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TABLE OF CONTENTS

Macro and micro effects of fiscal policy – experience from the COVID-19 pandemic: introduction to the thematic issue of Public Sector Economics

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Guest Editors' Introduction
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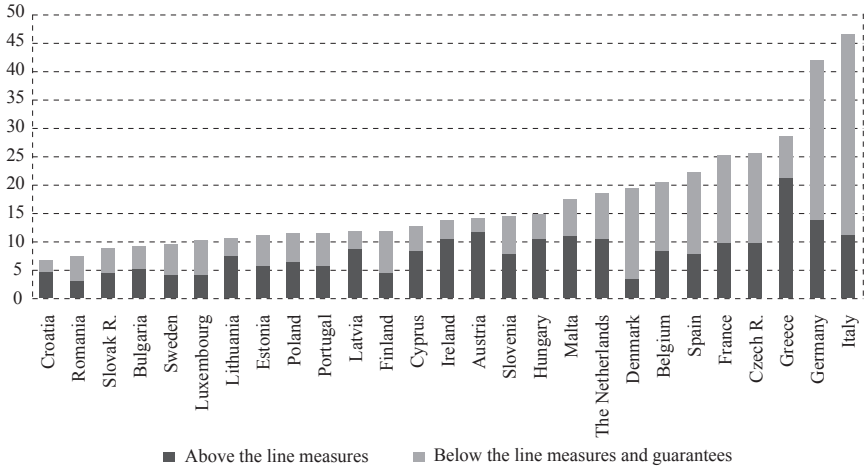
PUBLIC SECTOR ECONOMICS
45(4) 413-418 (2021)

Fiscal policy has taken centre stage in stabilizing economies hit by the pandemic shock in 2020 and 2021. Most governments responded to the disruptions caused by Covid-19 with various above-the-line measures (e.g., large expansion of health-related and other public expenditures and revenue deferrals), directly affecting economic activity via fiscal multipliers, and with below-the-line measures (e.g., equity injections, liquidity loans, debt assumptions) and guarantees, whose economic impact depended on how much they have been taken up and spent by targeted recipients. With respect to EU countries, total fiscal support to the economy from the beginning of the pandemic has ranged from around 7% of GDP in Croatia to above 45% in Italy (figure 1). If one focuses only on direct, above-the-line measures, these figures still indicate heavy fiscal support, ranging from 3.5% of GDP in Denmark to above 20% in Greece.

Figure 1

Summary of fiscal measures in response to the Covid-19 pandemic from February 2020 to July 2021 (percentage of 2020 GDP)



Source: IMF Fiscal Policies Database.

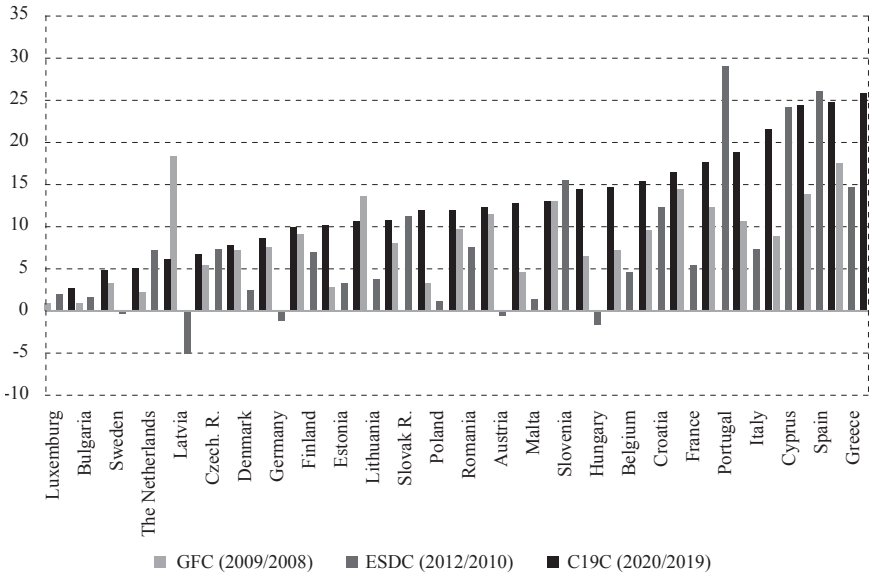
The fiscal response to the Covid pandemic has demonstrated that it is possible to quickly mobilize this powerful stabilisation policy tool and deploy it effectively in the face of a major exogenous shock, despite the well-known procedural challenges related to fiscal policymaking in parliamentary democracies. Active use of fiscal policy has also greatly relieved pressure on monetary policy, which had been "the only game in town" from the start of the Global Financial Crisis (GFC) until the pandemic. It is worth noting that central banks have also given strong support to fiscal authorities and economies in general through asset purchases programs, launched in some countries for the first time. In this context, many authors agree that the Covid-19 crisis represents a great example of adequate monetary-fiscal policy mix (e.g., Ubide, 2021; Buti and Messori, 2021).

PUBLIC SECTOR ECONOMICS
45(4) 413–418 (2021)

Although discretionary fiscal measures and automatic stabilizers cushioned the adverse economic effects of the Covid-19 shock, they have also led to a sharp increase in public debt, in both absolute and relative terms. Figure 2 shows that in most European countries the increase in public debt in 2020 was much more intense than during the GFC in 2008-09 or the sovereign debt crisis in 2010-12, due to both stronger fiscal reaction and a more substantial fall in GDP. The pandemic has also put intense pressures on healthcare systems around Europe, revealing many structural deficiencies and putting an additional burden on mid-term fiscal sustainability (OECD, 2020).

Figure 2

Change in public debt-to-GDP ratio in pp of GDP



Source: Eurostat; authors' calculations.

To facilitate national fiscal responses to the pandemic shock, EU policymakers used the flexibility of European fiscal rules under the Stability and Growth Pact (SGP) and activated the so-called general escape clause in 2020. As most EU economies are expected to return to pre-pandemic output levels by end-2022, fiscal rules will most likely be re-activated in 2023. At the same time, discussions are underway to reform the EU fiscal rules and facilitate a gradual return to debt sustainability through growth-friendly fiscal consolidation programs. Fiscal policy is thus expected to stay in the focus of policymakers, academic researchers and media in both the EU and in the rest of the World.

Against this background, we launched in early 2021 a call for papers for this special issue of *Public Sector Economics*. We selected six papers that provide a solid analytical background for discussions on the economic and fiscal effects of the pandemic recession and provide insights and policy recommendations that could

PUBLIC SECTOR ECONOMICS
45(4) 413-418 (2021)

inform discussions on future developments. The papers cover the economic and fiscal effects of the pandemic on income distribution, analyse the fiscal response, sustainability of healthcare systems, the effects on potential GDP, and changes in the monetary-fiscal policy mix. One common message of these contributions is that this crisis reminded us all that fiscal policy matters. Not only did fiscal policy measures mitigate the short-term effects of the Covid-19 shock but they also ensured that the long term potential of economies is not significantly shattered. However, several papers in this issue indicate that the issue of fiscal sustainability will come back to the table of policy makers really soon. This holds for specific sectors, such as healthcare for example, and for the public sector as a whole.

Dubravko Mihaljek tackles a very topical issue of the monetary-fiscal policy mix in *Interactions between monetary and fiscal policies: a brief history of a long relationship.* He compares and contrasts the policy mix in major economies during the pandemic recession with selected episodes from the past, notably the Great Inflation of the 1970s, the Great Moderation of the 1990s, and the Great Financial Crisis and its aftermath. The paper highlights the lack of consensus about the proper roles of monetary and fiscal policies during the Great Inflation and since the Great Financial Crisis, and the return of the fiscal stabilisation function in the pandemic recession noted above. Looking ahead, however, consensus on a "new normal" for monetary and fiscal policy mix is unlikely to emerge in the near term, as in the process of policy normalisation the two could at times work at cross purposes.

Vladimir Arčabić and Frane Banić analyse fiscal policy cyclicality and debt sustainability in their paper *Characteristics of fiscal policy in Croatia: does it depend on the phase of the business cycle?* The authors find evidence of asymmetric fiscal policy stances: in an expansionary regime, fiscal policy is countercyclical, while in a recessionary regime it alternates between a procyclical and an acyclical stance. In the expansionary regime, fiscal policy thus facilitates debt sustainability, while in the recessionary regime its effects are uncertain, although there is clear evidence that debt sustainability worsens.

In *The interplay of supply and demand shocks: measuring potential output in the Covid-19 pandemic*, Lovorka Grgurić, Nina Pavić and Ozana Nadoveza-Jelić show that the pandemic affected both the supply and the demand sides of the Croatian economy. Protective measures imposed unprecedented supply-side restrictions, while uncertainty about the course of the pandemic affected domestic and foreign demand, notably in tourism. Estimating potential GDP, which is difficult in stable economic conditions, was a major challenge as a result. The authors provide several methodological approaches and conclude that in 2020 there was a significant decline in potential GDP in Croatia accompanied by a record large negative output gap. Such developments indicate that the Covid-19 shock has spilled over to the Croatian economy through both supply side and demand side channels. Thus, the authors call for the strong expansionary measures that are

PUBLIC SECTOR ECONOMICS
45(4) 413–418 (2021)

necessary condition for stabilizing the economy and its faster recovery, not only in the short, but probably also in the medium term.

In *Fiscal (un)sustainability of the Croatian healthcare system: additional impact of the Covid-19 crisis*, Hrvoje Šimović, Maja Mihelja Žaja and Marko Primorac note that the Covid-19 crisis deepened and exacerbated the already existing financing problems of the Croatian healthcare system. They estimate the cost of public bailouts of the system at more than HRK 23 billion (around 6% of 2020 GDP) in 1994-2021. Nevertheless, the authors see the Covid-19 crisis as a chance to start solving the problems by implementing reforms on both the revenue and the expenditure sides of the healthcare system.

In *The impact of the Covid-19 crisis on income distribution under different protection schemes: the case of Spain*, Gonzalo Gomez-Bengoechea uses household survey data to estimate the costs of lockdowns under three different protection schemes for low-income earners: no low income benefit scheme, direct means-tested transfer from regional governments to households and national-wide means-tested program. His results show that although the pandemic shock reduced income for all deciles of the income distribution, the losses were not uniformly distributed. The worst economic effects have not been on the poorest households in the ex-ante income distribution, but on middle-income and wealthy households. Low-income households have experienced only moderate income losses owing to the fiscal measures aimed at the reduction of poverty and inequality.

Teboho Jeremiah Mosikari and Joel Hinaunye Eita focus on the relationship between public indebtedness and economic growth in their paper *Asymmetric effect of government debt on economic growth: evidence from Namibia*. They show that an increase in government debt is associated with slower GDP growth and vice versa – a decrease in debt helps raise GDP growth. Importantly, these effects are asymmetric: the harmful effect of higher debt on growth is greater than the marginal boost to growth from debt reductions. They conclude that, to accelerate GDP growth, it is important for Namibia to keep public debt at manageable levels and achieve fiscal sustainability. This conclusion probably holds for many other countries as well.

As the Guest Editors of this special issue, we would like to thank the authors for finding time in these exceptional circumstances to send us very interesting and analytically rich papers. We are also grateful to the reviewers for their patient reading and rich and helpful feedback, and to the great team from the Institute of Public Finance – Mihaela Bronić and Branko Stanić. Finally, we are especially grateful to Katarina Ott for giving us the opportunity to arrange this special issue. Almost 20 years ago, Bob Solow (2004) posed two big questions: *Is fiscal policy possible? Is it desirable?* We hope that this issue of *Public Sector Economics* shows that the answer to both questions is a resounding "YES!"

PUBLIC SECTOR ECONOMICS
45(4) 413-418 (2021)

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Interactions between fiscal and monetary policies: a brief history of a long relationship

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Article**
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PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

Abstract

This paper compares and contrasts interactions between monetary and fiscal policies in major economies following the recent pandemic recession with selected episodes from the past, notably the Great Inflation of the 1970s, the Great Moderation of the 1990s, and the Great Financial Crisis and its aftermath. Interactions between fiscal and monetary policies in these periods were characterised respectively by the collapse of consensus about fiscal dominance, strict separation of monetary and fiscal policies, and intermittent close coordination. The paper tentatively argues that a consensus on the "new normal" for the two policies is unlikely to emerge in the near term.

