates a variety of shocks, such as to confidence (global uncertainty and risk aversion)[1] and government expenditure. The output gap equation is

$$\hat{Y}_t = \alpha \hat{Y}_{t-1} + \varepsilon_t^{\hat{Y}}. \text{ (2)}$$

In turn, potential output is a nonstationary process driven by a supply output level shock $\varepsilon_t^{\bar{Y}}$ and the potential-output growth rate γ_t as follows:

$$\bar{Y}_t = \bar{Y}_{t-1} + \gamma_t + \varepsilon_t^{\bar{Y}}, \text{ (3)}$$

where the potential-output growth rate is a stationary process driven by a supply output growth shock ε_t^{γ} as follows:

$$\gamma_t = \theta \gamma_{t-1} + (1-\theta)\gamma + \varepsilon_t^{\gamma}. \text{ (4)}$$

Two measures of the potential-output growth rate can be used: $\bar{Y}_t - \bar{Y}_{t-1}$ and γ_t. The former is driven by output level and output growth shocks; the later, by output growth shocks.

As metric to gauge the depth and shape of the recession we use detrended output Y_t^{Det}. Detrended output is defined as the sum of the output gap and detrended potential output $\bar{Y}_t^{Det}$,

$$Y_t^{Det} \equiv \hat{Y}_t + \bar{Y}_t^{Det}, \text{ (5)}$$

where detrended potential output $\bar{Y}_t^{Det}$ is equal to potential output minus trend potential output $\bar{Y}_{\mathrm{t}}^{Trend}$,

$$\bar{Y}_t^{Det} \equiv \bar{Y}_t - \bar{Y}_{\mathrm{t}}^{Trend}, \text{ (6)}$$

and trend potential output is the hypothetical path of potential output in the case that all supply shocks were zero, as in

$$\bar{Y}_{\mathrm{t}}^{Trend} = \bar{Y}_{\mathrm{t-1}}^{Trend} + \gamma_{\mathrm{t}}^{Trend}, \text{ (7)}$$

[1] For a paper that incorporates global uncertainty and risk aversion as drivers of the output gap see Gómez-Pineda (2020a).

where γ_t^{Trend} is given by

$$\gamma_t^{Trend} = \theta\gamma_{t-1}^{Trend} + (1-\theta)\gamma. \quad (8)$$

In the absence of shocks, equations 7 and 8 mean that $\bar{Y}_t^{Trend}$ is simply a time trend. In addition, detrended output is normalized to zero in the base year, $\bar{Y}_{2019}^{Det} = 0$, so that trend potential output is equal to potential output in that base year, $\bar{Y}_{2019}^{Trend} \equiv \bar{Y}_{2019}$.

In equation 5, detrended output is the sum of the output gap and detrended potential output, or in other terms, (output – trend potential output) = (output – potential output) + (potential output – trend potential output). At the right hand side of the equation; the first term, the output gap, is stationary. In turn, the second term, detrended potential output, is not stationary. In other words, output converges to potential output while potential output drifts away from trend potential output. The output gap can be an important input in the formulation of monetary and fiscal policy. In turn, these demand policies can influence the output gap. In contrast, detrended potential output cannot be influenced by these demand policies; rather, it is the outcome of the containment, social-distancing, de-escalation and vaccination policies implemented to deal with the pandemic.

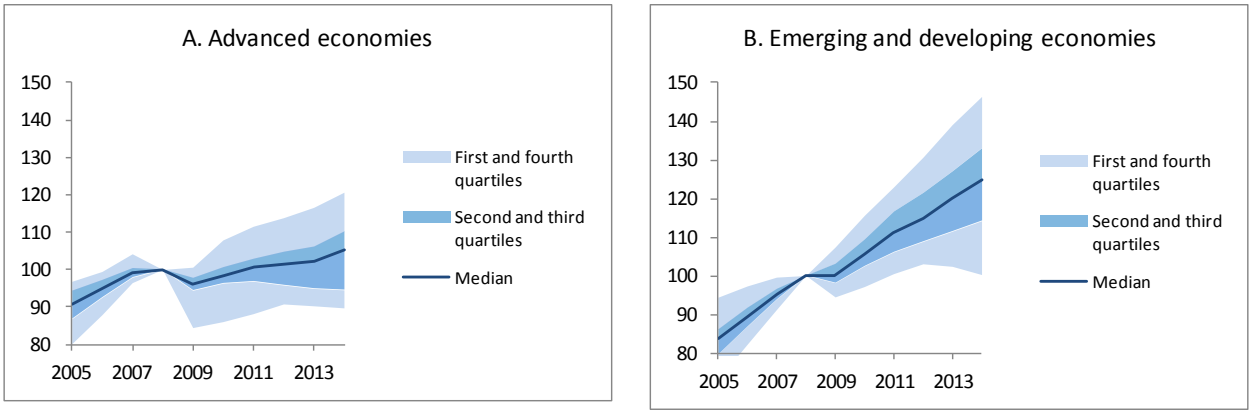
The simple structural model in equations 1 to 4 can be extended in several ways. On the demand side, the output gap equation can be enhanced to include confidence variables such as global uncertainty and global risk aversion. On the supply side, the potential output block in equations 2 and 3 can be augmented using information on containment measures such as quarantines, establishments and school closures and restrictions on local and international transportation, an example is Stannard, Steven, and McDonald (2020) and data is available in Thomas et al. (2020).

For expositional purposes, we go back to the global financial recession, so as to be able to use observed, historical data in the exposition of the model; afterwards, we use the growth forecasts data to deal with the covid-19 recession. Consider the historical output data in advanced and emerging and developing economies in Figure 1. Using (log) output level data, the shape of the recession can hardly be observed. Consider now Figure 2, where detrended output shows a broadly L-shaped recession in advanced economies and a swoosh-shaped recession in emerging and developing economies, particularly in the interquartile range that includes the more standard economies. In advanced economies the recession is deeper. In turn, the length of

the recession is difficult to grasp at this point as we have not yet incorporated a structural model. We now turn to this topic.

Figure 1. Observed output during the global financial recession

Quartile distribution

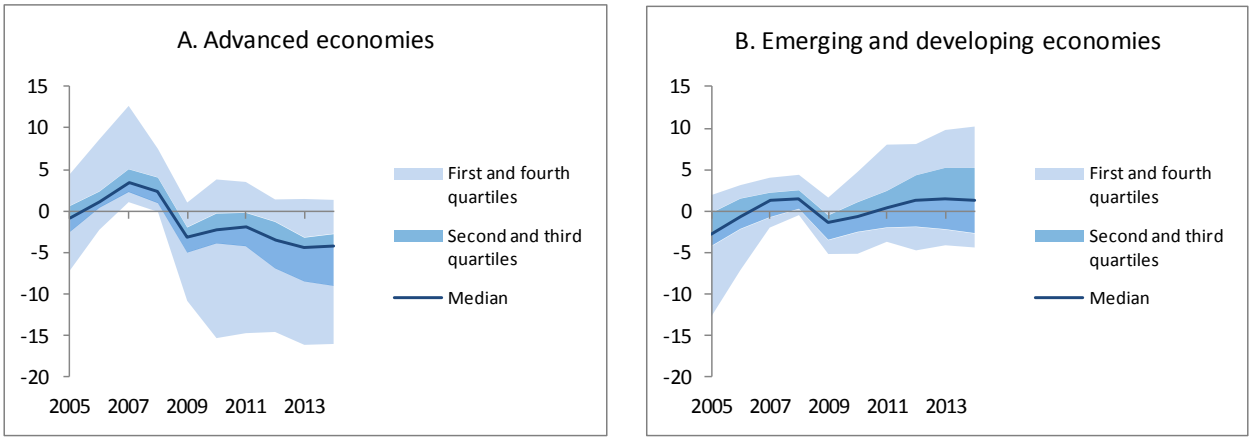


Note: the figure depicts log output normalized at 100 in 2019 The bottom 5 and top 95 percentiles were excluded.

Source: author's calculation based on growth forecasts from Focus Economics.

Figure 2. Detrended output during the global financial recession

Quartile distribution



Source: author's calculation based on growth forecasts from Focus Economics.

Both the output gap and detrended potential output can be obtained as the sum of current and past demand and supply shocks, respectively. An expression for the output gap as a function of current and past demand shocks can be obtained iterating equation (2) backwards

$$\hat{Y}_t = \varepsilon_t^{\hat{Y}} + \alpha\varepsilon_{t-1}^{\hat{Y}} + \alpha^2\varepsilon_{t-1}^{\hat{Y}} + \cdots + \alpha^{t-1}\varepsilon_1^{\hat{Y}} + \alpha^t\hat{Y}_0.^{2} \quad (9)$$

[2] For instance, $\hat{Y}_{2022} = \varepsilon_{2022}^{\hat{Y}} + \alpha\varepsilon_{2021}^{\hat{Y}} + \alpha^2\varepsilon_{2020}^{\hat{Y}} + \alpha^3\hat{Y}_{2019}$.

Importantly, with a stationary process as the one that defines the output gap in equation 2, demand shocks have effects that are transitory. It is then reasonable to talk about a length of the recession in the demand side of the model, in the output gap, because in the absence of shocks it eventually converges to zero. The story is different when dealing with supply shocks.

As a function of current and past supply shocks, detrended potential output can be obtained iterating backwards equations (3) and (4) to obtain[3]

$$\bar{Y}_t^{Det} = \left(\varepsilon_t^{\bar{Y}} + \varepsilon_{t-1}^{\bar{Y}} + \cdots + \varepsilon_0^{\bar{Y}}\right) + \left(\varepsilon_t^{\gamma} + 2\varepsilon_{t-1}^{\gamma} + 3\varepsilon_{t-2}^{\gamma} + \cdots + t\varepsilon_1^{\gamma}\right), \quad (10)$$

where use has been made of $\bar{Y}_t^{Det} \equiv \bar{Y}_t - (\bar{Y}_{-1} + t\gamma_0)$, and, for expositional purposes, $\theta \sim 1$.

Since, by equation 3, potential output is not stationary, supply shocks have effects on potential output that are permanent. In this light, there cannot be a length of the recession in the supply side of the model; that is, in detrended potential output. A similar rationale applies to detrended potential output.

Detrended output, defined in equation 5, can be obtained as the sum of current and past demand and supply shocks. Plugging equations 9 and 10 into equation 5 gives

$$Y_t^{Det} \equiv \left(\varepsilon_t^{\bar{Y}} + \varepsilon_{t-1}^{\bar{Y}} + \cdots + \varepsilon_0^{\bar{Y}}\right) + \left(\varepsilon_t^{\gamma} + 2\varepsilon_{t-1}^{\gamma} + 3\varepsilon_{t-2}^{\gamma} + \cdots + t\varepsilon_1^{\gamma}\right) + \varepsilon_t^{\hat{Y}} + \alpha\varepsilon_{t-1}^{\hat{Y}} + \alpha^2\varepsilon_{t-1}^{\hat{Y}} + \cdots + \alpha^{t-1}\varepsilon_1^{\hat{Y}}. \quad (12)$$

Again, inasmuch as supply shocks have permanent effects on output, there cannot be a length of the recession in detrended output.

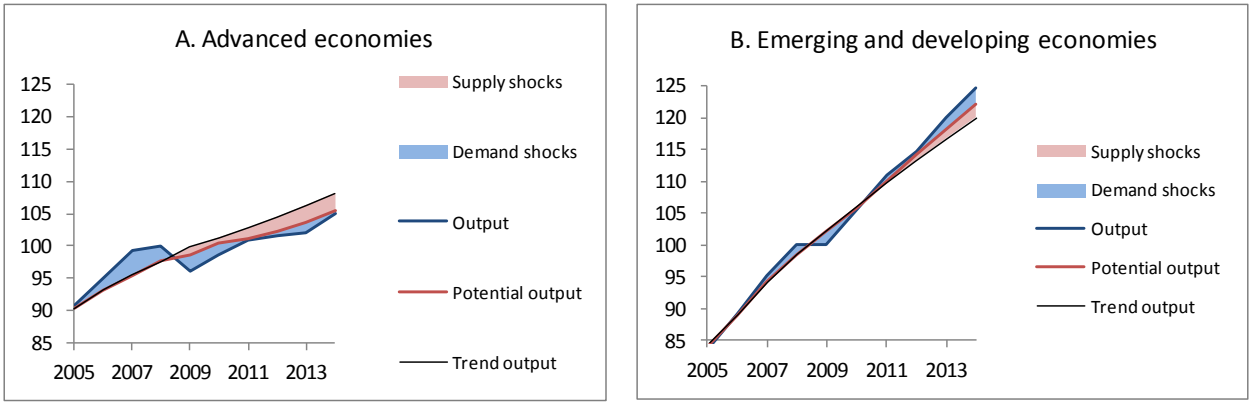
Going back to the global financial recession, Figure 3 shows potential output, trend output as well as the cumulative demand and supply shocks explaining the output gap and detrended potential output in the median advanced and emerging and developing economy. With the help of the concept of detrended output, the depth and shape of the recession in Figure 4 can be observed easier than in Figure 3.[4] In advanced economies the recession in detrended output is broadly L-shaped while in emerging and developing economies the recession in detrended output is swoosh-shaped. In advanced economies the length of the recession in the output gap is longer while in emerging and developing economies it is shorter.