Keywords: fiscal policy, monetary policy, policy coordination, policy interactions, fiscal dominance, pandemic recession, macroeconomic stabilisation

1 INTRODUCTION

The two prime macroeconomic powers of the state, monetary and fiscal policies, interact closely. Both have a major impact on aggregate demand and, to varying degrees, aggregate supply. Fiscal policy affects aggregate demand and supply directly through the taxes and incentives they create, by public investment, transfers to household and firms, and wages in the public sector. Monetary policy works more indirectly, primarily through the interest rate, which influences financing conditions and thereby consumption and investment. Its effects on the real sector, notably business fixed investment, are generally slower and less certain, but also more pervasive – interest rates in particular "get into all the cracks" (Stein, 2013).

In this paper the focus is on interactions between monetary and fiscal policies as macroeconomic stabilisation tools. The analysis is done in very broad strokes. Of particular interest are episodes when fiscal and monetary policies freed each other's space for action, and those when they worked at cross-purposes. Prime examples of positive interactions are coordinated global monetary and fiscal expansion after the outbreak of the Great Financial Crisis in 2008-09, and unprecedented fiscal and monetary stimulus across major economies in response to pandemic-induced lockdowns in 2020. Examples of less helpful interactions can also be found in the post-financial crisis period: with interest rates and inflation at all-time lows, a sustainable fiscal stimulus from 2012 on could have helped lift inflation in the short term and potential output in the long term. But fiscal policy was arguably too tight, stunting the recovery and shifting the burden of supporting the post-crisis recovery to monetary policy (Bernanke, 2013; Draghi, 2014).

A longer-term perspective is helpful in describing policy interactions because throughout history monetary and fiscal policies have been closely intertwined. To the extent that one can identify similarities and differences between policy roles in respective historical episodes, one can be in a better position to understand whether some issues are missing or are being overstressed in current policy discussions. This paper attempts to provide a broad background for that kind of discussion. It

PUBLIC SECTOR ECONOMICS 45(4) 419-432 (2021)

highlights the return of fiscal policy as a macroeconomic stabilisation tool during the pandemic. It also highlights the lack of consensus about the proper roles of monetary and fiscal policies in the face of some old and new challenges facing the global economy in the aftermath of the financial and pandemic crises.

The paper starts with a brief overview of monetary and fiscal policies during the Covid pandemic. The second section discusses the longstanding issue of the policy mix, illustrating it with the dilemma about the "right" amount of stimulus that many monetary and fiscal authorities face at the current juncture. The third section turns to two aspects of longer-term interactions: the issues of public debt sustainability and the dominance of fiscal over monetary policy. The concluding section provides some thoughts on what kind of consensus on the two policies might emerge.

2 MONETARY AND FISCAL POLICIES DURING THE COVID PANDEMIC

As the recession induced by lockdowns in 2020-21 unfolded, monetary and fiscal policy worked closely together to cushion the pandemic's economic fallout. Monetary policy stabilised the financial system, kept credit flowing and eased financing conditions more generally. Fiscal policy shielded firms and households through transfers and loan guarantees. In the process, both policies supported each other. Large-scale central bank purchases of sovereign debt eased government financing constraints, and fiscal backstops and guarantees leveraged the central bank's lending power.

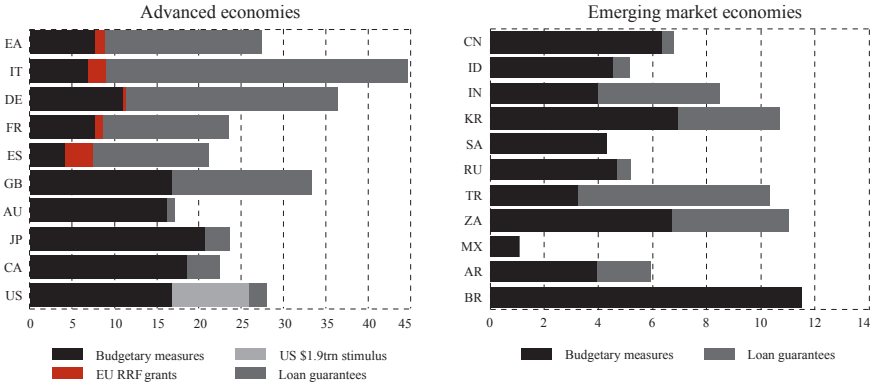
The combined stimulus provided by monetary and fiscal authorities was unprecedented. Fiscal support reached in aggregate over 9% of world GDP (around $10 trillion) as of March 2021. Among advanced economies, Australia, Canada, Japan, the United Kingdom and the United States provided the largest support, from 17 to 26% of GDP over 2020-21 (graph 1, left-hand panel). In Europe, the fiscal push was smaller, 7-11% of GDP, supplemented from mid-2021 by multi-year grants from the Next Generation EU Fund. In emerging market economies, the support was generally smaller, but nonetheless substantial: Brazil managed to provide 12% of GDP in fiscal support; China, Korea and South Africa close to 7%; and many others up to 5% (right-hand panel).

Monetary stimulus was no less forceful. Many central banks cut policy rates to all-time lows, often close to or below zero (graph 2, left-hand panel). They also deployed unconventional tools – large-scale asset purchases, special lending programmes, forward guidance, yield curve control – including in many emerging market economies (centre panel). As a result, the size of the major central banks' balance sheet is at a historical high in most countries (right-hand panel), largely because of an increase in the holding of government securities.

PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

Graph 1

Fiscal stimulus during the pandemic (as percentage of GDP) [1]

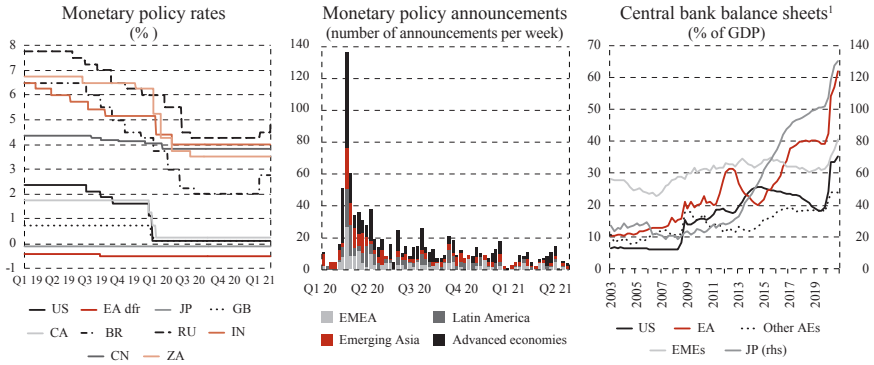


[1] *Including health and non-health related spending measures announced through March 2021, based on IMF's Fiscal Policies Database. For the European Recovery and Resilience Facility, 50% of grants assumed to be spent in 2021.*

Sources: European Commission; IMF, Fiscal Policies Database; OECD; author's calculations.

Graph 2

Monetary stimulus during the pandemic



[1] *Total assets; median values for eight advanced economies (AEs) and 22 emerging market economies (EMEs). EMEA = emerging Europe, Middle East and Africa.*

Sources: IMF; national data; BIS, Database on monetary policy announcements during Covid-19; Cantu et al. (2021).

The active role of fiscal policy in response to the pandemic shock is noteworthy because academic work and policy analysis had advocated against such stabilisation function ever since the 1970s' Great Inflation. This view was reflected in leading textbooks: Mankiw and Taylor (2011), for instance, highlighted long and uncertain lags in the implementation of tax and spending measures, and the consensus view that automatic stabilisers were far more effective for macroeconomic stabilisation over the business cycle than discretionary fiscal measures. That said, they acknowledged that automatic stabilisers were generally not sufficiently strong to prevent

recessions completely, and argued against a strict balanced budget rule, which could, in effect become an "automatic destabiliser" (ibid, 778).

The rebound of the global economy since mid-2020 suggests that the combined monetary and fiscal stimulus has been effective so far. However, the unprecedented size of the stimulus has raised a number of questions, including about the calibration of the policy mix in the short-term, the longer-term consequences of stimulus for individual countries and the global economy, and the nature of interactions between fiscal and monetary policies in an elusive "new normal" regime that has yet to emerge after the financial crisis.

2.1 SHORT-TERM INTERACTIONS

In the short term, monetary and fiscal policies interact mainly through their respective stances. The "right" policy mix depends on the stage of the business and financial cycle and the structure of the economy. At the current post-pandemic recession juncture, the key question is whether monetary and fiscal policies are doing "too little" or "too much" to support the recovery, i.e., whether they are withdrawing support too early or providing it for too long. Given that monetary policy has by and large reached the limits of its expansionary stance, this has mainly been a question about the "right" fiscal policy stance.

2.2 NOT ENOUGH STIMULUS?

The main risk of withdrawing stimulus too early is that the recovery will falter. The pandemic is far from over, and growth is still fragile and very uneven across sectors, regions, and countries. Recent output gap projections point to sizable slack until 2023 in most countries, especially where fiscal stimulus was modest (IMF, 2021a). Withdrawing fiscal stimulus too early would put pressure on monetary policy to close output gaps. That would probably delay the recovery because monetary policy alone is not as powerful as when it works together with fiscal policy. With interest rates already at the effective lower bound, monetary policy would have to rely on unconventional tools, which tend to become less effective over time.[1] The double-dip recession after the Great Financial Crisis, when fiscal policy in the United States turned too restrictive because of domestic political tensions, and in Europe because of the sovereign debt crisis, are recent examples.

Another risk of early withdrawal of fiscal stimulus and prolonged reliance on monetary policy could be excessive risk taking in the financial sector. This risk arose for instance during the Great Financial Crisis. Forward guidance, yield curve control and, to some extent, large-scale asset purchases typically induce investors to search for yield, which tends to heighten financial market volatility.

[1] Early rounds of central bank purchases of a given asset class seem to be more effective in reducing long-term yields than subsequent rounds (Krishnamurthy and Vissing-Jorgensen, 2013). Other studies find, however, that the sheer announcement of asset purchases works to reduce the eligible assets' credit spreads by up to four times as much as the actual purchases (Gilchrist et al., 2020). This suggests that, if credible, central bank communication policies may help reduce the ultimate size of asset purchases.

PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

Market participants also become highly sensitive to threshold effects of policy revisions, such as perceived interest rate "lift-off". A case in point is the "taper tantrum" episode in mid-2013, when US Treasury yields increased sharply after the Federal Reserve announced that, at some future date, it would reduce the volume of bond purchases under its quantitative easing programme.

In addition, asset valuations can become overstretched with prolonged monetary stimulus. For instance, equity prices increased sharply in most advanced economies during 2020-21 despite the fragile and uneven recovery. House prices were rising fast as well, partly due to demand factors (shift to work from home), partly due to lower interest rates and fiscal support, which helped households maintain their debt servicing capacity. These developments could lead to sharp corrections in equity and house prices if fiscal stimulus is withdrawn too early and monetary policy becomes "the only game in town", as was the case in 2012-13 (Rajan, 2013).

Withdrawing fiscal stimulus too early could also harm the prospects for raising potential growth. Public investment in education, transportation infrastructure, energy and telecommunications, digital and green technologies could catalyse private investment in these areas and help boost productivity growth over the medium term. Recent estimates suggest that well-targeted public investment of 1% of GDP can raise output over four years by 0.5 percentage points in emerging market economies, and 1.2 points in advanced economies (IMF, 2020). If productivity growth is sustained over a longer period, public investment could help raise the natural interest rate, r^*, as well, thereby creating room for monetary policy manoeuvre. Productivity-enhancing investments are also needed because prolonged lockdowns could lead to labour skill losses ("hysteresis effects"), which could be larger than in "normal" recessions in the sectors hit particularly hard by the pandemic. This could increase the risk of staying trapped in the regime of low potential growth, which characterised most of the post-GFC decade.