[3] For example, $\bar{Y}_{2022} = \varepsilon_{2022}^{\bar{Y}} + \varepsilon_{2021}^{\bar{Y}} + \varepsilon_{2020}^{\bar{Y}} + \varepsilon_{2022}^{\gamma} + 2\varepsilon_{2021}^{\gamma} + 3\gamma_{2019} + \bar{Y}_{2019}$. We have made use of the approximation.

[4] We use as long-term growth rate the average growth rate during 2010–2019. We also incorporated in the estimation the estimated output gaps.

Figure 3. Output, potential output and trend output during the global financial recession

Observed median output in the historical data and median estimated potential and trend output

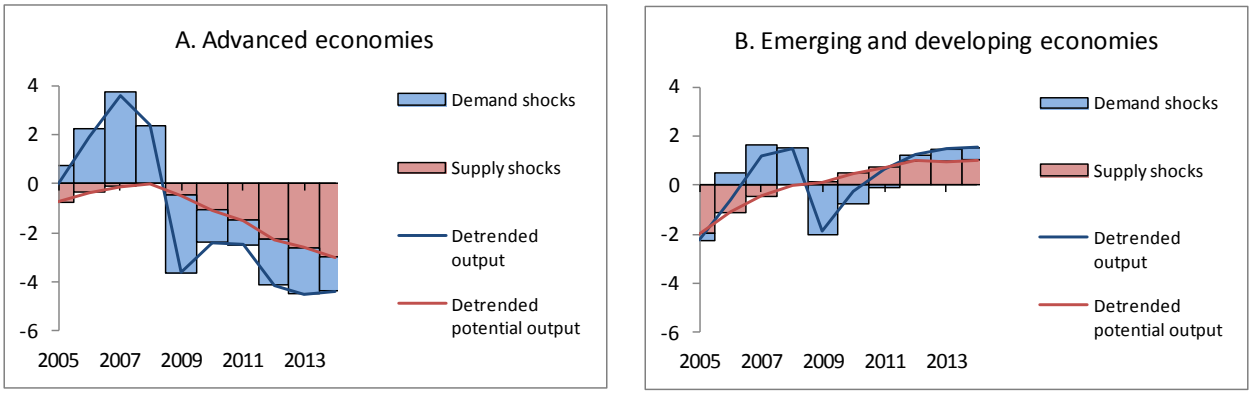


Source: author's estimation based on the model in the text and growth historical data from the IMF, April 2020, WEO database.

In advanced economies, the L-shaped recession is the result of a curved-shaped recession in detrended potential output and a V-shaped recession in the output gap, as shown in Figure 4. In emerging and developing economies, the swoosh-shaped recession is the result of a curved-shaped increase in detrended potential output and a V-shaped recession in the output gap.

Figure 4. Assumed cumulative demand and supply shocks during the global financial recession

Shock decomposition of estimated median detrended output



Source: author's estimation based on the model in the text and historical growth data from the IMF, April 2020, WEO database.

Concerning the shape of the recession in detrended potential output, in both, advanced and emerging and developing economies, it is curved-shaped and smooth. In advanced economies it is convex (or convex downward), particularly when increasing the sample until 2019 (not

reported) while in emerging and developing economies it is concave. The convexity or concavity feature arises from the potential-output growth rate, a topic we will deal with below.

The historical shock decomposition of the global financial recession is the result of the estimated output gap using historical output data. A different matter is the use of output forecasts for 2020 and into the future, combined with an assumed mix of demand and supply shocks from 2020 onwards, as discussed in the results section.

In order to build the mix of demand and supply shocks; or, in other words, a combined shock, we made identifying assumptions about the shock to demand relative to supply and the shock to the output level relative to the output growth. Using equations 1 to 4, the model shocks can be written as a function of the growth forecast and information available at time t as follows:

$$\varepsilon_t^{\hat{Y}} + \varepsilon_t^{\bar{Y}} + \varepsilon_t^{\gamma} = (Y_t - Y_{t-1}) + k_t, \text{ (12)}$$

where $Y_t - Y_{t-1}$ is the growth forecast and $k_t = (1-\alpha)\hat{Y}_{t-1} - \theta\gamma_{t-1} - (1-\theta)\gamma$ is past information available at time t.

According to equation 12, a given growth forecast is consistent with multiple combinations of demand and supply shocks. We then make assumptions about relative demand and a relative supply shocks to find the model shocks as

$$\varepsilon_t^{\hat{Y}} = \frac{\eta^{\hat{Y}}}{(1-\eta^{\hat{Y}})(1-\eta^{\bar{Y}})}\eta[(Y_t - Y_t) + k_t], \text{ (13)}$$

$$\varepsilon_t^{\bar{Y}} = \frac{\eta^{\bar{Y}}}{(1-\eta^{\bar{Y}})}\eta[(Y_t - Y_t) + k_t], \text{ (14)}$$

$$\varepsilon_t^{\gamma} = \eta[(Y_t - Y_t) + k_t], \text{ (15)}$$

where parameter $\eta^{\hat{Y}}$ is the relative demand shock, defined as $\eta^{\hat{Y}} \equiv \varepsilon_t^{\hat{Y}}/(\varepsilon_t^{\hat{Y}} + \varepsilon_t^{\bar{Y}} + \varepsilon_t^{\gamma})$; parameter $\eta^{\bar{Y}}$ is the relative supply level shock, defined as $\eta^{\bar{Y}} \equiv \varepsilon_t^{\bar{Y}}/(\varepsilon_t^{\bar{Y}} + \varepsilon_t^{\gamma})$; and $\eta = \left(1-\eta^{\hat{Y}}\right)\left(1 - \eta Y[\eta Y \eta Y + \eta Y 1 - \eta Y + \eta Y 1 - \eta Y + 1 - \eta Y(1-\eta Y)] - 1\right.$.

The identification of the combined shock is as follows. The output gap takes the restriction given by equation 13 on impact; that is, in the year of the shock. Afterwards, the output gap follows equation 2.[5] In turn, supply shocks can be obtained either by making supply level shocks

[5] Using the historical data in the case of the global financial recession of 2008, we use the estimated output gap data instead of equation 13.

endogenous to the growth forecast while supply growth shocks follow equation 15. Alternatively, supply output growth shocks are made endogenous to the growth forecast and supply level shocks follow equation 14.

These identifying assumptions about the combined shock can enable us to build a forward-looking story about how the covid-19 recession is to unfold. Such a story is, in principle, relevant for monetary policy, at least because the depth of the recession in the output gap is an input in Taylor rules and forecast rules that use the output gap. It is also relevant for fiscal policy as the depth of the recession in the output gap is important for estimating fiscal cyclical revenue as well as the structural balance—if fiscal rules are at all binding during the covid-19 recession. These identifying assumptions cannot be true; they are only assumptions subject to model uncertainty. In like fashion, growth forecasts are not true, they are subject to at least to additive (shock) uncertainty.

In the future, as more data becomes available and also with the benefit of hindsight, a story about the role of supply and demand shocks in the recession can be estimated; however, that would only be a historical account of the covid-19 recession. The research strategy in the paper is to make use of the identifying assumptions about the relative demand and supply shocks to find the implicit forward looking story about the projected recession conveyed in 2020 growth forecasts. We then analyze the robustness of the results to the identifying assumptions.

3. The data

Given the large amount of uncertainty surrounding growth forecasts we use yearly data. Growth forecasts at yearly frequency are available from sources Focus Economics and World Economic Outlook (WEO) database.[6] The sample of economies includes the economies available to us in the Focus Economics database; that is, a total of 65 economies, of which 29 are advanced and 36 are emerging and developing. In 2019, the economies in the sample accounted for 83.5 percent of world output, evaluated at PPP exchange rates, 38.7 for advanced economies, 44.8 emerging and developing economies and 25.6 for emerging and developing economies excluding China.[7]

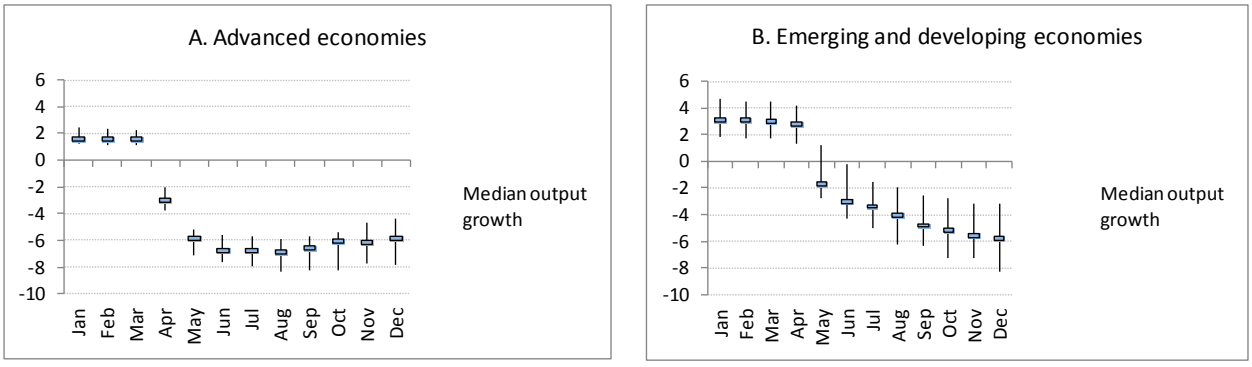
[6] In contrast with yearly forecasts, quarterly growth forecasts are typically available for a 2-year forecasting horizon.
[7] We used all the economies available in our Focus Economics service but excluded Puerto Rico because it was not in the IMF database for the period of the global financial recession and Myanmar and Malta because these countries

In the Focus Economics database, available growth forecasts for each economy are the median of a number of panelists. The panelists include organizations such as investment banks, universities, research institutions and one credit rating agency. The number of panelists in each economy ranges from 7 to 55, with a median of 22. The panelists are interviewed monthly for a total of 12 forecast vintages each year.[8]

Let us first see the growth forecast for 2020 as reported by the successive monthly forecasts vintages. The median growth forecast and interquartile ranges, across monthly Focus Economics 2020 forecast vintages, appear in Figure 5. Growth forecasts plunged since April. In advanced economies, growth forecasts reached a trough in July while in emerging and developing economies they dropped continuously throughout the year. The dispersion of growth forecasts is indicated in Figure 5 by the length of the vertical line, denoting the interquartile range. In advanced economies, the interquartile range increased gradually across forecast vintages, from 2 to about 4 percentage points. In emerging and developing economies, it increased gradually from 3 to about 5 percentage points.

Figure 5. Growth forecast for year 2020 across monthly 2000 forecast vintages

Median growth in 2020 and width of the interquartile range in the monthly 2020 Focus Economics forecast vintages



Source: author's calculation based on growth forecasts from Focus Economics.

We now turn to the growth forecast vintages over time, over the 2020-22024 forecast horizon. Figure 6 shows median output growth forecasts for selected, March, July and December forecast vintages. The March vintage is the last one that does not show the covid-19 recession.

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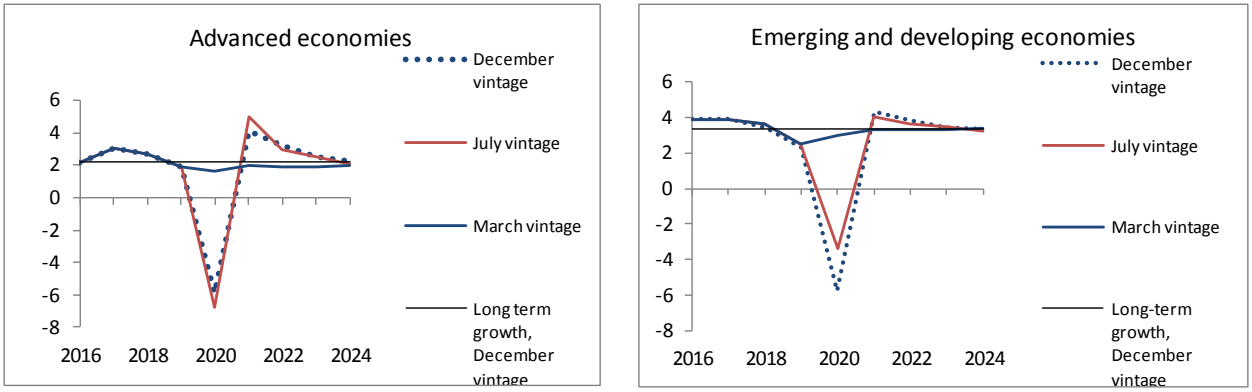
are small. In addition, we did not include the countries in the Middle East, North Africa and Sub-Saharan Africa because they are not in our available Focus Economics service.

[8]For each forecasting vintage, we use the information available at the beginning of the month. For example, for countries outside Latin America and the Caribbean, the Focus Economics July forecast vintage has information until the end-June. In turn, for countries in Latin America and the Caribbean, the Focus Economics July forecast vintage has information up to mid-July so for countries in this region we use the previous Focus Economics forecast vintage.