2.3 TOO MUCH STIMULUS?

The main risk of providing "too much" stimulus is that the economy overheats and inflation becomes hard to control. This was the case in the 1960s and 1970s, when many advanced economies experienced stagflation – stagnating growth with rising unemployment and inflation. One inflationary impulse at the time came from the 1973 oil price shock. Two others, more persistent, came from expansionary public spending and high wage demands of trade unions. Highly regulated economies and pervasive financial repression aggravated the situation and complicated policy choices. To cushion the rise in unemployment and the fall in real income, fiscal and monetary policies turned expansionary. Budget deficits, public debt and money supply increased rapidly, and real interest rates fell or turned negative for much of the 1970s. Many governments found it increasingly difficult to finance growing budget and balance of payments deficits. The UK government, for instance, approached the IMF in September 1976 for a loan of $3.9 billion, the largest amount ever requested from the Fund until then.

PUBLIC SECTOR ECONOMICS 45(4) 419-432 (2021)

Stagflation ended only after central banks regained credibility by tightening monetary policy and bringing down inflation, and after fiscal authorities started the long, arduous process of fiscal consolidation. The latter included changes in the tax system (including expansion of the value-added tax and reduction of harmful progressivity of the income tax); privatisation of loss-making public enterprises (to reduce expenditure); and deregulation of the economy and domestic financial liberalisation (to raise potential growth and wind down financial repression). Countries such as Germany and Switzerland, which maintained prudent fiscal policies and swiftly adopted a new nominal anchor – monetary targeting – after the collapse of Bretton Woods largely succeeded in escaping the great inflation. Their success partly paved the way for emphasis on stable public finances along with central bank independence and the anchoring of inflation expectations under inflation targeting.

Currently, the prospect of such 1970s-style stagflation seems remote. The recent rise in inflation seems to reflect for the most part one-off factors – base effects, indirect tax changes, increases in commodity and food prices, constrained supply and logistics (IMF, 2021b). With the exception of China and the United States, output gaps in major economies are not projected to be closed in the next two years. Recent empirical evidence based on historical data also suggests that even large fiscal expansions generate only modest inflation (Hazell et al., 2021). Importantly, fiscal expansion and upward revisions of growth forecasts in advanced economies have not lifted market participants' expectations of inflation over the medium term.

Nevertheless, pent-up demand from excess saving during lockdowns and fiscal stimulus could lead to overheating in some cases. One reason is that fiscal multipliers tend to be much larger when policy rates are at effective lower bound (Klein and Winkler, 2021; Amendola et al., 2019). Fiscal policy thus has to intervene more aggressively to compensate for less potent monetary policy, leading to higher and more volatile public debt (Hofmann et al., 2021). This effect is not limited to advanced economies. In Chile and Peru, for instance, authorities allowed the withdrawal of household savings accumulated in defined-contribution pension funds. Consistent with the notion that poorer households tend to have a higher marginal propensity to consume and that transfers to such households deliver higher spending multipliers, this has led to somewhat higher inflation than in countries where a proportionately greater share of fiscal support went to firms.[2]

In emerging market economies, an additional consideration is the threat of exchange rate depreciation and capital outflows. If inflation pressures persist, monetary easing could lead to further capital outflows (Banerjee et al., 2020). Central banks may thus be forced to raise interest rates. However, this may make domestic debt even less attractive to foreign investors and lead to further currency depreciation, given that higher domestic interest rates aggravate debt sustainability problems (Blanchard, 2004).

[2] Recent estimates, for instance, suggest that financially constrained recipients of one-off transfers (such as paychecks) spend 62% of the payment within two weeks, against 35% for unconstrained recipients (Karger and Rajan, 2020).

PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

3 LONG-TERM INTERACTIONS

In the longer term, interactions between monetary and fiscal policies face further challenges, notably from high public debt and threats to central bank independence, i.e., the risk of return to some form of fiscal dominance.

3.1 WILL PUBLIC DEBT REMAIN SUSTAINABLE?

The current juncture partly reflects deeper trends that the pandemic has exacerbated. Fiscal expansion in many countries took place from an already historically high level of public debt: overall fiscal deficits reached 12% of GDP on average in advanced economies and 10% in emerging market economies in 2020 (table 1). Global public debt stock climbed above 100% of GDP, more than 10 percentage points higher than before the pandemic. The increase was facilitated by central banks, which lowered policy rates and purchased government bonds in pursuit of their mandates, and, in some countries, larger public debt holdings by the domestic banking system.

Table 1

Government balance and public debt (as a percentage of GDP)

	General government balance			Gross public debt		
	2019	2020	2021	2019	2020	2021
Euro area	-0.6	-7.6	-6.7	84	97	98
France	-3.0	-9.9	-7.2	98	114	115
Germany	1.5	-4.2	-5.5	60	69	70
Spain	-2.9	-11.5	-9.0	96	117	118
Italy	-1.6	-9.5	-8.8	135	156	157
Japan	-3.1	-12.6	-9.4	235	256	257
United Kingdom	-2.3	-13.4	-11.8	85	104	107
United States	-5.7	-15.8	-15.0	108	127	133
Brazil	-5.9	-13.4	-8.3	88	99	98
China	-6.3	-11.4	-9.6	57	67	70
India	-7.4	-12.3	-10.0	74	90	87
South Korea	0.4	-3.1	-2.7	42	48	53
Mexico	-2.3	-4.6	-3.4	53	61	61
Russia	1.9	-4.1	-0.8	14	19	18
Turkey	-6.4	-7.4	-7.1	32	40	40
South Africa	-5.3	-12.2	-10.6	62	77	81

Source: IMF (2021c).

At the same time, nominal interest rates have never been so low, and in real terms they have been negative for even longer than during the Great Inflation (BIS, 2021). Despite record-high debt-to-GDP ratios, service costs are thus at post-war lows and the debt burden seems very light. This does not mean that debt sustainability issues are unimportant. Fiscal sustainability depends on the joint dynamics of the recovery and financing conditions for governments. If the recent optimistic growth expectations materialise, growth in GDP could replenish the tax base, enlarge fiscal space, and help deal with the rising nominal debt. The decline in real

PUBLIC SECTOR ECONOMICS 45(4) 419-432 (2021)

interest rates, which predated the pandemic recession, also helps generate a sustainable debt trajectory. Other secular trends – including slower population growth and longer duration of retirement, which strengthen the propensity to save – also suggest that real interest rates may remain low in the medium term (Furman and Summers, 2020). If so, government debt rollover may not call for outsized future tax increases or spending consolidation.

Favourable refinancing conditions cannot be taken for granted, however. In the longer term, the aging of the population will likely increase public debt burden through higher primary deficits, especially in countries with pay-as-you-go pension schemes. Larger debt exposes the economy to multiple equilibria because differentials between real interest rates (r) and real growth rates (g) are sensitive to the initial government debt level (Cochrane, 2021). Countries with higher initial public debt thus tend to experience a shorter duration of negative $(r - g)$ episodes, and larger increases in interest rates in response to greater financial market volatility. For instance, a 1 percentage point increase in debt/GDP in emerging market economies is associated with an almost 0.4 percentage points increase in $(r - g)$ when the legacy public debt exceeds 70% of GDP (Lian, Presbitero and Wiriadinata, 2020). These non-linearities may be explained by the self-reinforcing mechanism between risk premia and debt levels, which can lead to significantly different debt paths (i.e., multiple equilibria) even if the initial conditions change only marginally. Market sentiment can change particularly abruptly for countries that depend on external financing.

3.2 THREAT OF FISCAL DOMINANCE?

The second longer-term challenge for monetary-fiscal interactions is the risk of fiscal dominance. In broadest terms, fiscal dominance denotes a situation in which monetary policy is subordinated to fiscal policy objectives. This was the case, for instance, in advanced economies from the Great Depression in the mid-1930 until the collapse of the Bretton-Woods fixed exchange rate system in the early 1970s. In this period, central banks routinely engaged in financial repression to allow governments to issue debt at low interest rates, and often directed cheap credit to targeted industries or firms so as to fulfil their own economic objectives. These practices included capping interest rates, imposing high reserve requirements on banks, requiring banks to hold government debt via capital requirements, regulating competition in the banking sector, restricting international capital movements, and other measures that kept nominal interest rates typically below the rate of inflation. To the extent that interest rates were adjusted for other objectives, this was mainly at times of balance of payments pressures.

Interestingly, financial repression is also associated with the "golden age" of European growth from 1950 to 1973. In this period, authorities in countries such as France and Italy established a range of public and mixed ownership institutions specialised in credit allocation to targeted industries (Monnet, 2012). Economic growth and financial repression thus went hand in hand for a quarter century, without negative consequences being becoming apparent until the outbreak of inflation in the mid-1970s.

PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

Since the liberalisation of financial markets in the 1980s and widespread achievement of central bank independence in the 1990s, fiscal dominance has come to denote a situation in which monetary policy cannot be tightened because of the interest rate sensitivity of debt service costs. Strong institutional safeguards designed to shield the central bank's operational autonomy can be effective when pressures are purely of a political nature. But they can do relatively little when the constraint is economic. For instance, in emerging market economies higher interest rates to counter inflation may undermine the government's creditworthiness, especially where debt is at floating rates. This can trigger a disruptive capital outflow, a sharp currency depreciation, and even higher inflation.

Fiscal constraints can also tie the central bank's hands in advanced economies. One example is the sovereign debt crisis in Europe in 2011-12, when the loss of market access for some governments disrupted the transmission mechanism of monetary policy in the euro area and gave rise to currency denomination risk. Another is the sovereign-bank nexus: in a fiscal crisis, banks holding large amounts of government bonds are exposed to distress or outright crisis. Banking crises in turn lead to large fiscal costs and big increases in sovereign debt, typically in the order of 20-25% of GDP over a five-year window (Laeven and Valencia, 2018). Fragilities in the non-financial corporate sector can further aggravate matters if domestic banks are heavily exposed to it.

To what extent could large-scale central bank purchases of government debt, conducted as part of quantitative easing operations, heighten the risk of fiscal dominance? How far could such measures blur the boundaries between monetary and fiscal policies?

From the perspective of the consolidated public sector balance sheet, government bond purchases under quantitative easing programmes are equivalent to large debt management operations: the public sector retires long-term government debt from the secondary bond market and replaces it with overnight debt, i.e., interest-bearing central bank reserves (Blommestein and Turner, 2012). The distinguishing element of monetary financing is the explicit link to fiscal deficits and governance arrangements whereby the finance ministry decides the size, time and duration of central bank bond purchases. That link is missing in the case of quantitative easing. Central banks have undertaken bond purchases in the context of a surge in government borrowing needs, with a view to keeping sovereign bond markets liquid and functional, and supporting the smooth financing of emergency fiscal spending. Such operations are fully in line with central banks' primary objectives of safeguarding macroeconomic and financial stability (Bailey, 2020). Importantly, central banks have retained full control over such operations and can unwind them as economic circumstances require.

A related question that has attracted considerable attention in academic literature is whether the *form* of deficit financing itself matters for inflation outcomes.

PUBLIC SECTOR ECONOMICS 45(4) 419-432 (2021)

According to monetarists, monetising a deficit results in a higher rate of inflation than bond financing. However, Sargent and Wallace (1981) derived conditions under which bond financing could lead to higher long-run inflation. Under such "unpleasant monetarist arithmetic", tightening current monetary conditions requires higher growth of interest-bearing debt. Because the government must eventually pay primary deficits and the increase in debt and accumulated interest, the central bank has to raise the money supply at some point. This results in higher inflation than if the central bank had not resorted to tightening in the first place. A valuable insight of this analysis is that fiscal dominance is generally higher where the creditworthiness of the sovereign is weaker, not stronger.

4 CONCLUDING REMARKS

How is the relationship between fiscal and monetary policies likely to evolve after the pandemic? Will the complementarity forged during the anti-recession effort in 2020-21 endure? Or will the two policies separate again, as they did during the Great Moderation?