The July vintage is the one with the deepest recession and also the earliest where the shape of the recession broadly stabilizes. The December vintage is the latest available at the time of updating this paper. In the March vintage, median output growth forecasts in both, advanced and emerging and developing economies are nearly flat. In contrast, in the July and December forecast vintages growth forecasts are wave-shaped in advanced economies and broadly V-shaped in emerging and developing economies. Importantly, in the July and December forecast vintages growth forecasts for 2021 rise above and beyond the long-term, potential-output growth rate, strongly in advanced economies and rather weakly in emerging and developing economies. In addition, by the end of the forecast horizon, growth forecasts converge gradually to the long-term, potential-output growth rate.

Figure 6. Growth forecasts over the 2020-2024 forecast horizon in selected forecast vintages

Median output growth forecast in the Focus Economics March, July and December 2020 forecast vintages



Source: author's calculation based on growth forecasts from Focus Economics.

We now study the dispersion of growth forecasts over the forecast horizon. The growth forecasts quartile distribution in the July forecast vintage appears in Figure 7.[9] The interquartile range, including the more standard economies, is waved-shaped in advanced economies and broadly V-shaped in emerging and developing economies.[10]

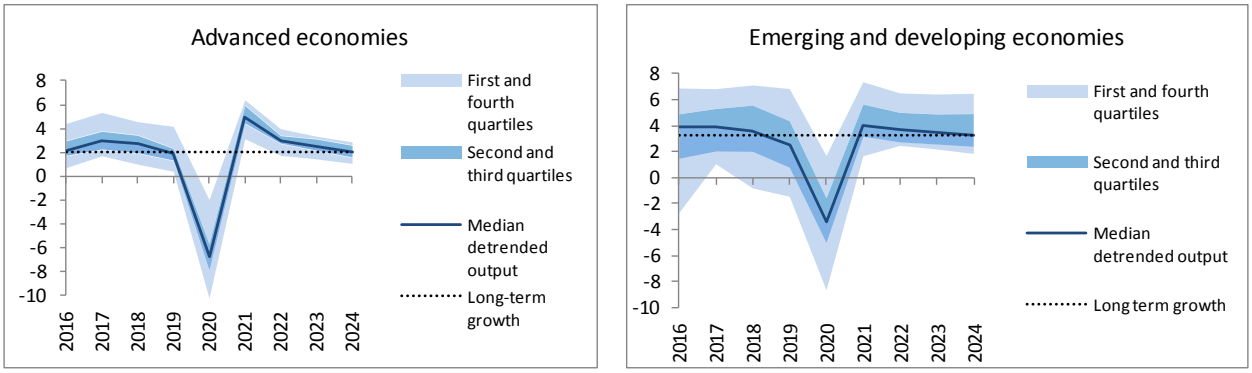
Concerning growth forecasts from source IMF, Figure 8 presents the growth forecast data from source WEO, October 2020 database. Most of the features explained for the Focus Economics data also apply to the WEO data. In particular, after the collapse in 2020, growth

[9] To exclude atypical values, the figures exclude the lowest and highest 5 percentiles.
[10] There is a small number of exceptions to this stylized fact. In advanced economies, growth forecasts for Portugal are V-shaped while in emerging and developing economies growth forecasts for China, Peru, Malaysia and Vietnam are waved-shaped.

forecasts for 2021 rise above and beyond the long-term, potential-output growth rate, especially in advanced economies.

Figure 7. Growth forecasts over the forecast horizon

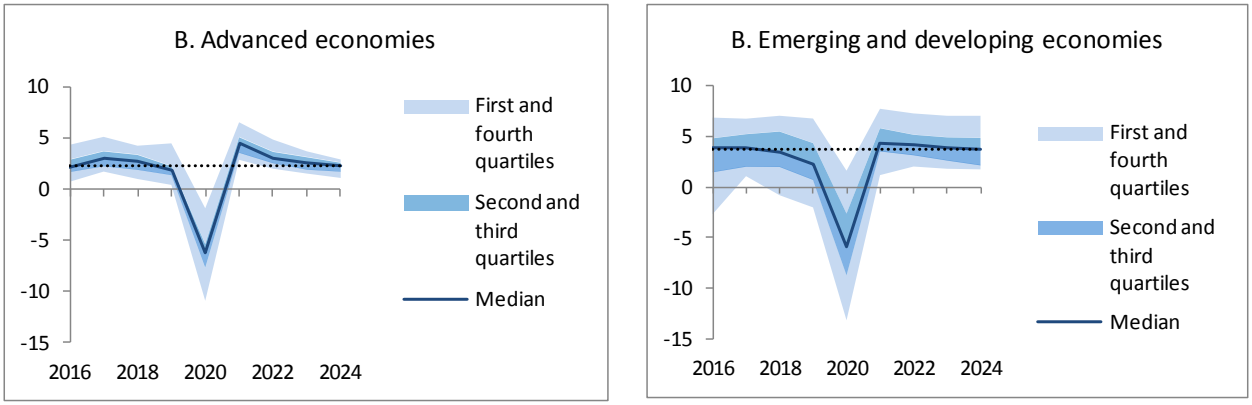
Quartile distribution of growth forecasts in the Focus Economics July 2020 vintage



Source: author's calculation based on growth forecasts from Focus Economics.

Figure 8. Growth forecasts over the forecast horizon, as projected by the IMF

Quartile distribution of growth forecasts in the WEO, October 2020 database



Source: author's calculation based on growth forecasts from the IMF.

Output gap data is available, for most of the advanced economies, in the World Economic Outlook (WEO) database, October 2019. Output gap data is not available from this source for 6 advanced economies as well as for all of the emerging and developing economies in the sample. For these economies the output gap was estimated.[11] [12]

[11] Output level data for the period 1995–2019 was constructed using output growth data from source the World Economic Outlook database, April 2020. (Log) output level data was constructed accumulating growth rates; that is, using $Y_t = Y_{t-1} + g_t$, where Y_t is log output and g_t is output growth. The percent growth figures were transformed into logarithmic growth with the expression $g_t = 100 \times \log(1 + G_t/100)$, where G_t is percent growth. To construct PPP weighted data we used variable weights.

4. Calibration and estimation

The calibration and estimation of the model involved three parts: first, the calibration and estimation of three parameters; second, the estimation of the output gap; and third, the detrending method.

We first deal with the calibrated and estimated parameters. They are the persistency of the potential-output growth rate θ, the persistency of the output gap α and the long-term, potential-output growth rate γ.

The persistency of the potential-output growth rate θ was set at 0.5 so as to have the potential-output growth rate converge to the long-term, potential-output growth rate by the end of the forecast horizon. This will be made clearer below in the impulse response analysis.[13] Given the calibrated persistency of the potential-output growth rate, the effect of an output growth shock on the potential output level is twice as large as the effect of a level shock, as will be made clearer below.

The persistency of the output gap α was estimated. Table 1 presents the estimation results. The obtained posterior estimates are different from the prior means, reflecting the contribution of the data to the estimated parameters.[14]

The long-term, potential-output growth rate γ was set equal to the growth forecast at the end of the forecast horizon, in 2024.[15]

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[12] In the exercises that use IMF growth forecasts, the sample of economies in the exercises that deal with the global financial recession includes the same countries as in the exercises that deal with the covid-19 recession. In contrast, in the exercises using the Focus Economics October 2009 forecast vintage the sample of economies only includes the then available data including 36 economies, 18 advanced economies and 18 emerging and developing economies.

[13] The convergence criteria here is that by the end of the forecast horizon the response to an output growth shock is one order of magnitude smaller that the shock.

[14] The prior standard deviations were shrunk in a series of estimation runs until convergence of the regularized likelihood to the maximum was achieved. The estimation process took about three estimation runs.

[15] Because they are historical data and not projected trends, for the historical estimations dealing with the global financial recession we instead used as long-term, potential-output growth rate the average over the period 2010–2019.

Table 1. The estimated output gap persistence

	Prior	Posterior		Prior	Posterior
Advanced economies	0.65	0.66			
			Emerging and developing economies		
Emerging and developing economies	0.4	0.41			
			Argentina	0.45	0.46
Emerging and developing economies excluding China	0.4	0.41	Bangladesh	0.5	0.50
			Belize	0.65	0.65
			Bolivia	0.85	0.81
			Brazil	0.65	0.66
Advanced economies			Brunei Darussalam	0.75	0.75
			Cambodia	0.7	0.70
Australia	0.6	0.62	Chile	0.55	0.57
Austria	0.5	0.51	China	0.3	0.30
Belgium	0.4	0.41	Colombia	0.65	0.68
Canada	0.5	0.51	Costa Rica	0.55	0.56
Cyprus	0.8	0.79	Dominican Republic	0.75	0.77
Estonia	0.55	0.56	Ecuador	0.7	0.70
Finland	0.55	0.57	El salvador	0.45	0.46
France	0.6	0.62	Guatemala	0.55	0.56
Germany	0.2	0.20	Haiti	0.35	0.36
Greece	0.95	0.91	Honduras	0.6	0.61
Hong Kong SAR	0.35	0.35	India	0.1	0.10
Ireland	0.7	0.73	Indonesia	0.7	0.74
Italy	0.75	0.74	Jamaica	0.75	0.76
Japan	0.7	0.72	Lao P.D.R.	0.75	0.74
Korea	0.1	0.10	Malaysia	0.25	0.25
Latvia	0.7	0.71	Mexico	0.35	0.36
Lithuania	0.6	0.60	Mongolia	0.6	0.63
Luxembourg	0.4	0.41	Nicaragua	0.55	0.56
Netherlands	0.65	0.67	Pakistan	0.8	0.80
New Zealand	0.8	0.79	Panama	0.85	0.83
Portugal	0.85	0.83	Paraguay	0.45	0.46
Singapore	0.3	0.30	Peru	0.35	0.36
Slovak Republic	0.55	0.57	Philippines	0.15	0.15
Slovenia	0.7	0.71	Russia	0.55	0.56
Spain	0.9	0.85	Sri Lanka	0.35	0.36
Switerland	0.45	0.46	Thailand	0.6	0.63
Taiwan Province of China	0.3	0.31	Trinidad and Tobago	0.25	0.25
United Kingdom	0.7	0.71	Uruguay	0.8	0.78
United States	0.75	0.75	Vietnam	0.45	0.46

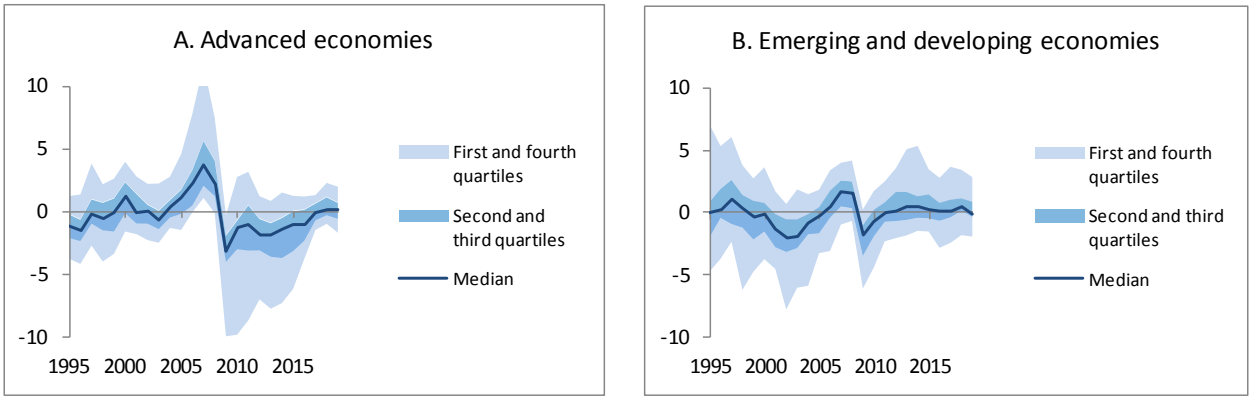
Source: author's estimation based on the model in the text and data from Focus Economics and the IMF, April 2020, WEO database.

Now we turn to the estimation of the output gap. As mentioned above, in economies with available output gap data these data was incorporated into the model. This was the case in 23 out of the 29 advanced economies in the sample.[16] In turn, in economies without readily available output gap data the output gap was estimated. This was the case for some advanced economies and all of the 36 emerging and developing economies in the sample.[17] The estimation involved calibrating two relative standard deviations, first, the standard deviation of the demand shock relative to the standard deviation of the supply shocks, $\sigma_{\varepsilon^{\bar{Y}}}/(\sigma_{\varepsilon^{\bar{Y}}} + \sigma_{\varepsilon^{Y}})$; second, the standard deviation of the output level shock relative to the standard deviation of the output growth shock, $\sigma_{\varepsilon^{\bar{Y}}}/(\sigma_{\varepsilon^{\bar{Y}}} + \sigma_{\varepsilon^{Y}})$. The first relative standard deviation was set at 0.3.[18] The second one was calibrated in the range 0.175–0.75, depending on the economy, with a median of 0.175.

The output gaps that are available in the source as well as those that were estimated appear in Figure 9. During the global financial recession the downturn in the output gap in advanced economies was deeper and longer lasting.