In the years ahead, regaining room for manoeuvre will be important for both policies. The above analysis suggests that for some central banks the relationship with fiscal policies may have become "too close for comfort" (Weidmann, 2020). One scenario is thus a return to some form of separation between the two policies. Fiscal authorities will need to ensure public debt sustainability, and central banks will need to continue fulfilling their stability mandates. This implies that the two policies could at times work at cross-purposes, with fiscal consolidation putting pressure on monetary policy to remain easy, and monetary policy normalisation putting pressure on government borrowing costs.

Uncertainty about the respective roles of monetary and fiscal policies is thus likely to stay with us for some time. As noted above, interactions between them have typically swung from periods of consensus to those of uncertainty about the relationship. Goodhart (2016) identified two periods of consensus since the Second World War: about fiscal dominance (through the early 1970s); and about the separation of two policies, i.e., independent central banks and inflation targeting on the one hand, and prudent fiscal policy, possibly supported by fiscal rules, on the other (mid-1980s to 2007). There were also two periods in which central banks searched for consensus: stagflation in the 1970s; and financial instability, slow growth and low inflation after the Great Financial Crisis. Innovations in central bank policies introduced after the crisis – balance sheet policies and macroprudential measures – have strengthened the monetary policy toolkit and are likely to remain part of it in the future. But as discussed above, they also carry some risks for central banks' decision-making autonomy.

The disruptions caused by the Covid pandemic have added a new element of uncertainty to this relationship, notably the recent rise in inflation. Although this increase is currently seen as temporary, it complicates the plans for policy

normalisation. In addition, new challenges have been added to policy agendas: addressing the rise in inequality and climate related risks, among others. The expectations about what central banks in particular can do are thus not likely to diminish (Bartscher et al., 2021). This might create additional strains for the relationship between monetary and fiscal policies, as they cannot deliver on these expectations without the help of structural economic policies.

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PUBLIC SECTOR ECONOMICS
45(4) 419-432 (2021)

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Characteristics of fiscal policy in Croatia: does it depend on the phase of the business cycle?

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PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

Abstract

This paper analyzes fiscal policy sustainability and cyclicality in Croatia. The main novelty of the paper is that our fiscal response function allows for asymmetric behavior over the business cycle. We allow fiscal policy sustainability and cyclicality to differ across the expansionary and recessionary regimes. The overall results suggest that fiscal policy in Croatia is both sustainable and countercyclical. We find evidence of asymmetric behavior of fiscal policy cyclicality. In the expansionary regime, fiscal policy is countercyclical, while in the recessionary regime, it varies between procyclical and acyclical. On the other hand, we find only limited evidence of asymmetric behavior of public debt sustainability. During good times, Croatian policymakers try to keep fiscal policy both sustainable and countercyclical, which is required fiscal policy behavior. In recessionary times, the characteristics of fiscal policy are not so clear, but tend to be procyclical or acyclical.

Keywords: fiscal policy, sustainability, cyclicality, uncertainty, public debt, nonlinear models

1 INTRODUCTION

Given the adverse effects of the global financial crisis (GFC) on the economy and public finances, the possibilities and limitations of fiscal policy become an important research question, especially its sustainability and cyclicality. Many countries recorded unfavorable fiscal indicators in the aftermath of the GFC, including Croatia. Shortly after Croatia's accession to the European Union (EU) in 2013, an excessive deficit procedure (EDP) was launched in 2014 and abrogated in 2017 by a council decision based on a recommendation by the Commission due to noncompliance with Treaty reference values. During that period, the excessive deficit in Croatia was corrected: the general government deficit-GDP ratio dipped below 3%, and the public debt-GDP ratio was stabilized.

Although it is noticeable that fiscal policy was stabilized in the period from 2014 to 2017, questions of the extent to which fiscal policy is sustainable and the nature of its behavior during the business cycle arise. The aim of the paper, then, is to analyze fiscal policy sustainability and cyclicality. Strengthening fiscal discipline and consequently creating fiscal space to alleviate the adverse effects of the crisis on fiscal indicators should be the main focus of fiscal policymakers. Information on fiscal policy behavior and public debt sustainability in Croatia is very important for fiscal policymakers in relation to accession to the euro area, given the fiscal convergence criteria.

This paper analyzes public debt sustainability and fiscal policy cyclicality using Bohn's (1998) fiscal reaction function. The main point of the paper is that we analyze fiscal policy characteristics over different phases of the business cycle, e.g., expansions and recessions. Therefore, we study the asymmetric behavior of fiscal policy, allowing for different behavior depending on the business cycle phase. Public debt sustainability tells us how policymakers react to indebtedness.

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

Public debt is considered sustainable when the primary balance increases as a response to higher indebtedness. On the other hand, fiscal policy cyclicality tells us whether fiscal policy behaves pro or countercyclically. Countercyclical fiscal policy is preferred as it smooths business cycles.

To analyze the asymmetric behavior of fiscal policy over the business cycle, we estimate Bohn's (1998) fiscal reaction function using two nonlinear models, e.g., threshold regressions and the Markov switching model. The nonlinear models allow for an endogenous switch depending on the output gap, which defines different regimes. Then, the estimated coefficients differ across the regimes. The upper and lower regime could be related to periods of expansion and recession, respectively. Consequently, the analysis is focused on potential asymmetric effects from the aspect of fiscal policy cyclicality and public debt sustainability.

We take business cycle measurement seriously and use two univariate output gap measures (Hamilton, 2018; Hodrick and Prescott, 1997) and one bivariate measure based on the structural vector autoregressive model (SVAR). All three measures are used both for output gap and cyclically adjusted primary balance (CAPB) calculation; regarding the character of fiscal policy, that is, it is more appropriate to use a cyclically adjusted primary balance instead of the primary balance. Then, the effect of the cycle on the budget is removed, and consequently, the problem of endogeneity is avoided. Also, the cyclically adjusted primary balance provides information on the discretionary measures of fiscal policymakers, which directly determine the behavior of fiscal policy.

In our analysis, Bohn's (1998) fiscal reaction function is extended with lagged cyclically adjusted primary balance and with the growth rate of the economic policy uncertainty index (EPU index) in the robustness check. The EPU index was applied given the assumed impact of uncertainty on the discretionary measures of fiscal policymakers.

Our findings indicate the public debt sustainability and the countercyclical behavior of fiscal policy in Croatia. We find stronger evidence of asymmetry in fiscal policy cyclicality than of public debt sustainability. In other words, fiscal policy cyclicality changes over the business cycle, typically switching from countercyclical in the upper regime (expansions) to acyclical in the lower regime (recessions). Controlling the models for economic policy uncertainty does not change the results substantially.

The paper is divided into five sections. The next section presents a literature review and discusses empirical research in the context of fiscal policy cyclicality and public debt sustainability. The third section describes the construction of variables applied in the analysis and the research methodology. The fourth section presents the results on the asymmetry of fiscal policy behavior and public debt sustainability, more specifically, the results of rolling regressions, linear and nonlinear models, while the fifth section presents concluding remarks.

2 LITERATURE REVIEW

In empirical research, fiscal sustainability is mostly assessed using the fiscal response function initially proposed by Bohn (1998). The economic intuition of the fiscal response function is twofold. First, it provides information on the cyclical nature of fiscal policy, i.e., procyclical or countercyclical behavior, and second, it provides information on public debt sustainability.

Most empirical research indicated the existence of a fiscal response function, i.e., empirical confirmation of the positive relationship between the budget or primary balance and lagged public debt (Berti et al., 2016; Cassou, Shadmani and Vázquez, 2017; Piergallini and Postigliola, 2012; Checherita-Westphal and Žd'árek, 2017; Banić, 2020). In other words, an increase in public debt will result in an increase in the budget or primary balance in order to mitigate the negative impact of public debt accumulation on the sustainable management of public finances. Such a response is considered to reflect sustainable fiscal policy. Checherita-Westphal and Žďárek (2017) assessed the function of the fiscal response in the European Union using a dynamic panel analysis for the period from 1970 to 2013. Furthermore, the primary balance to GDP ratio represents a function of the lagged public debt GDP ratio, control variables, i.e., lagged primary balance to GDP ratio, and certain institutional and political factors. The results of the panel analysis indicate a positive reaction of fiscal policymakers, i.e., an increase in the primary balance by about 0.03-0.05% when the share of public debt in GDP increases by one percentage point. Berti et al. (2017) assessed the fiscal response function on a sample of twelve Central and Eastern European countries in the period from the mid-1990s to 2013. In an empirical study, they applied various methods of static (pooled ordinary least squares (OLS) and panel model with fixed effects) and dynamic (generalized method of moments, GMM) panel analysis for the purpose of checking the robustness of the model, where the primary balance is defined as a function of the lagged primary balance, lagged public debt, expenditure gap and inflation. Regardless of the chosen method, all the obtained results indicated a statistically significant and positive relationship between the primary balance and lagged public debt. Piergallini and Postigliola (2012) analyzed public debt sustainability in Italy, assessing the function of the fiscal response in the period from 1861 to 2009. The results of the estimated vector autoregression (VAR) model indicate the positive fiscal response in Italy, emphasizing the fiscal policymakers' awareness of the negative consequences of public debt accumulation on the efficient management of public finances. Observing fiscal sustainability in Croatia, Banić (2020) estimated the function of fiscal response applying the method of least squares (LS) in the period from 2002 to 2020. Given the increase in the primary balance-GDP ratio due to the accumulation of public debt in Croatia, a positive reaction of fiscal policymakers is noticeable in response to the potential deterioration of public finances.

In contrast to findings of the positive reaction of fiscal policymakers to the accumulation of public debt, empirical research by Arčabić (2018) and Berti et al. (2016) indicates the absence of any reaction by fiscal policymakers. In more

detail, Arčabić (2018) analyzed the sustainability of fiscal policy in the period from 2002 to 2017 in the EU-28 member states. The results of a dynamic panel system GMM estimator with common correlated effects indicate unsustainable fiscal policy at the EU level; fiscal policymakers do not increase the primary surplus due to the accumulation of public debt, with exceptions related to the EU-13 group and the sample of countries with a public debt-GDP ratio greater than 90%. An analysis of fiscal sustainability in the EU-13 member states suggests dual results (Berti et al., 2016), for the fiscal response function was estimated by a vector error correction model (VECM) in the period from 1950 to 2013, the function for each country in the sample being estimated separately. The results show the absence of a fiscal response function with regard to the statistical insignificance of the public debt coefficient, while the example of France shows a fiscally unsustainable situation with regard to the negative sign of the lagged public debt coefficient in the model. However, by including in the model a dummy variable to identify the onset of the global financial crisis in 2009, the results point to a significant change in the behavior of fiscal policymakers. Moreover, for most countries in the selected group, the lagged public debt coefficient becomes positive and statistically significant. Consequently, research (Berti et al., 2016) emphasizes the importance of the dynamics of the relationship between the primary balance and public debt, which, in contrast to the assumed linear relationship in the aforementioned empirical research, could also be nonlinear.

Gosh et al. (2011) point out that the relationship between the budget balance and lagged public debt is not exclusively linear but depends on the level of debt, i.e., the public debt-GDP ratio, emphasizing that fiscal policymakers react only when the share of public debt in GDP exceeds a certain limit that may jeopardize fiscal sustainability.[1] Also, significant accumulation of public debt can result in fiscal unsustainability despite the positive reaction of fiscal policymakers. Therefore, many studies assess the nonlinear function of the fiscal response, setting thresholds that indicate a change in the direction of fiscal policy. For example, Gosh et al. (2011) indicated the existence of a nonlinear relationship between the primary balance and lagged public debt in a sample of 23 developed economies in the period from 1970 to 2007. The relationship is approximated by the cubic function, where at low debt levels, the correlation between the primary balance and public debt does not exist, and if it does, then it is negligible. Furthermore, the panel analysis shows not only that the accumulation of public debt results in an increase in the primary balance but also that over time the reaction of fiscal policymakers tends to disappear and become completely absent at high, unsustainable levels of public debt. Cassou, Shadmani and Vázquez (2017) analyzed the fiscal sustainability of the USA in the period from 1955 to 2013, applying nonlinear threshold (TR) and Markov Switching (MS) models. An analysis on a short sample, from 1955 to 1995, indicates that fiscal policy is sustainable only in the switching model, given that the primary deficit is declining

[1] Reinhart and Rogoff (2010) also argue that public debt higher than 90% of GDP can have a negative effect on economic growth. However, this argument became controversial and was often rejected by subsequent research, see Arčabić et al. (2018).

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

due to increasing debt. On a larger sample, from 1955 to 2013, the results point to fiscal sustainability exclusively in the Markov switching model and only during periods of economic expansion.

The behavior of fiscal policy can be countercyclical and procyclical. Tax revenues are sensitive to business cycles, i.e., they act as automatic stabilizers, and it is important to look at fiscal sustainability in the context of the cyclical nature of fiscal policy. The countercyclical policy is more desirable, and it can stimulate demand in recession by increasing government spending or reducing tax rates and do the opposite in times of economic expansion (Galí and Perotti, 2003). Arčabić (2018) determined the countercyclical behavior of fiscal policy in a sample of EU-28 countries using dynamic panel analysis. He showed a positive relationship between the output gap and the primary surplus, which can be explained as creating fiscal space to mitigate the negative effects of cycles in times of crisis. Dalić (2013) used panel data models to analyze the cyclical properties of government expenditure in the period 1999-2011 for Croatia and new member states that joined the EU in 2004 or later. Using the disaggregated approach, Dalić (2013) showed that the total general government expenditure and its main subcomponents (capital and current expenditure) behaved procyclically, while the social transfers behaved countercyclically. Regarding business cycle asymmetry, the results indicated procyclical behavior for total non-interest expenditure, capital expenditure, and non-wage government consumption in good and bad times, while for the other subcomponents, there is no strong statistical evidence of a difference in cyclical behavior during good and bad times. Cassou, Shadmani and Vázquez (2017) indicate the asymmetry of fiscal policy in the USA, given that fiscal policy in the threshold model is countercyclical during recessionary periods and less countercyclical during expansionary periods. On the other hand, fiscal policy is procyclical according to the Markov-switching model. Cassou, Shadmani and Vázquez (2017) explain the procyclicality of fiscal policy through empirical confirmation in research (Balassone, Francese and Zotteri, 2010) pointing out that, on the example of the EU, the increase in expenditures during the expansion is not accompanied by a decrease in expenditures during the recession, as is noticeable with revenues. Balassone, Francese and Zotteri (2010) stipulated the existence of cyclical asymmetry on a sample of EU-14 countries in the period 1970-2004, given that the budget balance deteriorates in a recession, but also that the balance does not improve during economic expansion. In the case of Croatia for the period 2003-2019, the results of Deskar Škrbić and Raos (2018) point to procyclical fiscal policy behavior during expansions and countercyclical fiscal policy behavior during recessions. The results of Deskar Škrbić and Grdović Gnip (2020) for the same period suggest the same conclusions regarding fiscal policy behavior during expansions, but not during recessions. The austerity measures implement, they suggest, resulted in procyclical fiscal policy behavior during recessionary periods. Furthermore, a significant contribution was made to the procyclical behavior of fiscal policy during expansion by expenditure growth, which is largely influenced by political cycles (Deskar Škrbić and Grdović Gnip, 2020).

3 DATA AND METHODOLOGY

3.1 DATA CONSTRUCTION AND SOURCES

Our sample consists of quarterly data on the Croatian economy from 2000:1 to 2020:1. We decided to restrict our analysis to the period prior to the Covid-19 pandemic. The Covid-19 pandemic caused huge disturbances and created large outliers in the data, which could affect the results (see, for example, Lenza and Primiceri, 2020 on how to deal with such outliers). Extending the data to the most recent period would provide only three to four additional observations per series. Therefore, the analysis of the pre-crisis period is more reliable, and the results are not affected by huge outliers.

We use data on real GDP, public debt, and budget balance obtained from the Eurostat database. Real GDP and budget balance series are seasonally adjusted. In addition, we use the economic policy uncertainty index for Croatia developed by Sorić and Lolić (2017). The EPU index is based on the frequency of articles in leading Croatian newspapers (*Jutarnji list*, *Večernji list*, and *24 sata*) and news websites (index.hr, Poslovni dnevnik, and Dnevnik.hr), spanning the period from January 2003 to the present, various terms related to economics, politics, and uncertainty being used for the construction of the index. The index is regularly updated by the authors and can be downloaded from Baker, Bloom, and Davis (2021).

We calculate cyclically adjusted primary balance (CAPB) in two steps. In the first step, we exclude interest payments from the budget balance to obtain the primary balance. Primary balance is calculated using the following equation: $pb_t = R_t - E_t + i_t \times B_t$, where R_t and E_t are government revenues and expenditures, including interest payments. To exclude interest payments, we cancel them out by adding $i_t \times B_t$, term, which refers to interest payments on the existing debt. The interest payments series is from the Eurostat database. In the second step, the aggregate method is used to compute cyclically adjusted primary balance (see Švaljek, Vizek and Mervar, 2009). We estimate the primary balance elasticity with respect to output gap using the following equation: $pb_t = a + b\tilde{y}_t + e_t$. Primary balance in percent of GDP (pb_t) is regressed on the output gap ($\tilde{y}_t$) using OLS and the estimated coefficient $\hat{b}$ represents the elasticity. Then, CAPB is simply calculated as a difference between primary balance and the output gap multiplied by the estimated elasticity:

$$capb_t = pb_t - \hat{b} \times \tilde{y}_t \tag{1}$$

We use three estimates of output gap when calculating cyclically adjusted primary balance, univariate Hodrick and Prescott (HP) (1997) and Hamilton (2018) filters, and the bivariate decomposition based on the structural vector autoregression (SVAR) model.

Hodrick and Prescott (1997) decompose a time series into its trend and stationary components using the following optimization procedure:

$$\min_{\tau} \left(\frac{1}{T} \sum_{t=1}^{T} \left(y_t - \tau_t \right)^2 + \lambda \frac{1}{T} \sum_{t=2}^{T-1} \left[\left(\tau_{t+1} - \tau_t \right) - \left(\tau_t - \tau_{t-1} \right) \right]^2 \right) \tag{2}$$

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

where y_t represents GDP, T is the number of time series observations, and λ is a smoothing parameter that we set to 1600, which is considered common for quarterly data. The optimization process selects the τ_t series, which minimizes the sum of squares, thus giving the trend of the series, which is considered as potential output. We calculate the business cycle as a percentage deviation of GDP from the potential output. The HP filter is criticized in the literature for producing spurious cycles and for being imprecise at the beginning and the end of the sample (see Cogley and Nason, 1995; Hamilton, 2018).

Therefore, we use other filters as well. Hamilton (2018) proposes an alternative for the HP filter as a regression of y_t series on a constant and four lags of y_t two years ago. For our GDP series, we estimate the following equation:

$$y_t = a_0 + a_1 y_{t-8} + a_2 y_{t-9} + a_3 y_{t-10} + a_4 y_{t-11} + c_t \tag{3}$$

Then, the residual c_t from the equation (3) represents the business cycle.

The third output gap measure is obtained from the bivariate SVAR model proposed by Blanchard and Quah (1989), where supply and demand shocks are identified through long-run restrictions. The vector of endogenous variables contains GDP growth and unemployment, or $X_t^{'} = [\Delta y_t, u_t]$, and we estimate the following VAR model:

$$A(L)X_t = e_t \tag{4}$$

To identify supply and demand shocks, we impose the restriction that demand shocks do not affect GDP growth in the long run. Potential output is then calculated as a part of the GDP that is affected by supply shocks only. Historical decomposition is used to decompose GDP into its supply and demand components. As in the previous case, the output gap is calculated as a percent deviation of the GDP from the potential output. Such a measure of the output gap is also used in Furlanetto et al. (2020).

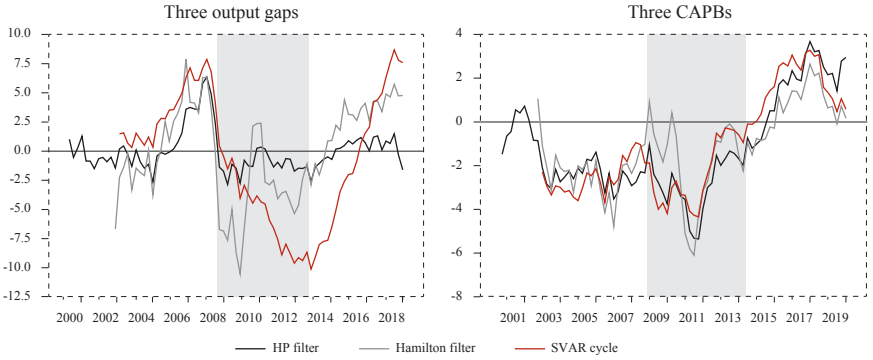
Figure 1 shows three output gap estimations and three corresponding cyclically adjusted primary balances. The shaded area represents the recession period in Croatia. It is obvious that the three methods for output gap calculation give different results (left panel of figure 1). Hamilton's filter is the most volatile, and provides a good description of the expansion prior to the global financial crisis (GFC) and of the sudden and deep recession starting in 2009. It also captures the increase in the Croatian output gap from 2014 onward. The HP filter is less volatile. It captures the expansion and potential overheating of the Croatian economy prior to the GFC, but the recession does not seem to be that deep in comparison to Hamilton's filter. In general, business cycle fluctuations are mostly close to the potential GDP according to the HP filter. Finally, the SVAR is not as volatile as the Hamilton filter but is describes business cycle fluctuations in Croatia as large swings.

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

The SVAR model shows a deep recession starting in 2009, with the output gap constantly decreasing until the end of the recession in 2014. The recovery after 2014 is rather strong in comparison to the other two output gaps. Such large swings from the bivariate SVAR model capture changes not only in GDP but also in the labor market. A strong recovery after the crisis is more pronounced in the SVAR model because of a substantial decrease in the unemployment rate and overall positive trends in the labor market in Croatia after the GFC.

Figure 1

Three output gaps and three cyclically adjusted primary balances in percent of GDP



Note: Shaded areas represent the recession periods in Croatia.

The differences in output gap calculation reflect the cyclically adjusted primary balance as well, which is shown in the right panel in figure 1. Nevertheless, all three balances show similar dynamics. The deficit was increasing, and it reached its maximum in 2011. After that, the policy measures by fiscal authorities turned the trend around, and the cyclically adjusted primary balance started to recover quickly. Soon after the end of the GFC in Croatia, all three measures show a surplus in the cyclically adjusted primary balance. The surplus reached its maximum in 2017 that corresponds with the end of the excessive deficit procedure in Croatia.

3.2 METHODOLOGY

Our fiscal response function can be described as the following OLS regression:

$$capb_t = \alpha + \rho\, capb_{t-1} + \beta_1 d_{t-1} + \beta_2 \tilde{y}_{t-1} + \varepsilon_t \tag{5}$$

where $capb_t$ is cyclically adjusted primary balance, d_t is public debt, $\tilde{y}_t$ is a measure of the output gap, and ε_t is the regression residual, which is assumed to be an *iid* error.

Fiscal policy is considered to be sustainable when the estimated coefficient next to lagged public debt is positive ($\beta_1 > 0$). In that case, the government increases the cyclically adjusted primary balance by raising taxes or reducing spending as a response to higher indebtedness. This is considered sustainable behavior.

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

On the other hand, fiscal policy is considered countercyclical when the estimated coefficient next to the output gap is positive ($\beta_2 > 0$). As a response to the increase in the output gap, the government increases cyclically adjusted primary balance, thus smoothing the business cycle. We check the robustness of our results by changing the definition of the output gap between the HP, Hamilton, and SVAR gaps.