Figure 9. The output gap

Quartile distribution of the estimated output gap



Source: the output gap is from the IMF, October 2019, WEO database for the following countries (in ISO codes): AU, AT, BE, CA, CY, EE, FI, FR, DE, GR, IE, IT, JP, KR, LU, NL, NZ, PT, SK, SI, ES, GB and US. The output gap was estimated by the author for the following countries: HK, LV, LT, SG, CH, TW, AR, BD, BZ, BO, BR, BN, KH,

[16] Using ISO codes, the economies are the following: AU, AT, BE, CA, CY, EE, FI, FR, DE, GR, IE, IT, JP, KR, LU, NL, NZ, PT, SK, SI, ES, GB and US.

17 The economies are the following: HK, LV, LT, SG, CH, TW, AR, BD, BZ, BO, BR, BN, KH, CL, CN, CO, CR, DO, EC, SV, GT, HT, HN, IN, ID, JM, LA, MY, MX, MNNI, PK, PA, PY, PE, PH, RU, LK, TH, TT, UY and VN.

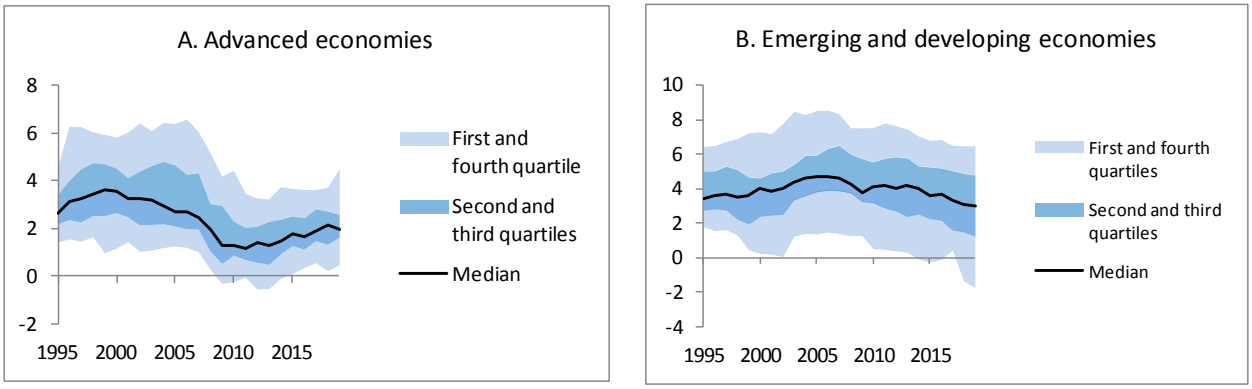
[18] For clarity, this relative standard deviation is for estimation purposes over the historical sample period 1995–2019. This relative standard deviation is different from the relative demand shock in 2020, a relative shock in 2020 that is used for forecasting purposes.

CL, CN, CO, CR, DO, EC, SV, GT, HT, HN, IN, ID, JM, LA, MY, MX, MNNI, PK, PA, PY, PE, PH, RU, LK, TH, TT, UY and VN.

The estimation of the output gap is related to the estimation of the potential-output growth rate; the later appears in Figure 10. Starting the global financial recession, the potential-output growth rate is convex in advanced economies and concave in emerging and developing economies. In advanced economies, the convex path explains the negative supply shocks and the path of detrended potential output in Figure 4. In emerging and developing economies, the concave path explains the positive supply shocks and the path of detrended potential output in Figure 4.

Figure 10. The potential-output growth rate

Quartile distribution of the estimated potential-output growth rate



Source: own estimation based on the model in the text and data from the IMF, October 2019, WEO database.

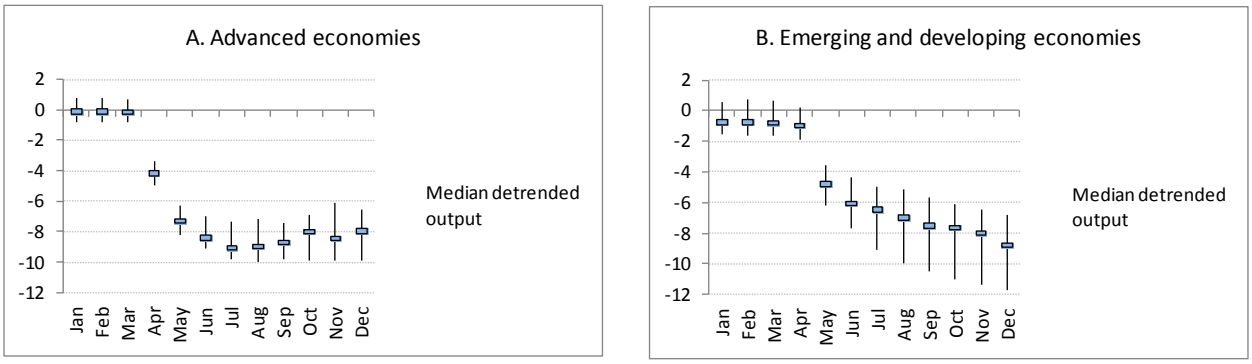
The third part of the estimation and calibration of the model involves the detrending method, in particular, the preferred long-term, potential output growth rate. Dealing with historical data, we have used an average of past data. A different matter is a forward looking projection, as the projected recession over the 2020–2024 forecast horizon. Commonly, an average of past data is used as preferred long-term, potential output growth rate; that is, current, forward looking projections are evaluated against the benchmark of past, backward looking averages. Instead, we use the currently projected rate of growth at the end of the forecast horizon, a forward looking measure. Our measure of long-term, potential-output growth rate is the steady state that eventually will have to be surmounted during recovery. Nonetheless, as shown below, the results are robust to the choice of long-term, potential-output growth rate.

5. Results

The first result is about the depth of the recession. The July 2020 forecast vintage conveys recessions of –9.1 and –6.4 percentage points, in the median advanced and emerging and developing economy, respectively.[19] In the December forecast vintage, the projected depth of the recession improved in advanced economies and deteriorated in emerging and developing economies. In advanced economies the median depth of the recession improved about 1.1 percentage point to –7.9 percent, from –9.1 percent in July.[20] In emerging and developing economies the median depth of the recession deteriorated about 2.3 percentage points to –8.8 percent, from nearly –6.4 percent in July (Figure 11 and Table 2). The December projections can be considered relatively reliable for 2020, as they are based on observed data for up to the second and third quarters of the year.

Figure 11. The projected depth of the covid-19 recession across 2000 monthly forecast vintages

Median detrended output and width of the interquartile range in the Focus Economics 2020 forecast vintages



Note: the dots denote median detrended output; the vertical lines denote the interquartile range.
Source: own estimation based on the model in the text and growth forecasts from Focus Economics.

In July 2020, growth forecasts tended to be negatively correlated with per capita income (Figure 12, Panel A). In contrast, in December 2020, growth forecasts tended to be positively correlated with per capita income (Figure 12, Panel B). As a result, the prospects for advanced economies improved while those for emerging and developing economies deteriorated (Figure 12, Panel C).

[19] Growth figures and the trough of the recession may change with a number of factors. First, the measure of central tendency; that is, whether the median or the weighted average is used. Second, with the definition of distance; whether logarithmic or percent distance is used. Third, they may also change with the sample of economies included in the estimation. The reported figures are the median of the logarithmic deviation of the sample of economies described in the data section.

[20] Figures may not add up because of rounding.

Table 2. The projected depth of the covid-19 recession

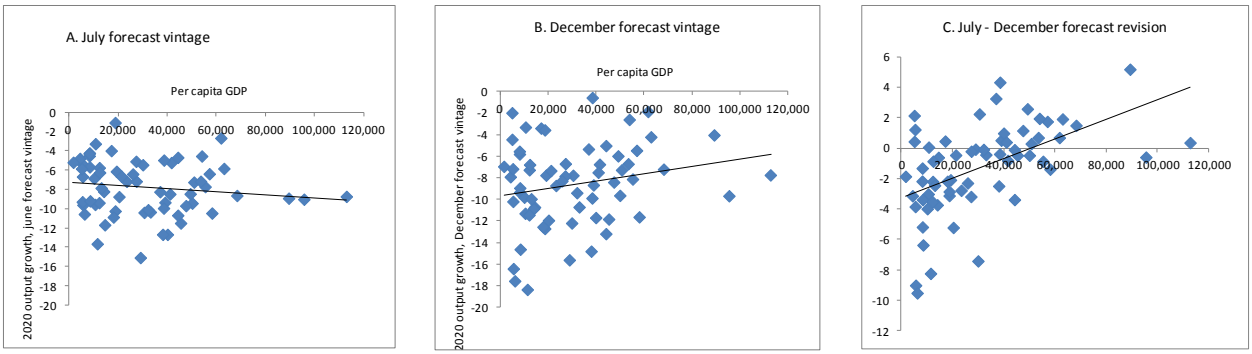
Detrended output in 2020

	Advanced economies		Emerging and developing economies	
	Median	Width of the interquartile range	Median	Width of the interquartile range
Focus Economics, July 2020	-9.1	2.5	-6.4	4.2
Focus Economics, December 2020	-7.9	3.4	-8.8	4.9
WEO April 2020	-8.4	1.5	-6.1	3.1
WEO October 2020	-8.5	3.8	-8.7	5.5

Source: author's estimation based on the model in the text and growth forecasts from Focus Economics and IMF.

Figure 12. Growth forecast for 2020 and per capita GDP

Per capita GDP *vs.* growth forecast for 2020 in the Focus Economics, December 2020 forecast vintage



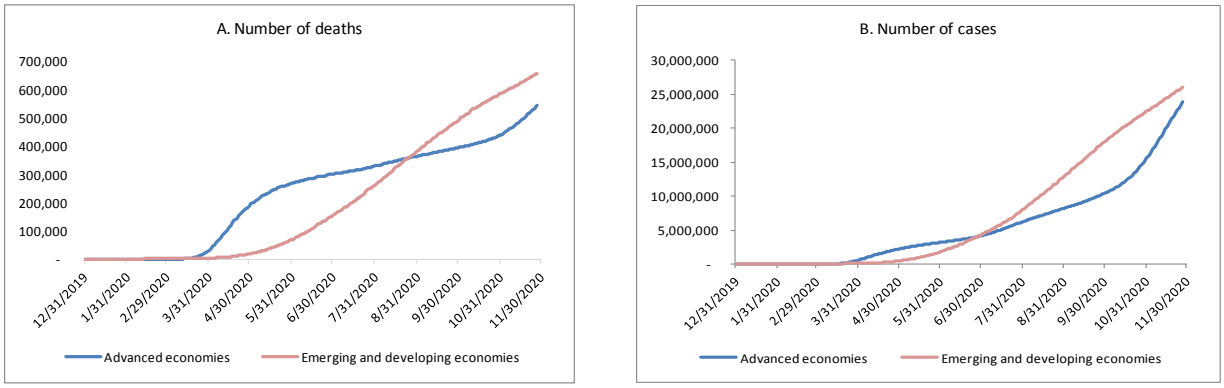
Source: author's estimation based on growth forecasts from Focus Economics and per capita GDP from the IMF, October 2019, WEO database.

The deeper projected recession in emerging market and developing economies at end-2020 may be explained by the increase in the prevalence of the disease in the second half of the year, as gauged by the number of deaths and cases (Figure 13). It can also be explained by the more limited reach of fiscal and monetary policies, see for instance Alberola et al. (2020), Cavallino and De Fiore (2020) and Deb et al. (2020).

The second result is about the shape of the recession. Figure 14 shows a V-shaped recession with partial recovery in the median advanced economy and an L-shaped recession in the median emerging and developing economy.

Figure 13. Covid-19 deaths and cases

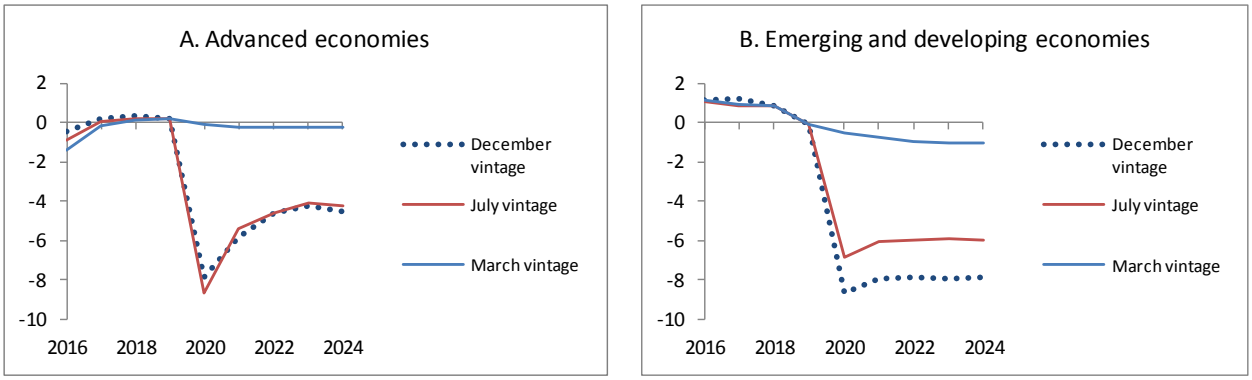
Number of deaths and cases in the countries in the sample



Source: author's calculation based on covid-19 deaths and cases data from John Hopkins University.