Our model includes richer dynamics than initially proposed by Bohn (1998) by adding lagged cyclically adjusted primary balance in the equation, which it is in line with (Cassou, Shadmani and Vázquez, 2017).

The main novelty of the paper is that we allow for the asymmetric behavior of fiscal policy. To capture such asymmetric behavior, we use two different nonlinear or switching models. We use the threshold autoregression model and Markov switching model with time-varying transition probabilities.

Our threshold autoregression model allows for two regimes depending on the endogenously selected threshold value θ:

$$capb_t = \begin{cases} \alpha_1 + \rho_1 capb_{t-1} + \beta_{11} d_{t-1} + \beta_{12} \tilde{y}_{t-1} + \varepsilon_t & if \quad q_{t-d}^{TR} < \theta \\ \alpha_2 + \rho_2 capb_{t-1} + \beta_{21} d_{t-1} + \beta_{22} \tilde{y}_{t-1} + \varepsilon_t & if \quad q_{t-d}^{TR} \geq \theta \end{cases} \tag{6}$$

where q_t^{TR} is the threshold variable with the delay parameter $d = 2$ which is used to account for the problem of endogeneity of the threshold variable. The model is estimated with OLS, and the threshold value θ is endogenously selected based on the Bai-Perron tests of $L + 1$ vs. L sequentially determined thresholds. We trimmed the highest and the lowest 10% of values prior to the threshold selection procedure.

We use the output gap as a threshold variable q_t^{TR} to assess fiscal asymmetry, where the upper and lower regimes are typically interpreted as expansionary and recessionary regimes. They can also be related to good and bad economic times. We are looking for the asymmetric behavior between regimes. Asymmetric effects are found when $\beta_{11} \neq \beta_{21}$ which implies that fiscal sustainability depends on the regime, and when $\beta_{12} \neq \beta_{22}$ which implies that fiscal cyclicality depends on the regime.

We also use a two-state Markov switching model with transition probability dependent on the observable output gap (see Filardo, 1994), which is comparable to the threshold autoregression model. The Markov switching model is described as follows:

$$capb_t = \alpha(s_t) + \rho(s_t) capb_{t-1} + \beta_1(s_t) d_{t-1} + \beta_2(s_t) \tilde{y}_{t-1} + \sigma(s_t) \varepsilon_t \tag{7}$$

where s_t is the state variable that allows for two unobservable regimes. All independent variables are allowed to switch between states. States are determined by the transition matrix and transition probabilities p_{ij} given by:

$$P = \begin{bmatrix} p_{11} & 1-p_{22} \\ 1-p_{11} & p_{22} \end{bmatrix} \tag{8}$$

Transitional probabilities p_{ij} depend on the observable variable q_t based on the logistic function of the following form:

$$\begin{aligned} p_{11}(q_t) &= \frac{\exp(o_{10}+o_{11}q_t)}{1+\exp(o_{10}+o_{11}q_t)}, \\ p_{22}(q_t) &= \frac{\exp(o_{20}+o_{21}q_t)}{1+\exp(o_{20}+o_{21}q_t)}. \end{aligned} \tag{9}$$

This type of model is proposed by Filardo (1994), and it is used in a similar application of public debt sustainability by Cassou, Shadmani and Vázquez (2017). Again, asymmetric behavior is found when coefficients β_1 or β_2 are different across regimes.

All the models are estimated with HAC standard errors based on the Newey-West window and four lags.

4 RESULTS

4.1 FISCAL POLICY CYCLICALITY AND SUSTAINABILITY

Figure 2 shows the results of a simple rolling regression based on equation (5). The left panel of figure 2 shows the results of fiscal sustainability by plotting the rolling window coefficient next to public debt. Positive coefficient signals fiscal sustainability. The right panel of figure 2 shows fiscal cyclicality, the positive relationship between CAPB and output gap signaling countercyclical fiscal policy. Blue lines are 95% confidence intervals. Each row in figure 2 shows the results for different output gap measures, which affect both CAPB calculation and the output gap. For simplicity, the shaded area represents the recession period in Croatia from 2009:1 to 2014:2, while two vertical red lines represent the beginning and the end of the excessive deficit procedure in Croatia, 2014:1 and 2017:2, respectively.

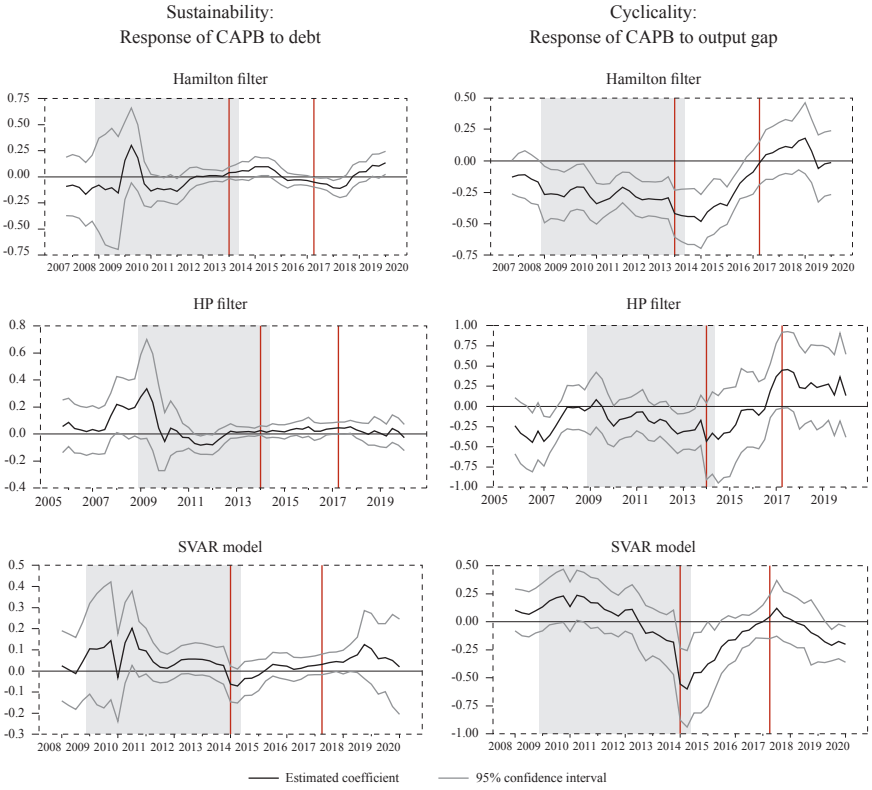
It is evident that fiscal sustainability varies over time, but the estimated coefficient is mostly positive and very low during the observed period. An exception is the beginning of the GFC between 2009 and 2012. However, the estimated confidence intervals show that the coefficient switches from positive to statistically equal to zero. The confidence intervals are especially wide at the beginning and the end of the period, and the coefficient is statistically insignificant most of the time.

However, a structural change is visible during and right after the EDP period, when the estimated coefficient is positive and increasing. At the same time, the

estimated confidence intervals are unusually narrow, suggesting much lower standard errors. The reason for this is twofold. First, the substantial changes in the demarcation of the general government debt after Croatia's EU accession had an effect on debt sustainability. Furthermore, the EDP procedure motivated the policymakers to take firm measures with respect to public debt. Second, at the end of 2014, the recession in Croatia was over, and the GDP growth accelerated in 2015, thus decreasing the debt-to-GDP ratio.

FIGURE 2

Public debt sustainability and cyclicality, rolling window regression results



Note: Shaded areas represent the recession periods in Croatia. Vertical red lines indicate the beginning and the end of the excessive deficit procedure in Croatia (2014:1-2017:2). The rolling window size is 20 quarters (five years). Regression is estimated with HAC standard errors based on the Newey-West window and four lags.

The right hand panel of figure 2 shows fiscal cyclicality, which also shows evidence of structural change. Most of the time, fiscal policy is found to be procyclical when the Hamilton filter is observed and acyclical when the HP and SVAR model are observed. Only the magnitude of the estimated coefficient varies. A structural change can be observed during the EDP, as all three models show a substantial increase in the estimated coefficient. Such an increase indicates a change in the character of fiscal policy, going from procyclical to countercyclical. After the end of

the EDP, all three models show a positive but insignificant response of CAPB to an increase in the output gap, suggesting that fiscal policy tends to be acyclical.

The initial results obtained from the rolling regression show a potential structural change in the fiscal response function, just as shown in Gosh et al. (2011). Such results motivate the use of more sophisticated models, such as threshold regression and Markov switching models, to assess the potential asymmetric behavior of fiscal policy over the business cycle.

Table 1 shows the results of the estimated linear and nonlinear models. We present different models in the first row. LM-HAM is a linear model in which the Hamilton filter is used to calculate the output gap and the cyclically adjusted primary balance. Furthermore, LM-HP represents a linear model in which the HP filter is used to calculate the output gap and the cyclically adjusted primary balance, while LM-SVAR represents the linear model in which we use the SVAR model to estimate the output gap and the cyclically adjusted primary balance. Accordingly, Threshold (TR) and Markov-switching (MS) models are presented in a similar way depending on which filter is applied to estimate the output gap and calculate the cyclically adjusted primary balance. In all cases, the threshold or switching variable in the TR and MS models is the output gap. We further test the asymmetry by checking the Wald test on the equality of coefficients in the two regimes. Results of the Wald test for debt to GDP ratio and the output gap are reported at the bottom of the table. Finally, we report test statistics for each model, including log-likelihood or R-squared, regimes volatilities for the MS models, serial correlation tests, and White's heteroskedasticity test.

From the aspect of public debt sustainability, linear models indicate the sustainable reaction of fiscal policymakers in Croatia, given that the increase in the public debt-GDP ratio results in an increase in the cyclically adjusted primary balance-GDP ratio. This is in line with the results of empirical research on fiscal sustainability in Croatia (Banić, 2020), in which the dependent variable is the primary balance. Furthermore, linear models indicate the countercyclical behavior of fiscal policy in Croatia with regard to the positive and significant sign of the lagged output gap. This result is robust to different measures of the output gap, except the SVAR model, which suggests acyclical fiscal policy, as indicated by the insignificant coefficient next to the output gap.

However, linear models do not provide information on the behavior of fiscal policy in different phases of business cycles. Therefore, in order to examine the existence of nonlinearity or asymmetry in the models, TR and MS models were estimated.