Figure 14. The projected depth and shape of the covid-19 recession in selected forecast vintages

Median detrended output in the Focus Economics March, July and December 2020 forecast vintages



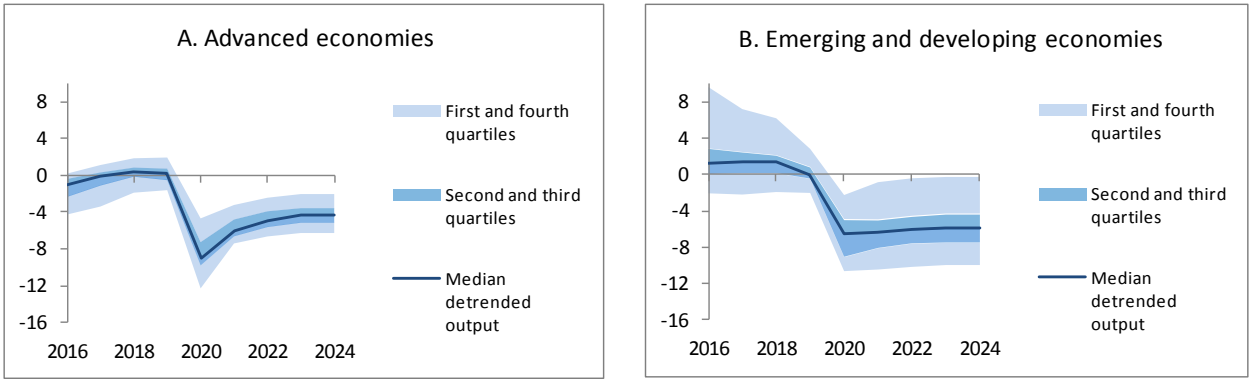
Source: author's estimation based on the model in the text and growth forecasts from Focus Economics.

The shape of the recession is maintained across the quartile distribution (Figure 15). In addition, the dispersion is broadly maintained within the interquartile range. Outside the interquartile range, in emerging and developing economies the dispersion is larger (Figure 15, Panel B).

Similar results about the depth and the shape of the recession are obtained using the WEO, October 2020, forecast database (Figure 16). The depth and shape of the recession are similar to those obtained using the Focus Economics database.

Figure 15. The projected depth and shape of the covid-19 recession

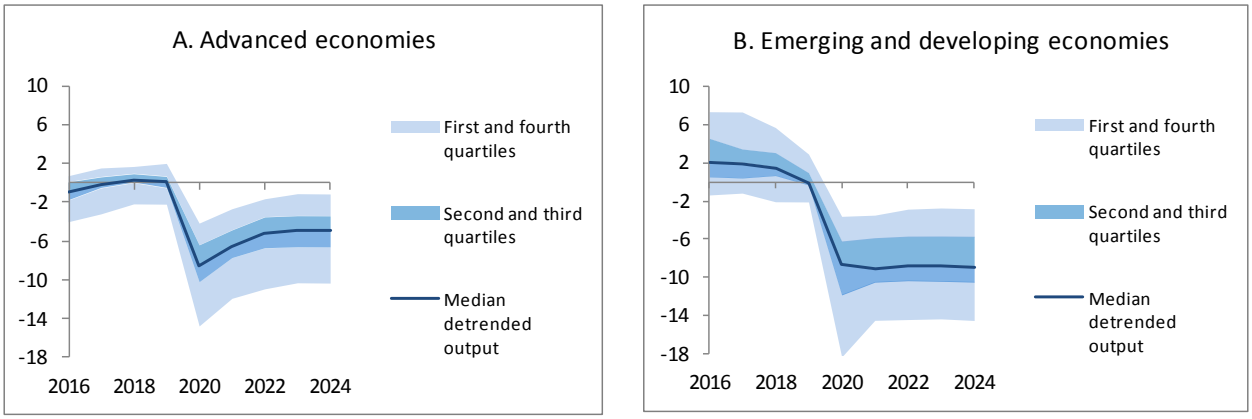
Quartile distribution of detrended output in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and growth forecasts from Focus Economics.

Figure 16. The projected depth and shape of the covid-19 recession, as projected by the IMF

Quartile distribution of detrended output in the WEO, October 2020 database



Source: author's estimation based on the model in the text and growth forecasts from IMF.

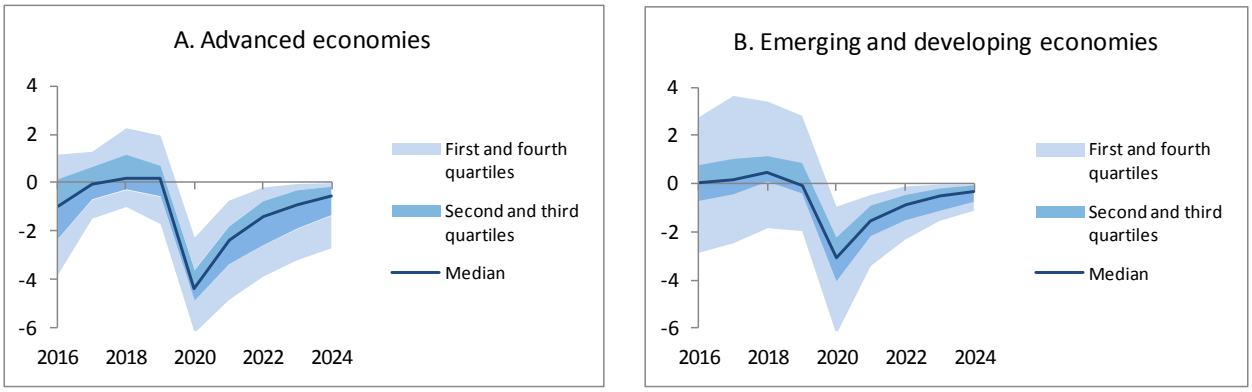
The third result is about the length of the recession. An idea about the length of the recession should be evaluated using the output gap. The reason is that shocks to the output gap eventually die out. In contrast, shocks to potential output do not die out and so have permanent effects. Figure 17 shows the quartile distribution of the projected output gap. If we take the length of the recession as the time necessary for the output gap to shrink by 4, the length of the recession is about 4 years for the standard economies accounted for within the interquartile range.

The fourth result is that the recession can be better characterized in advanced economies as a consequence of an output level shock and in emerging and developing economies as the result of an output growth shock. To explain this result we present some impulse response analysis.

Figure 18 presents the response to a combined demand and supply shock amounting to 1 percentage point of potential output. In Panel A the relative demand shock is ½ while the supply shock is an output level shock; that is, the relative supply shock is 1. In Panel B the relative demand shock is ½ while the supply shock is an output growth shock; that is, the relative supply shock is 0.

Figure 17. The assumed depth and the estimated length of the covid-19 recession

Quartile distribution of the forecasted output gap



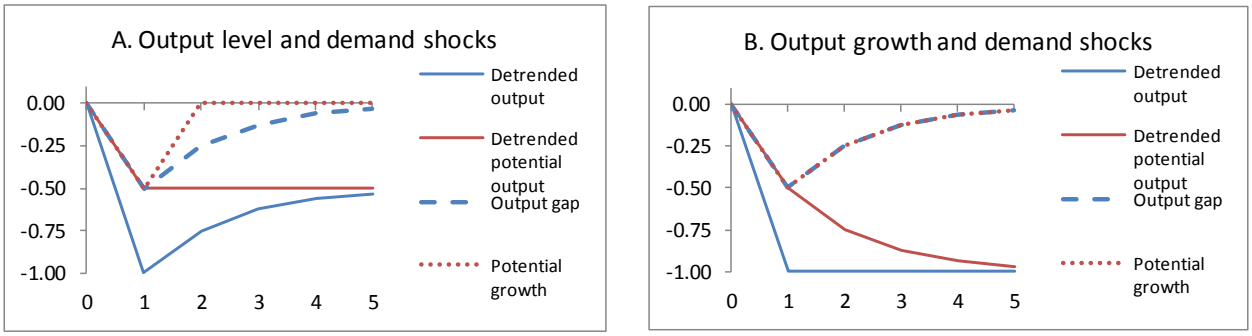
Source: author's estimation based on the model in the text and growth forecasts from the Focus Economics, July 2020 forecast vintage.

When the supply shock is an output level shock, Panel A, the recession in detrended output is V-shaped with partial recovery. Recall that detrended output is equal to detrended potential output plus the output gap (see equation 5). The V-shaped recession with partial recovery is the result of a V-shaped recession in the output gap, the dashed blue line in Figure 18; plus an L-shaped recession in detrended potential output, the solid red line in Figure 18. The latter L-shaped recession in detrended potential output is the result of a shock to equation 2 in period 1. From period 2 onwards, the red line depicting detrended potential output is constant because potential output growth, the red dotted line, returns to zero immediately after the shock.

When the supply shock is an output growth shock, Panel B, detrended output follows an L-shaped recession. Again, note that detrended output is equal to detrended potential output plus the output gap. The L-shaped recession is the result of a V-shaped recession in the output gap, the dashed blue line, plus a curved-shaped recession in detrended potential output, the solid red line. In turn, the curved-shaped recession in detrended potential output is the result of a shock to equation 3 in period 1. From period 2 onwards, potential output growth begins a gradual convergence to zero, the red dotted line, diving below zero throughout the recession and so

pulling detrended potential output along a curved-shaped recession. Detrended potential output converges to –1 as fast as the output gap converges to zero. While detrended output and the output gap diverge, they add up to 1, an L-shaped recession in detrended output ensues.[21]

Figure 18. Response to a combined supply and demand shock



Source: author's simulation based on the model in the text.

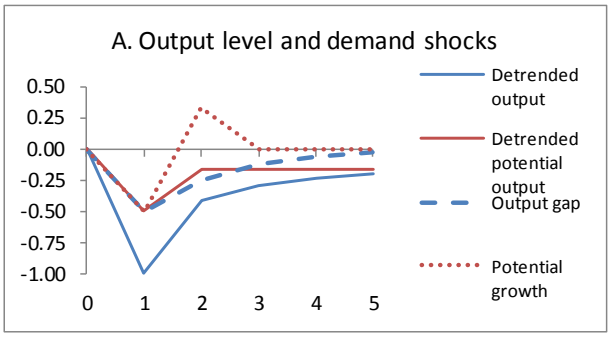
In the impulse responses considered, the scarring effects in emerging and developing economies are twice as large as those in advanced economies. The scarring is the sequel or permanent effect of supply shocks on potential output. A tentative measure of scarring would be potential output in deviation from trend potential output; that is, detrended potential output. In Figure 18, five years after the shock, the scarring is –0.5 percentage points when the supply shock is an output level shock and –1 percentage points when the supply shock is an output growth shock. Note that when the supply shock is an output level shock, Panel A, the complete scarring takes place on impact. In comparison, when the supply shock is an output growth shock, Panel B, the scarring builds up gradually and is almost complete about four to five years after the shock.

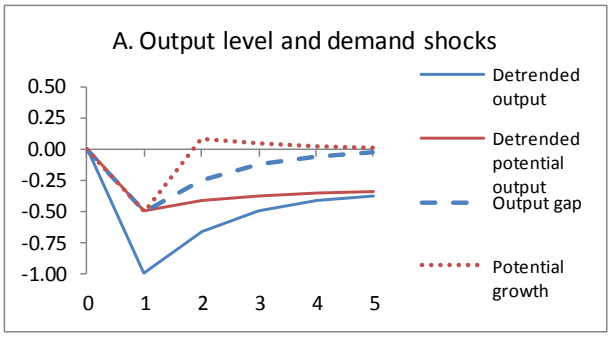
Incomplete scarring in potential output obtains if the combined demand and supply shock on impact is followed by a supply shock with opposite sign. In Figure 19, Panel A shows incomplete scarring with output level shocks while Panel B shows incomplete scarring with output growth shocks. No matter the type of supply shock, detrended potential output undergoes a V-shaped recession with partial recovery.[22]

[21] The recession in detrended output is L-shaped if potential output growth persistence is maintained in 0.5 and output gap persistence is also 0.5. If output gap persistence rises above 0.5, the L-shaped recession is convex. If output gap persistence decreases below 0.5, the L-shaped recession is concave.

[22] In the example in Figure 19, the impact supply shock $\varepsilon_t^{\bar{Y}}$ is followed by a shock of $-\frac{2}{3}\varepsilon_t^{\bar{Y}}$.

Figure 19. Response to a combined demand and supply shock with incomplete scarring





Source: author's simulation based on the model in the text.

We now turn to the issue of the shock identification strategy. A look at the impulse responses in Figure 18 and at the shape of the recessions in Figure 15 reveals that, taking the growth forecasts as given, and with the help of the model, supply shocks may better be characterized as output level shocks in advanced economies and output growth shocks in emerging and developing economies.[23] We then turn this observation into the assumption that in advanced economies supply shocks are output level shocks while in emerging and developing economies they are output growth shocks. The story is, broadly, an impact output level shock in advanced economies and an impact output growth shock in emerging and developing economies. In the robustness section, we make the opposite assumption, that shocks in advanced economies are output growth shocks while in emerging and developing economies they are output level shocks. We find that the opposite assumption makes a simple story difficult to understand.