Table 1
Results on fiscal policy sustainability and cyclicality

	LM-HAM	LM-HP	LM-SVAR	TR-HAM	TR-HP	TR-SVAR	MS-HAM	MS-HP	MS-SVAR
Threshold				-3.352	-0.655	0.413			
Constant	-1.055**	-0.761**	-1.184*						
	(0.024)	(0.044)	(0.059)						
Lagged CAPB/GDP	0.798***	0.918***	0.863***						
	(0.000)	(0.000)	(0.000)						
Lagged debt/GDP	0.013**	0.013**	0.018*						
	(0.044)	(0.022)	(0.065)						
Lagged output gap	0.061**	0.101***	0.009						
	(0.020)	(0.008)	(0.649)						
Constant – UP				-1.049**	-2.119***	-3.472***	-1.239***	-0.828**	-1.066
				(0.035)	(0.000)	(0.000)	(0.000)	(0.015)	(0.150)
Constant – DOWN				-0.642	-0.321	-2.066*	-0.370	-0.214***	-1.222***
				(0.602)	(0.486)	(0.079)	(0.733)	(0.000)	(0.000)
Lagged CAPB/GDP-UP				0.761***	0.766***	0.439***	0.642***	0.928***	0.856***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged CAPB/GDP-DOWN				-0.797	1.005***	0.872	1.06***	0.929***	1.039***
				(0.151)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged debt/GDP-UP				0.014**	0.034***	0.036***	0.017***	0.013**	0.016
				(0.045)	(0.000)	(0.004)	(0.005)	(0.014)	(0.149)
Lagged debt/GDP-DOWN				-0.131***	0.008	0.032*	0.004	0.018***	0.024***
				(0.006)	(0.202)	(0.075)	(0.822)	(0.000)	(0.000)

	LM-HAM	LM-HP	LM-SVAR	TR-HAM	TR-HP	TR-SVAR	MS-HAM	MS-HP	MS-SVAR
Lagged output gap-UP				0.06***	0.114***	0.177***	0.070***	0.097**	0.002
				(0.005)	(0.003)	(0.000)	(0.002)	(0.035)	(0.945)
Lagged output gap-DOWN				-0.674***	0.158***	0.027	0.017	0.198***	0.071***
				(0.007)	(0.007)	(0.493)	(0.822)	(0.000)	(0.000)
1st-regime volatility							-0.949***	-0.476***	-0.549***
							(0.000)	(0.000)	(0.000)
2nd-regime volatility							0.064	-6.008***	-3.786***
							(0.699)	(0.000)	(0.000)
Log-likelihood/R-squared	0.779	0.914	0.941	-77.405	-63.870	-41.652	-75.288	-59.593	43.460
Wald Test – lagged output gap				9.096***	0.444	6.471**	0.496	4.764**	6.833**
(Chi-Square(1), p-value)				(0.003)	(0.508)	(0.013)	(0.484)	(0.039)	(0.012)
Wald Test – lagged debt/GDP				9.617***	9.973***	0.044	0.516	1.208	0.464
(Chi-Square(1), p-value)				(0.002)	(0.002)	(0.835)	(0.473)	(0.272)	(0.499)
Serial Correlation LM Test	27.083***	21.267**	29.412***	23.728**	17.714	32.279***	24.507**	18.895*	23.677**
(Chi-Square(1), p-value)	(0.008)	(0.047)	(0.003)	(0.022)	(0.125)	(0.001)	(0.017)	(0.091)	(0.023)
White Heteroscedasticity Test	10.371	12.899	5.702	15.008	27.61*	15.272			
	(0.321)	(0.167)	(0.769)	(0.524)	(0.091)	(0.705)			

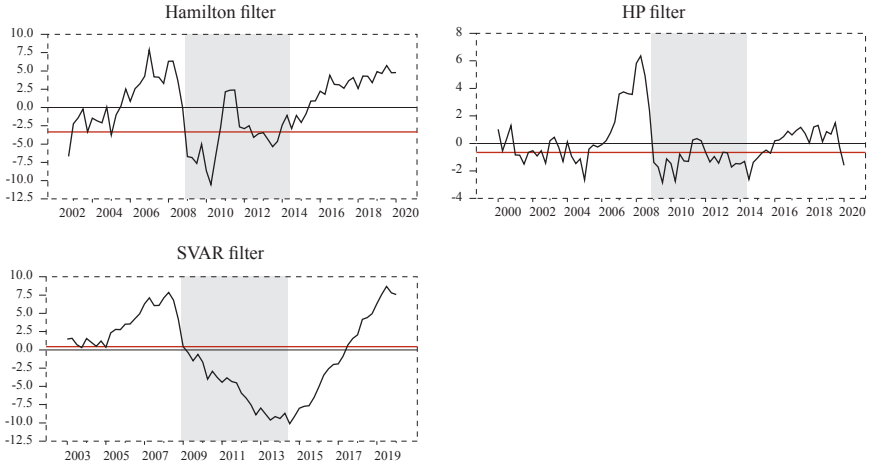
*Note: *,** and *** indicate significance at the 10%, 5% and 1% level. p-values in parenthesis. HAC standard errors based on the Newey-West window and four lags are used.*

It is important to emphasize the distinction between the two regimes in the TR and MS models. Intuitively, for TR models, if the value of the output gap is above the threshold, the upper regime (UP) can be related to periods of expansion, and if the value of the output gap is below the threshold, the lower regime (DOWN) can be related to periods of recession. For MS models, the regimes are estimated depending on the probability of the unobserved state variable, with the regimes aligned with business cycles to relate them to expansion and recession periods. For simplicity, we still refer to them as upper and lower regimes (UP and DOWN) to relate with the TR model, even though the models differ. Cassou, Shadmani and Vázquez (2017) emphasize the difference between regime identification in TR and MS models, which may lead to different results. Namely, in TR models, the same level of innovation volatility above and below the threshold is assumed, while in MS models it is not, which is why the volatility in each regime is analyzed. In each of the endogenously identified regimes, we measure fiscal sustainability and cyclicality by analyzing how the cyclically adjusted primary balance responds to changes in lagged public debt and the output gap.

In figure 3, we show output gaps calculated with different filters together with the corresponding threshold values from the estimated models, depicted with a horizontal red line. The common reasoning is that the threshold should be close to zero. In that case, the upper regime corresponds with the expansion periods and positive output gaps, while the lower regime indicates negative output gaps and recessions. The estimated threshold values in the case of the HP filter and SVAR model indeed are close to zero; more precisely, they are -0.65 and 0.41, respectively. The Hamilton filter yields a much lower threshold value of -3.35. Nevertheless, in all three cases, there are enough observations in each regime for the proper inference.

FIGURE 3

Output gaps and estimated thresholds



Note: Horizontal red line represents the estimated threshold value. Shaded areas represent the recession periods in Croatia.

Our results suggest that fiscal policy in Croatia is mainly sustainable and countercyclical. Furthermore, we find only limited evidence of asymmetry in public debt sustainability and more pronounced evidence of asymmetric behavior when it comes to fiscal policy cyclicality. Out of six models, we find firm evidence that public debt sustainability depends on the business cycle in only two models. In four out of six models, fiscal policy cyclicality depends on the business cycle stage (expansion vs. recession).

When the upper regime results are observed, fiscal policy is both sustainable and countercyclical in all models except the MS-SVAR. Therefore, the findings of fiscal sustainability and countercyclical behavior of fiscal policy are fairly stable and certain in the upper regime, which corresponds with the expansionary phase of the business cycle.

The lower regime corresponds to the recessionary phase of the business cycle, and the results on sustainability and cyclicality are mixed. Still, in three out of six models, we find that fiscal policy is sustainable and countercyclical. Nevertheless, our result suggests higher model uncertainty in the lower regime.

The results of the TR-HAM, TR-HP, MS-HAM, and MS-SVAR models indicate asymmetry in the context of public debt sustainability, but the evidence is not entirely clear. Above the threshold, during expansionary periods, fiscal policymakers increase the cyclically adjusted primary balance due to the accumulation of lagged public debt, which is considered sustainable fiscal policy. In table 1, it is shown by positive coefficients next to lagged public debt. However, below the threshold, during recessions, either the accumulation of public debt results in a reduction of the cyclically adjusted primary balance, or the response is statistically equal to zero, which is not considered sustainable. However, the evidence is not completely robust, as the difference between the coefficients in the upper and lower regime is confirmed by the Wald test only for the TR-HAM and TR-HP models. In the case of the MS-SVAR model, we find the inverse response of cyclically adjusted primary balance, e.g., cyclically adjusted primary balance does not respond to an increase in public debt above the threshold, while the response is positive below the threshold.

Similarly, we find evidence of asymmetric behavior of fiscal policy cyclicality in the TR-HAM, TR-SVAR, MS-HAM, and MS-SVAR models. In the upper regime, fiscal policy is found to be countercyclical, while in the lower regime, it is either procyclical (TR-HAM) or acyclical. Again, the MS-SVAR model is an exception, showing the opposite characteristics between the regimes. The Wald test results confirm differences in estimated coefficients between two regimes in TR-HAM, TR-SVAR, MS-HP, and MS-SVAR.

We can observe that TR-HAM and MS-SVAR models stand out, both suggesting an asymmetric behavior of fiscal policy but with the opposite signs. It should be

noted that the estimated threshold for the TR-HAM model is rather low, with a value of -3.35, which can affect the results. Also, different volatility in regimes, as well as estimates of the output gap, may result in different assessments of fiscal policy behavior and sustainability. In the MS models, the volatility in the first regime, which refers to expansion, is about three to six times lower than in the second regime, which refers to recession.

This indicates that during good times, Croatian policymakers try to keep fiscal policy both sustainable and countercyclical, which is considered sound fiscal policy behavior. Below the threshold, in recession times, the characteristics of fiscal policy are not so clear, as our models provide different results. We find asymmetric behavior of public debt sustainability in only two out of six models. On the other hand, fiscal policy cyclicality depends on the phase of the business cycle in four out of six models. Therefore, we find some evidence of asymmetric behavior of fiscal policy cyclicality but only limited evidence of asymmetry in public debt sustainability.

4.2 ROBUSTNESS CHECK

We test the robustness of our results by including a growth rate of the index of economic policy uncertainty (EPU index) as a control variable in equations (5), (6), and (7). The economic policy uncertainty is recognized in the literature as a shock that has a significant but rather short and weak effect on both the real and financial sector in Croatia (Sorić and Lolić, 2017; Arčabić, 2015). Still, during the global financial crisis in Croatia from 2009 to 2014, economic policy uncertainty was very high, and we use it to capture its effects on fiscal policy. Deskar Škrbić and Raos (2018) emphasize the importance of policy influence in decision-making that may not be in line with medium- and long-term fiscal targets and, given that the EPU index may to some extent be of added value to assess the fiscal policy behavior.

The results of the linear models, which are presented in table 2, indicate fiscal policy sustainability, as well as the countercyclical behavior of fiscal policy; this is identical to the results of linear models in table 1. Furthermore, the LM-SVAR shows acyclical behavior of fiscal policy, which is identical to the previous results. EPU index is found to be positive and statistically significant only in the LM-HP model.

Table 2

Robustness check of fiscal policy cyclicality and sustainability with the included economic policy uncertainty

	LM-HAM	LM-HP	LM-SVAR	TR-HAM	TR-HP	TR-SVAR	MS-HAM	MS-HP	MS-SVAR
Threshold				-3.592	-0.254	2.055			
Constant	-0.901**	-1.208***	-5.571***						
	(0.032)	(0.000)	(0.000)						
Lagged CAPB/GDP	0.839***	0.901***	0.393***						
	(0.000)	(0.000)	(0.004)						
Lagged debt/GDP	0.011*	0.018***	0.083***						
	(0.061)	(0.005)	(0.000)						
Lagged output gap	0.053**	0.115***	0.091						
	(0.045)	(0.004)	(0.101)						
EPU index	0.001	0.002*	0.002						
	(0.406)	(0.064)	(0.726)						
Constant – UP				-1.241**	-2.802***	-3.223***	-1.666***	-1.291***	-2.196***
				(0.015)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant – DOWN				-7.197***	0.510	-1.327	-0.233	-0.548***	-1.318
				(0.000)	(0.265)	(0.181)	(0.754)	(0.000)	(0.438)
Lagged CAPB/GDP-UP				0.785***	0.766***	0.545***	0.628***	0.896***	0.517***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged CAPB/GDP-DOWN				-0.102	1.084***	0.878***	1.174***	0.981***	0.737***
				(0.565)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged debt/GDP-UP				0.016**	0.042***	0.026*	0.017***	0.018***	0.028***
				(0.021)	(0.000)	(0.066)	(0.002)	(0.006)	(0.007)
Lagged debt/GDP-DOWN				0.062***	0.000	0.022	0.001	0.021***	0.027
				(0.000)	(0.958)	(0.152)	(0.912)	(0.000)	(0.254)