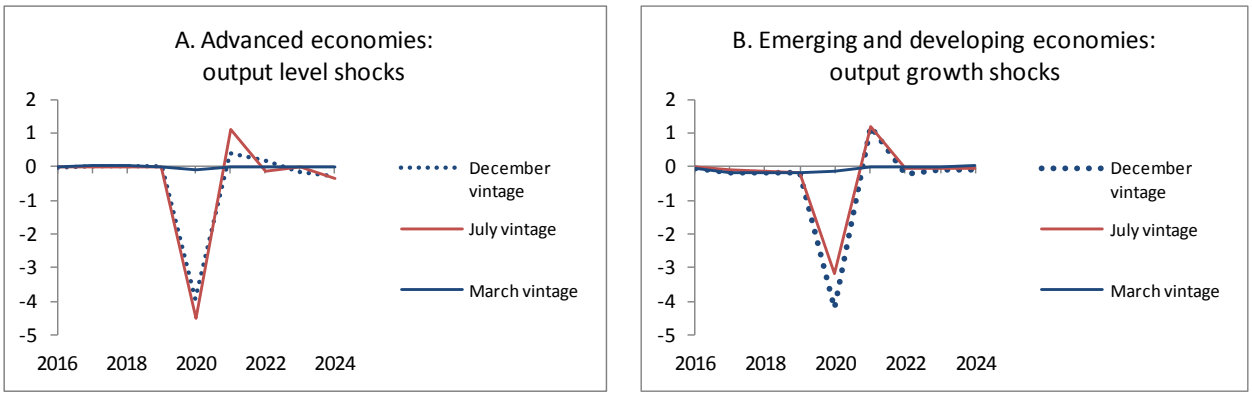
As mentioned above, we work backwards from the growth forecasts to the shocks that may give raise to them. In addition, we use assumptions about the relative demand and supply shocks. The relative supply shock was identified as mentioned above. In turn, identification of the relative demand shock is surrounded by large uncertainty. Some authors suggest demand shocks are larger than supply shocks while other authors suggest the opposite, see Baqaee and Farhi (2020), Balleer et al. (2020) and see also the overview in Macaulay and Surico (2020). Therefore, given the large amount of uncertainty surrounding the relative demand shock, we assume a relative demand shock of ½.

[23] In other terms, the relative supply level shock in advanced economies is 1 and in emerging and developing economies is 0.

Using the growth forecasts, the assumed relative demand shock, the identified relative supply shocks, and the backward engineer methodology, the implicit supply shocks appear in Figure 20. In advanced economies, in Panel A, the implicit output level shocks are not entirely stylized or V-shaped as those that give raise to the responses in Figure 18. Indeed, small and decreasing supply shocks, opposite in sign to the impact shock, appear from 2021 onwards, indicating incomplete, although incipient, scarring effects. The implicit output growth shocks in emerging and developing economies, in Panel B, are not entirely stylized and V-shaped either; a small positive output growth shock arises in 2021, indicating somewhat incipient incomplete scarring.

Figure 20. The projected supply shocks in the covid-19 recession

Median output level and growth shocks in the Focus Economics March, July and December 2020 forecast vintages



Source: author's estimation based on the model in the text and data from Focus Economics.

The distribution of the implicit supply shocks appears in Figure 21. In advanced, as well as in emerging and developing economies, the interquartile range, including the more standard economies, depicts almost stylized, V-shaped shocks with a small shock with opposite sign in 2021.

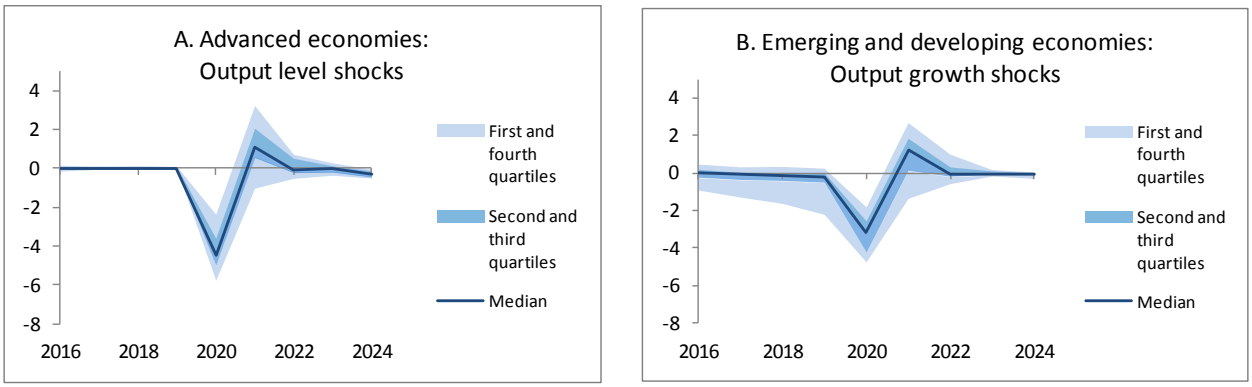
In conclusion, the implicit forward-looking account is, in advanced economies, a story of a combined demand and output level supply shock with incomplete scarring, while, in emerging and developing economies, a story of a combined demand and output growth supply shock with almost complete scarring.

We now turn to another aspect of the recession, the shock decomposition. The decomposition of median detrended output into supply and demand shocks in the July 2020 forecasting vintage appears in Figure 22. First, cumulative demand shocks explain the recession

in the output gap. Second, cumulative supply shocks explain the recession in detrended potential output. And third, cumulative demand and supply shocks explain the recession in detrended output. As dictated by the series of projected supply shocks, in advanced economies the recession in detrended potential output is broadly L-shaped while in emerging and developing economies is curved-shaped. In turn, driven by the series of projected demand and supply shocks, in advanced economies the recession in detrended output is V-shaped with partial recovery while in emerging and developing economies it is L-shaped.

Figure 21. The projected supply shocks during the covid-19 recession

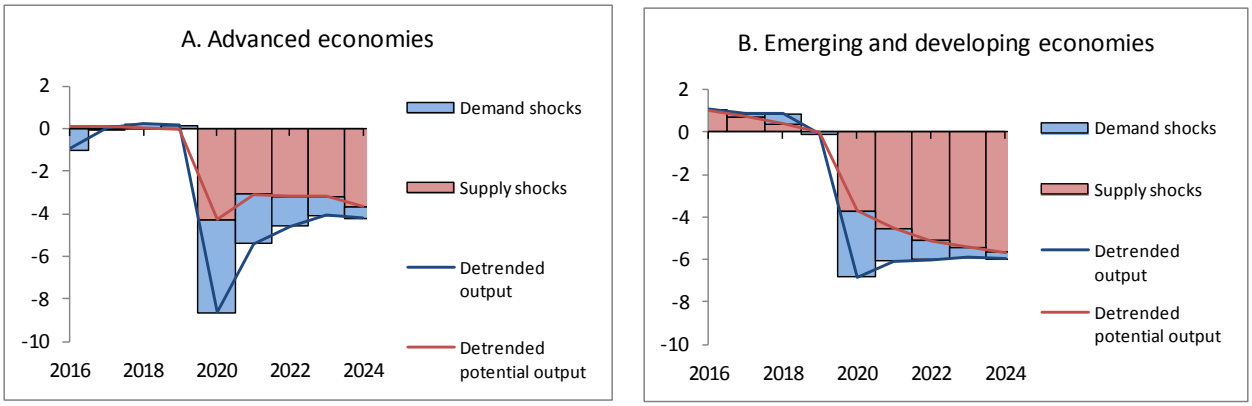
Quartile distribution of output level and growth shocks in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and data from Focus Economics.

Figure 22. The assumed demand and supply shocks during the covid-19 recession

Shock decomposition of median detrended output in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and data from Focus Economics.

In summary, end-2020 growth forecasts convey recessions of about –8 in advanced economies and –9 percent in emerging and developing economies. In advanced economies, the recession in detrended output is V-shaped with partial recovery while in emerging and

developing economies, L-shaped. The recession can be better characterized, in advanced economies, as the result of an output level shock while, in emerging and developing economies, as the result of an output growth shock.

The results are derived from the growth forecasts and the model. Growth forecasts differ from realized future outcomes in many aspects, particularly in additive uncertainty, namely, the realization of future shocks.

6. Discussion

Growth forecasts tell a story about how demand and supply shocks might unfold during the forecast horizon. A plausible story about the extent of the aggregate demand shock is critical for monetary and fiscal policies. An aggregate demand shock conveys information about the depth of the recession in the output gap, a critical element in monetary and fiscal policies. Yet, most forecast evaluation usually takes place in the form of forecast precision, that is, a horse race between analysts, models and root mean squared errors. It seems reasonable that before forecast precision we need a good forward-looking story of the unfolding demand and supply shocks that could help grasp the recession at least in terms of its likely depth, length and shape.

It is widely known that the record in forecasting the past global financial recession was poor. This record; however, refers to the lack of anticipation of the global financial recession. Another matter is the anticipation of the depth, length and shape of the recession after the recession had begun; from this standpoint, the record was also poor, particularly for emerging and developing economies.

We go back to the global financial recession to study how well the forecasts of the time anticipated the depth and shape of the recession. Available growth forecasts for the then unfolding global financial recession are from source IMF, April and October 2009, WEO databases and from the Focus Economics, October 2009 forecast vintage.[24]

Starting with the IMF, April 2009, WEO database, that is, 6 months after Lehman bankruptcy, Table 3 shows the projected depth of the recession, measured by mean detrended

[24] From source Focus Economics, forecast vintages preceding the global financial recession are available for emerging and developing economies, not for advanced economies. Nonetheless, for a forecast vintage ranging from end-August to early-October 2009, growth forecasts are available from this source for both groups of economies.

output in 2009. In advanced economies, the projected depth of the recession is –3.8, compared with –3.2 using the historical data. In emerging and developing economies, the depth is –1.4, compared with –1.4 in the historical data. The results point to the conclusion that the depth of the recession can be well approximated 6 months after it begins.

Table 3. The projected depth of the global financial recession

Forecasted *vs.* observed detrended output in 2009

	Advanced economies		Emerging and developing economies	
	Median	Width of the interquartile range	Median	Width of the interquartile range
IMF WEO, April 2009	-3.8	4.1	-1.4	2.7
IMF WEO, October 2009	-3.4	3.9	-1.9	2.1
Historical data for the WEO sample	-3.2	3.0	-1.4	3.0
Focus Economics, October 2009	-4.8	4.9	-2.9	3.1
Historical data for the FE sample	-3.9	2.8	-2.5	3.1

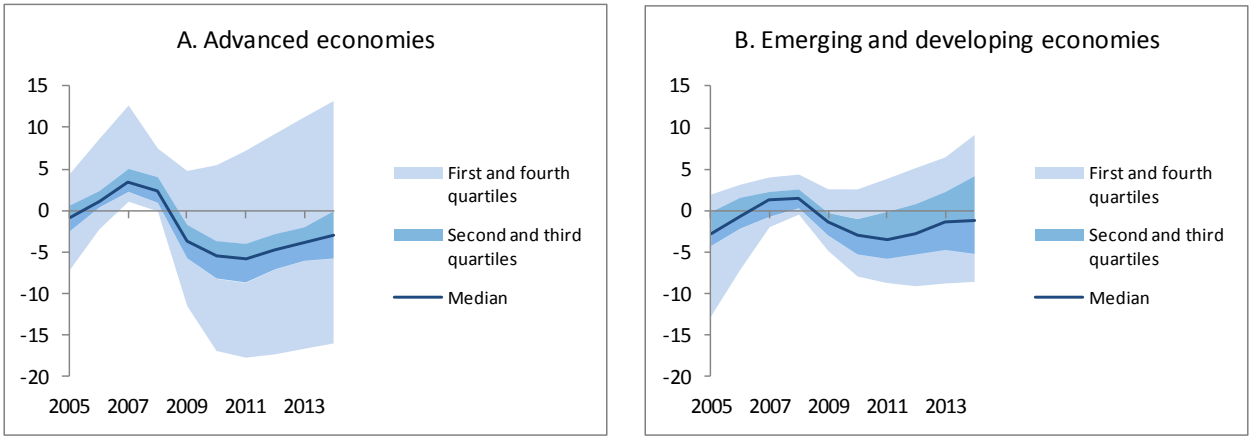
Note: the recession trough is the logarithmic deviation of median detrended output for the sample of economies described in the data section.
Source: author's estimation based on the model in the text and growth forecasts from Focus Economics and IMF.

While the depth of the recession can be approximated as early as 6 months after it begins, the shape of the recession may not. In advanced economies, Figure 23, the projected recession is curved-shaped, instead of L-shaped as it turnout to be in the historical data. In turn, in emerging and developing economies the projected recession is curved-shaped and convex (Figure 23), instead of swoosh-shaped as in the historical data (Figure 2).

Consider the projected depth of the recession 12 months after the outbreak. The then available growth forecasts are from source IMF, October 2009, WEO database and also the analysts' growth forecasts from source Focus Economics. Using the IMF data, Table 3 shows that in advanced economies the depth of the projected recession is –3.4, compared with –3.2 in the historical data. In turn, in emerging and developing economies the depth of the projected recession is –1.9, compared with –1.4 in historical data. In conclusion, from this standpoint, the depth of the recession can be projected about right as far as 12 months after the recession begins, particularly for advanced economies.

Figure 23. The projected depth and shape of the global financial recession

Quartile distribution of detrended output in the WEO, April 2009 database



Source: author's estimation based on the model in the text and growth forecasts from IMF.

As to the shape of the recession projected 12 months after the outbreak, Figure 24 shows an envisaged L-shaped recession in advanced economies, matching the shape estimated using the historical data. In emerging and developing economies, nonetheless, the projected recession is round-shaped and concave, in contrast with the swoosh-shaped recession in the historical data. In this light, the record in forecasting the shape of the recession can be considered good 12 months after it begins in advanced economies; however, in emerging and developing economies the record does not seem to be that good.

Turning to the Focus Economics growth forecasts that were available nearly 12 months after the beginning of the global financial recession, Table 3 and Figure 25 show that the projected depth of the recession was –4.8 in advanced economies, compared with –3.9 in the historical data. In turn it was –2.9 in emerging and developing economies, compared with –2.5 using the historical data.

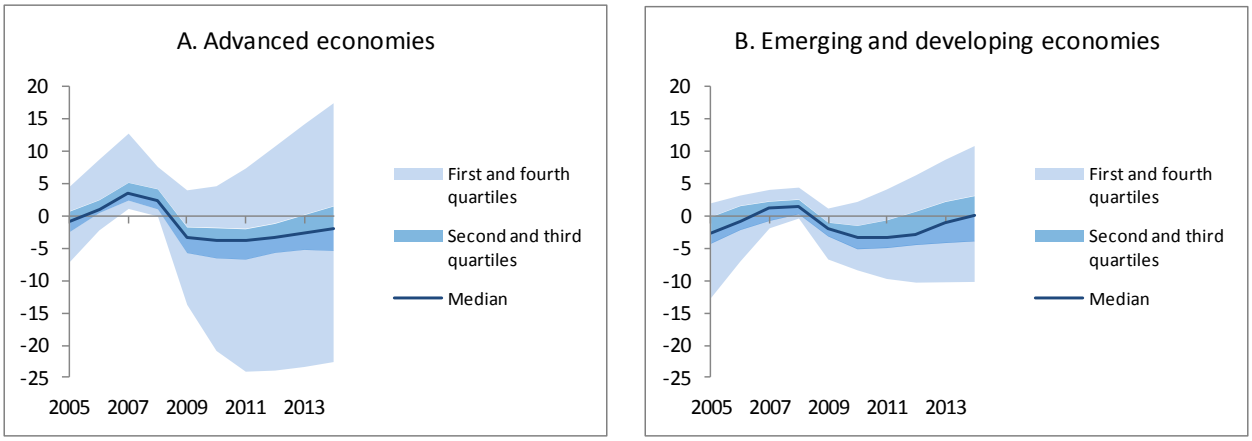
Returning to the covid-19 recession, it begun in the first quarter of 2020 in China and, broadly, in the second quarter of 2020 in the rest of the world. According to the analysts' as well as the IMF growth forecasts, the forward-looking story about the unfolding covid-19 recession would be as follows:

In advanced economies the recession in detrended output is about –8 percent deep, V-shaped with partial recovery, with incomplete scarring. It is the result of combined demand and supply shocks where the supply shock is likely an output level shock. In emerging and

developing economies the recession in detrended output is about –9 percent deep, L-shaped, with almost complete scarring. It is the result of a combined demand and supply shock where the supply shock is likely an output growth shock. As for the recession in the output gap, it is about 4 years long.

Figure 24. The projected depth and shape of the global financial recession: the IMF data

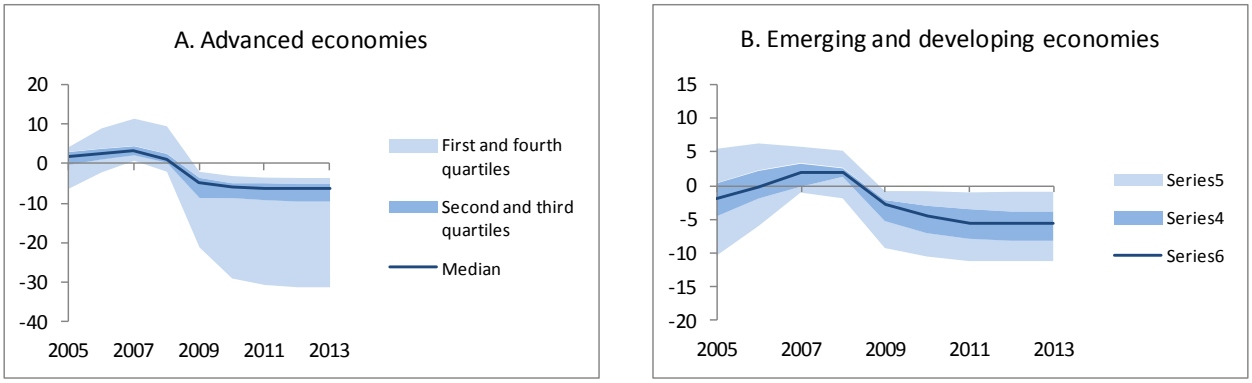
Quartile distribution of detrended output in the WEO, October 2009 database



Source: author's estimation based on the model in the text and growth forecasts from IMF.

Figure 25. The projected depth and shape of the global financial recession

Quartile distribution of detrended output in the Focus Economics October 2009 forecast vintage



Source: author's estimation based on growth forecasts from Focus Economics.

Is this story plausible? In light of the forecast record during the global financial recession, the answer to this question is that growth forecasts can be informative about the depth of the recession 6 months after the beginning of the recession; however, for emerging and developing economies, growth forecast may not be as informative about the shape of the recession even 12 months after the recession began.

7. Robustness

We next deal with the robustness of the results to changes in the model assumptions and parameterization.

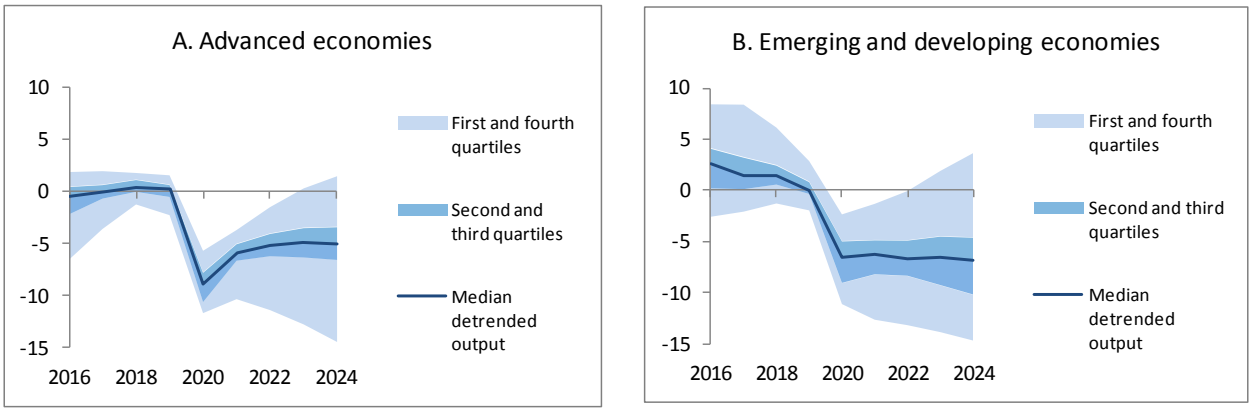
The first robustness exercise is about the long-term, potential-output growth rate. In the base case, the long-term, potential-output growth rate is equal to the forecasted growth rate at the end of the forecast horizon, in 2024. In the robustness exercise, we use as long-term, potential-output growth rate the average of 2010–2019.

The robustness exercise indicates that the results are robust for standard economies within the interquartile range. In contrast, in nonstandard economies outside interquartile range the alternative parameter can change detrended potential output by the end of the forecast horizon and can also change the shape of the recession.[25]

Compare the economies within the interquartile range in Figures 15 and 26. The depth and shape of the recession are similar. In contrast, in countries outside the interquartile range the results are not robust. The reason is that during 2010–2019 these economies had highly stylized rates of growth.[26]

Figure 26. Robustness: The long-term, potential-output growth rate

Quartile distribution of detrended output in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and growth forecasts from the Focus Economics July 2020 forecast vintage.

[25] Note that since potential output growth has persistence, potential output growth converges to the long-term, potential-output growth rate only gradually.

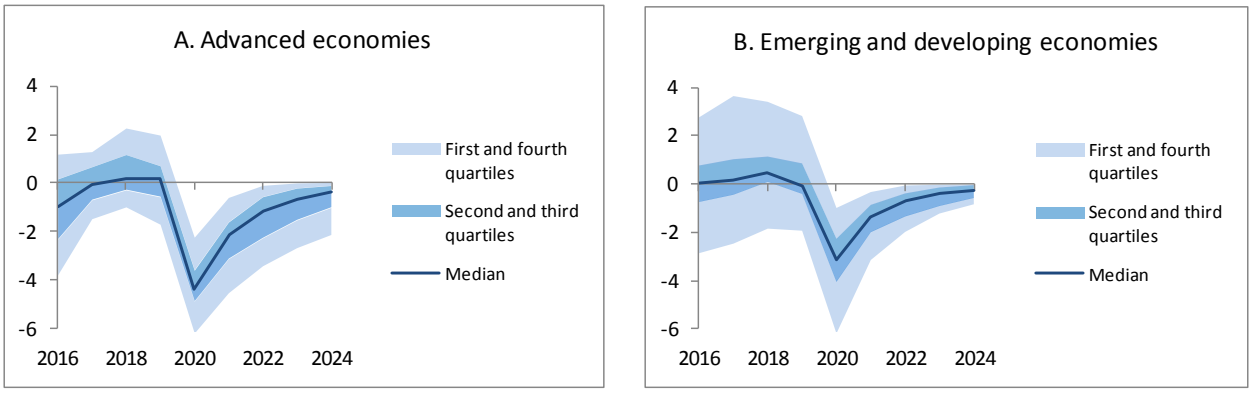
[26] Examples of countries outside the interquartile range are Greece, Portugal, Iceland and Singapore. Output growth in these countries had a highly idiosyncratic behavior during the estimation period 2010–2019.

The second robustness exercise deals with output gap persistence. Output gap persistence affects the speed of convergence of the output gap throughout the forecast horizon thereby changing the length of the recession in the output gap. In the base case, the output gap persistence coefficient is the one estimated for each economy and reported in Table 1. The base case is in Figure 17.

In a first alternative scenario, the output gap persistence coefficient decreases 5 percentage points (Figure 27). The result is that the output gap closes faster. The upper quartile; that is, the median of the upper half of countries, rises by 0.3 percentage points in advanced economies and by 0.2 percentage points in emerging and developing economies. Hence, the gain in output gap convergence is small as it involves only fractions of one percentage point of the output gap.

Figure 27. Robustness: Output gap persistence decrease by –5 percentage points

Quartile distribution of the forecasted output gap



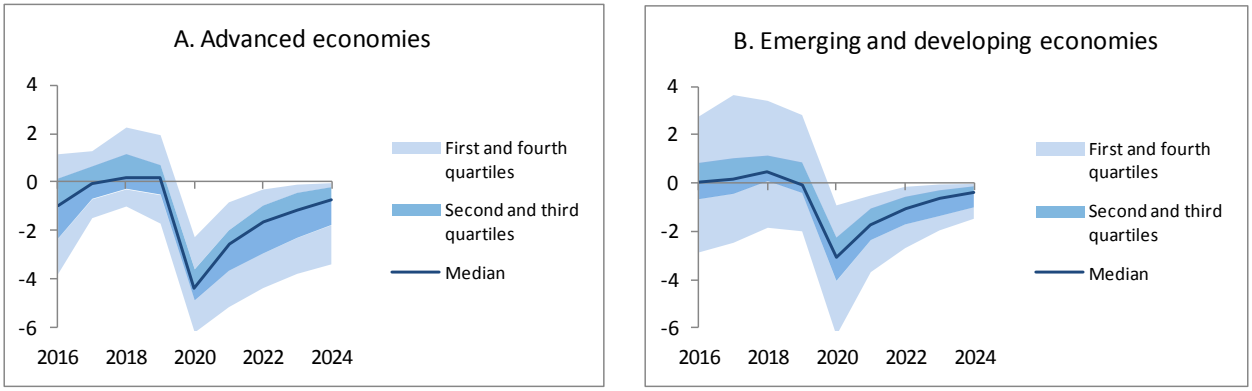
Source: author's estimation based on the model in the text and data from the Focus Economics July 2020 forecast vintage.

In a second alternative assumption, the output gap persistence coefficient increases 5 percentage points (Figure 28). The output gap closes slower. The lower quartile, or the median of the lower half of the countries, drops by –0.1 percentage points in advanced economies and by –0.1 percentage points in emerging and developing economies. Hence, the loss in output gap convergence is small as it involves only fractions of one percentage point.

In summary, output gap persistence can affect the speed of convergence of the output gap; however, variations in the output gap persistence coefficient such as those considered here involve changes in output gap convergence that are small. The results about the length of the recession in the output gap are robust to changes in output gap persistence.

Figure 28. Robustness: Output gap persistence rises by +5 percentage points

Quartile distribution of the forecasted output gap



Source: author's estimation based on the model in the text and data from Focus Economics.

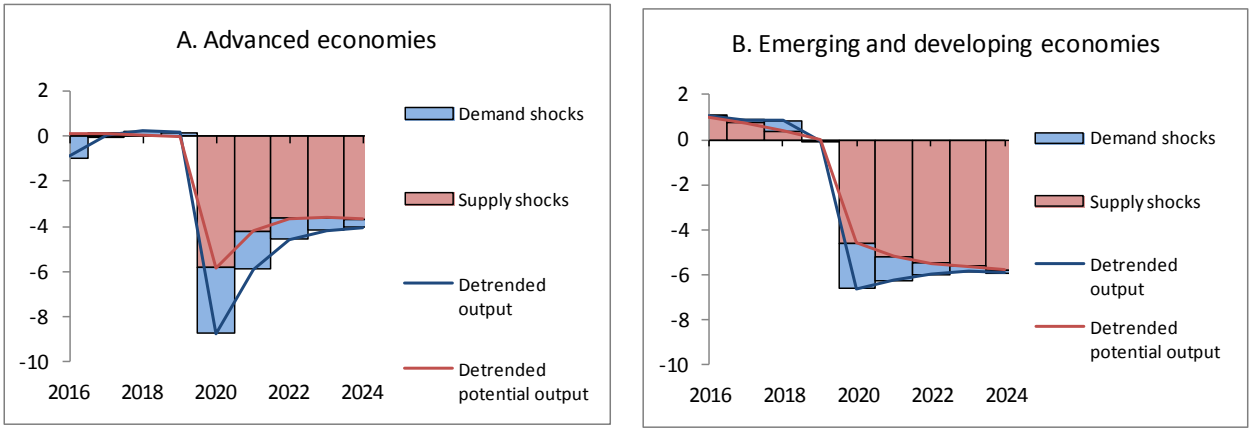
The third robustness exercise deals with the assumed role of demand and supply shocks in the covid-19 recession; or, in other words, with the extent of the relative demand shock. In the base scenario the demand and supply impact shocks are equal to each other; that is, the relative demand shock is 1/2. As the recession in detrended output does not depend on the relative demand shock, alternative assumptions about the relative demand shock do not change the depth and shape of the recession in detrended output. They can, nonetheless, affect the depth of the recession in the output gap and the depth and shape of the recession in detrended potential output.

Consider a relative demand shock of 1/3 in Figure 29. In both advanced and emerging and developing economies the depth of the recession in detrended potential output is deeper while the depth of the recession in the output gap, shallower. In advanced economies, Panel A, the recession in detrended potential output becomes V-shaped, from L-shaped in the base case. In emerging and developing economies, the recession in potential output is curved-shaped and becomes more convex.

Consider now a relative demand shock of 2/3 in Figure 30. In both advanced and emerging and developing economies the depth of the recession in detrended potential output is shallower while the depth of the recession in the output gap is deeper. In advanced economies the recession in detrended potential output is broadly L-shaped. In emerging and developing economies the recession is curved-shaped and less convex.

Figure 29. Robustness: Relative demand shock decreases to 1/3

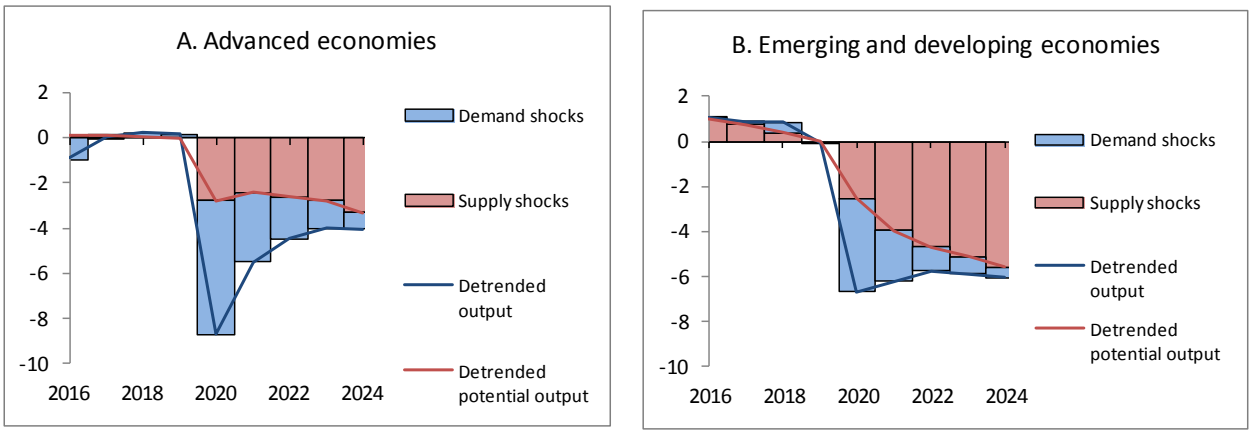
Shock decomposition of median detrended output in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and data from Focus Economics.

Figure 30. Robustness: Relative demand shock increases to 2/3

Shock decomposition of median detrended output in the Focus Economics July 2020 forecast vintage



Source: author's estimation based on the model in the text and data from Focus Economics.

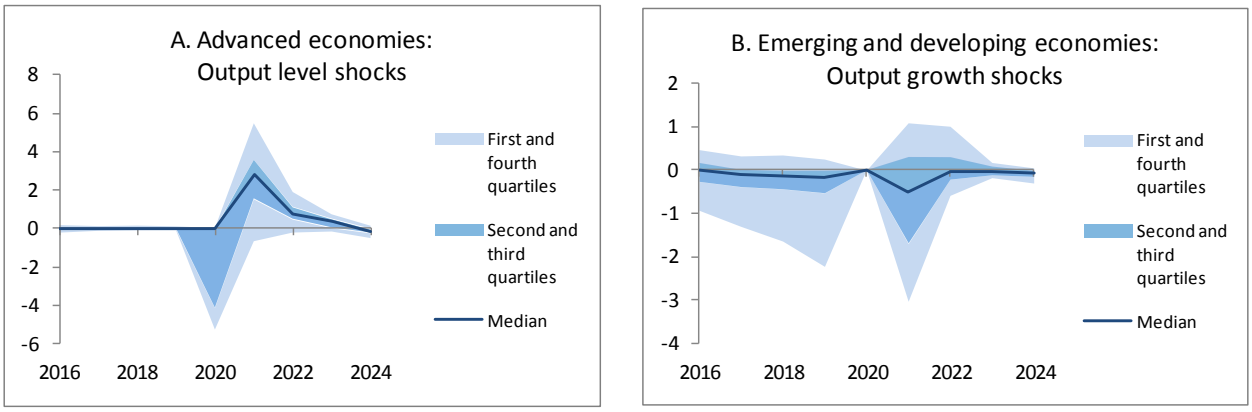
Taking stock, the results of the paper about the shape of the recession in detrended output are invariant to different assumptions about the relative demand and supply shocks. The results about the shape of the recession in the output gap and in detrended potential output are naturally not. This lack of robustness is relevant because the depth of the recession in the output gap is important for monetary and fiscal policy. The results of the paper about the depth of the recession in the output gap depend on the identifying assumption about the relative demand shock.

The next robustness exercise shows the suitability of the assumption that in advanced economies the supply shock is an output level shock while in emerging and developing economies it is an output growth shock; robustness about the relative output level shock. The exercise consists of shifting the type of shock, using output growth shocks in advanced economies and output level shocks in emerging and developing economies.[27]

The robustness of the assumption about the relative output level shock is presented in Figure 31. In advanced economies the interquartile range of the output level shock is wave-shaped, instead of V-shaped as in the base case. In emerging and developing economies the interquartile range of the output growth shock is V-shaped with only a partial return to 0, as the impact shock is followed by a series of negative supply shocks. In sum, the change in assumption makes a simple story difficult to understand.

Figure 31. Robustness: Switch in the assumed relative supply shock

Quartile distribution of output level and growth shocks in the Focus Economics July 2020 forecast vintage



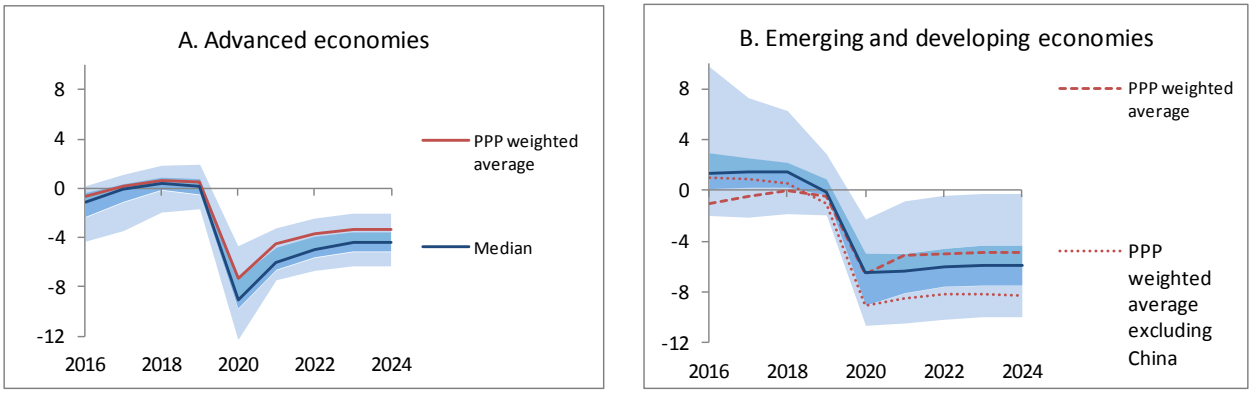
Source: author's estimation based on the model in the text and data from Focus Economics.

The fifth robustness exercise is the use of the PPP-weighted average as measure of central tendency for growth forecasts, instead of the median as in the base case. The results about the shape of the recession, in Figure 32, are robust to the measure of central tendency. The recession is V-shaped in advanced economies and L-shaped in emerging and developing economies. As to the depth of the recession, the results are broadly robust as the trough of the recession in detrended output can differ simply because the median and the weighted average are different measures of central tendency.

[27] In other terms, we shift the relative supply shock to 0 in advanced economies and to 1 in emerging and developing economies

Figure 32. Robustness: The measure of central tendency,

PPP-weighted average *vs.* quartile distribution of detrended output in the July 2020 forecast vintage



Source: author's estimation based on the model in the text, growth forecasts from Focus Economics and PPP weights from the IMF, April 2019, WEO database.

8. Conclusions

It seems reasonable that before forecast precision we need a good forward-looking story of the unfolding demand and supply shocks that could at least help grasp the recession in terms of its likely depth, length and shape.

We use growth forecasts and a simple structural model to build backwards from the growth forecasts to an implicit forward-looking story about the extent of the demand and supply shocks likely explaining the unfolding covid-19 recession.

The forward looking story is as follows: in advanced economies the recession is about –8 percent deep, 4-years long and V-shaped with partial recovery and incomplete scarring. It is the result of combined demand and supply shocks including an output level shock. In emerging and developing economies the recession is about –9 percent deep, 4-years long, L-shaped and with almost complete scarring. It is the result of combined demand and supply shocks likely involving an output growth shock.

The results are derived from the growth forecasts and the model; they do not necessarily mean that growth forecasts are not surrounded with uncertainty, particularly given the unprecedented level of uncertainty during the unfolding covid-19 recession.

The results of the paper about the depth and shape of the recession in detrended output are robust to changes in the long-term, potential-output growth rate, for standard economies within

the interquartile range. The results about the depth of the recession in the output gap are naturally the consequence of the identifying assumption about the relative demand shock.

In the policy implications, a forward looking estimate of the depth of the recession in output and in the output gap is critical for monetary and fiscal policies, yet there is plenty of uncertainty about the depth of the recession in the output gap. Concerning monetary policy, an estimated output gap is an input in Taylor and forecast rules. In the case of the Taylor rule, because the output gap is an argument at the right hand side of rule; in the case of forecasts rules, because the output gap affects the inflation forecast. As for fiscal policy, first, debt sustainability analysis requires output growth projections. Second, a forward looking the estimation of the structural balance requires a forward looking projection of the output gap. The former depends critically on the projected shape of the recession, the later depends on the projection of the output gap.

Detrended potential output is a supply object and thus it cannot be the subject matter of demand policies, only the output gap can be. Nonetheless, detrended potential output may be susceptible to be shaped by policies such as containment, de-escalation and vaccine distribution policies.

In the future, as more output data is available, the depth, length and shape of the recession can be estimated easier; however, that would be a historical account of the recession, not a forward-looking story that can inform demand policies at the time they have to be formulated. The research strategy in the paper is to make use of identifying assumptions about the relative demand and supply shocks in order to find the implicit forward-looking story contained in the current growth forecasts. We then analyzed the robustness of the results to these identifying assumptions and found the results robust; except, naturally, for the assumption about the extent of the demand shock.

Also in the policy implications, structural models, such as the one used here, can deal with a separate role for supply and demand shocks. In contrast, nonstructural filters such as univariate filters can smooth out potential output thereby misleadingly attributing a larger part of output variability to demand shocks. In this light, a structural model such as the one proposed here can help find better estimates of potential output and the output gap.

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