	LM-HAM	LM-HP	LM-SVAR	TR-HAM	TR-HP	TR-SVAR	MS-HAM	MS-HP	MS-SVAR
Lagged output gap-UP				0.061**	0.164***	0.224***	0.059***	0.096*	0.159***
				(0.012)	(0.000)	(0.000)	(0.003)	(0.065)	(0.000)
Lagged output gap-DOWN				-0.319***	0.237***	0.031	0.020	0.201***	0.081**
				(0.000)	(0.000)	(0.416)	(0.834)	(0.000)	(0.018)
EPU index-UP				0.003	0.003***	0.0001	-0.001	0.001	0.001
				(0.120)	(0.002)	(0.352)	(0.1951)	(0.516)	(0.857)
EPU index-DOWN				-0.029***	-0.000	0.000	0.005*	0.002	0.001
				(0.000)	(0.988)	(0.971)	(0.057)	(0.000)	(0.726)
1st-regime volatility							-0.990***	-0.529***	-0.750***
							(0.000)	(0.000)	(0.000)
2nd-regime volatility							-0.061	-4.528***	-0.993***
							(0.7655)	(0.000)	(0.000)
Log-likelihood/R-squared	0.798	0.931	0.646	-65.321	-51.838	-41.869	-68.748	-50.577	-37.686
Wald Test – lagged output gap				37.966***	1.043	8.616***	0.140	3.957**	2.065
(Chi-Square(1), p-value)				(0.000)	(0.307)	(0.003)	(0.708)	(0.047)	(0.157)
Wald Test – lagged debt/GDP				0.003	24.217***	0.033	1.309	0.082	0.001
(Chi-Square(1), p-value)				(0.857)	(0.000)	(0.856)	(0.253)	(0.775)	(0.981)
Serial Correlation LM Test	23.894**	19.969*	12.158	25.041**	31.499***	31.155***	25.063*	10.634	27.900
(Chi-Square(1), p-value)	(0.021)	(0.068)	(0.433)	(0.015)	(0.002)	(0.002)	(0.015)	(0.561)	(0.006)
White Heteroscedasticity Test	17.125	13.619	24.456	27.948	35.773	30.542			
	(0.250)	(0.478)	(0.143)	(0.361)	(0.180)	(0.387)			

*Note: *, ** and *** indicate significance at the 10%, 5% and 1% level. p-values in parenthesis. HAC standard errors based on the Newey-West window and four lags are used.*

Public debt is again found to be sustainable in all models in the upper regime, which is related to the expansionary phase of the business cycle. We find evidence of asymmetric behavior of public debt sustainability in four out of six models. In TR-HP, TR-SVAR, MS-HAM, MS-SVAR, we find a positive response in the upper regime but a statistically insignificant response in the lower regime. No response of cyclically adjusted primary balance to increasing public debt is considered unsustainable. However, the Wald test confirms the difference in coefficients between regimes for only one model – TR-HP. Therefore, our results confirm only limited evidence of asymmetric behavior of public debt sustainability.

We find more evidence of asymmetry in fiscal policy cyclicality. In the upper regime, all the models show countercyclical fiscal policy, while in the lower regime, there is more uncertainty. We find procyclical behavior in the TR-HAM model and acyclical behavior in TR-SVAR and MS-HAM. Other models do not show signs of asymmetry. Again, we can confirm the findings from the benchmark model where some evidence of asymmetric behavior of fiscal policy cyclicality exists.

4.3 DISCUSSION

The absence of countercyclical behavior of a fiscal policy is noticeable in the research of Balassone, Francese and Zotteri (2010), which can be explained by the fact that procyclical behavior at the same time requires a focus on sustainable debt, which could accumulate significantly during a recession and consequently jeopardize fiscal rules. Also, regarding Croatia, fiscal policy behavior is mostly procyclical during both expansion and recession, according to Deskar-Škrbić and Grdović Gnip (2020), reflecting the impact of austerity measures during the recession and the impact of the political cycle on public expenditure growth. The results of our research are identical to those of Deskar-Škrbić and Grdović Gnip (2020) for the period of recessions but not for the period of expansion. Furthermore, some research results (Deskar-Škrbić and Raos, 2018) are opposite to ours, i.e., fiscal policy behavior is procyclical during expansion and countercyclical during recessions. There are many possible reasons why the results differ. Initially, the research by Deskar-Škrbić and Raos (2018) was conducted using descriptive methods. This allows for a precise determination of the fiscal policy behavior for each year, but by using this approach is not possible to assess the impact of the output gap on the cyclically adjusted primary balance. Also, different results potentially arise from the methodology of calculating the output gap and consequently the cyclically adjusted primary balance.

5 CONCLUSION

This paper aims to assess the behavior of fiscal policy and the sustainability of public debt during business cycles in Croatia by using Bohn's (1998) fiscal response function. We assess the robustness of our findings through different estimates of the output gap using univariate (Hamilton and HP) and multivariate (SVAR) models. Furthermore, to control for the effect of the business cycle, and in contrast to most research, the fiscal response function was estimated using the cyclically adjusted

PUBLIC SECTOR ECONOMICS
45(4) 433-457 (2021)

primary balance as a dependent variable. The choice of cyclically adjusted primary balance in relation to the primary or budget balance is meaningful in this research due to the empirical question of whether the behavior of fiscal policy depends on the business cycle, with the cyclically adjusted primary balance abstracting the impact of the cycle on budgetary categories. Therefore, the aforementioned framework is appropriate for the assessment of discretionary measures, which consequently determine the behavior of fiscal policymakers.

Since the results from the rolling regression signal a potential structural change in the fiscal response function, we used nonlinear threshold regression and Markov switching models to analyze potential fiscal policy asymmetry over the business cycle. In the nonlinear models, we use output gap as threshold/switching variable to assess fiscal asymmetry where the lower regime could be related to recessions while the upper regime could be related to expansions.

The results of linear models indicate public debt sustainability. Nonlinear models show only limited evidence of the asymmetric behavior of public debt sustainability. Four out of six nonlinear models signal asymmetric behavior in the context of public debt sustainability, but such asymmetry is confirmed by the Wald test in only two models. Therefore, fiscal policy is considered sustainable in the upper regime, while in the lower regime, results are less clear. To test the robustness, we included the growth rate of the economic and policy uncertainty index. The results of linear as well as nonlinear models are robust, but since the Wald test confirms the difference in public debt-GDP ratio coefficients between regimes for only one model, one can say that results confirm only limited evidence of the asymmetric behavior of public debt sustainability.

From the aspect of fiscal policy cyclicality, we find more evidence of the asymmetric behavior of fiscal policy. According to linear models, fiscal policy can be mostly characterized as countercyclical. Regarding the nonlinear models, the results indicate the asymmetric behavior of fiscal policy cyclicality in four out of six models. In other words, in the upper regime, fiscal policy behavior is countercyclical, while in the lower regime, it is either procyclical or acyclical, with the exception of one model with the opposite results. Also, the difference between the coefficients in the upper and lower regime is confirmed by the Wald test in three models, showing the opposite signs in models, which could be a result of different estimates of the output gap and threshold value as well as different volatility in Markov switching regimes. Regarding the robustness of results, in the upper regime, all the models indicate countercyclical fiscal policy, while in the lower regime, there is more uncertainty.

Overall, the results of empirical research mostly indicate that fiscal policy in Croatia is sustainable and countercyclical. Also, from the aspect of asymmetry, there is stronger evidence of asymmetry in fiscal policy cyclicality compared to public debt sustainability. The latter could reflect the dominance of discretionary

measures in the lower regime, as well as policy makers' focus on public debt sustainability in the lower regime, which could be related to the excessive deficit procedure. Additionally, the empirical findings are highly important and favorable with respect to accession to the euro area, given the stability of public finances. In the context of research limitations, in subsequent research, an exogenously determined threshold value of zero output gap may be used instead of an endogenously determined threshold in order to identify the business cycle according to the author's assumptions. Also, the public debt to GDP ratio could be considered as a threshold or switching variable.

Disclosure statement

All authors state that they do not have any financial or other substantive conflict of interest.

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The interplay of supply and demand shocks: measuring potential output in the COVID-19 pandemic

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PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

Abstract

The coronavirus triggered a record fall of GDP in Croatia, 8.1% in 2020, one of the largest declines in the EU. The large macroeconomic shock stemming from the pandemic has affected both supply and demand. On the one hand, government measures have imposed unprecedented supply-side restrictions. On the other hand, growing uncertainty affected domestic and foreign demand. Croatia was particularly affected by a plunge in international tourism demand. Such a major macroeconomic shock poses a challenge for estimating potential GDP, which is difficult to estimate even in stable economic conditions. When estimating potential GDP in the context of the corona crisis, the main issue is the breakdown of the shock into a permanent and a temporary part (supply and demand shock). In this paper, we try to give the most logical breakdown of Croatian data and describe possible methodological approaches to the estimation of potential GDP during the pandemic.

Keywords: production function, factors of production, Cobb Douglas, potential output, capacity utilization, Croatia

1 INTRODUCTION

The macroeconomic shock caused by the coronavirus pandemic resulted in an annual GDP decline of a record 8.1% in 2020. Such a large shock poses a challenge to the estimation of potential GDP, an unobservable variable that is difficult to estimate even in normal economic times.

When estimating potential GDP in the context of the corona crisis, the main issue is to break down the shock into a permanent part (supply shock), a part directly caused by containment measures (temporary supply shock), and a standard temporary part (demand shock). Even if it were possible accurately to identify the nature of the shock in the short run, uncertainty surrounding the impact of the pandemic shock on potential GDP and long-term growth would continue. The latter is difficult to assess because, among other things, the duration of the pandemic is still unknown.

Although we cannot answer these issues with certainty, this paper aims to estimate potential GDP, for economic policymakers to rely on when making decisions. For that purpose, we analyse several possible methodological approaches and calibrations for estimating Croatian potential GDP including recent data from the onset of the COVID-19 pandemic. However, as the authors of the ECB's analysis (2020) point out, all estimates of potential GDP at this point are preliminary and characterized by a high degree of uncertainty given that we have data for only one year after the outbreak of the pandemic. Accordingly, revisions to potential GDP data in the future as the consequences of the pandemic become clearer are certain.

Traditionally, potential GDP is defined as the highest level of output that can be achieved without creating inflationary pressures in the economy. Although unobserved, potential GDP is one of the most important macroeconomic indicators. For

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

purposes of economic policies, estimates of the potential GDP level and growth are important in both the short and long term. In the short run, real GDP can be above or below potential GDP. The output gap signals the stage of the cycle the economy at some point, and thus provides key information to economic policymakers about when to implement countercyclical economic measures. In the long run, estimates of potential GDP give insight into a sustainable long-term GDP growth rate that an economy can expect in the future. Potential GDP reflects economic conditions on the supply side, such as changes in the main factors of production (labour, capital and their productivity), while fluctuations in GDP around the potential are associated with factors on the demand side (ECB, 2020). The macroeconomic shock caused by the coronavirus pandemic affected both supply and demand at the same time. On the one hand, government measures designed to curb the spread of the virus have imposed unprecedented supply-side restrictions. On the other hand, the uncertainty related to the pandemic affected domestic and foreign consumption, which was reflected in domestic and foreign demand. Croatia was particularly affected by a plunge in international tourism demand.

According to the conventional view, economic policies have a limited impact on potential GDP in the long run. On the other hand, there is ample empirical evidence that inadequately designed economic policies may in the short run affect the potential GDP level and growth in the medium and long run (Cerra, Fatas and Saxena, 2020). In addition, inadequate estimation of potential GDP (and thus of the output gap) in the short term leads to sub-optimal economic policies. For economic policies to be optimal, they need to be adapted to the business cycle of the economy. This especially refers to inadequate fiscal policies, which can increase the volatility of GDP growth rates in the short run. Ramey and Ramey (1995) emphasized the association of high volatility of growth rates in the short run with lower growth rates in the long run. Therefore, an adequate estimation of potential GDP becomes crucial, especially in times of crisis, because potential GDP is a key macroeconomic variable that can provide economic policymakers timely information on the size of the output gap and the stage of the business cycle.

Potential GDP cannot be measured directly because it is an unobservable variable. Therefore, it needs to be projected from the available data in some way using various statistical and econometric methods (ECB, 2011a). Each of the frequently used methods has its advantages and disadvantages. The lack of a single conceptual framework for estimating potential GDP and the use of different methodological approaches result in significant estimation uncertainty even in normal economic times. Although it is exceptionally important to have information about the impact of COVID-19 on the output gap and potential GDP, estimation of the latter is more difficult than ever.

The paper is organized as follows. The second chapter provides a brief historical overview of the conceptual and practical framework for estimation of potential GDP. In this chapter we also emphasize the conventional view of potential GDP

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

and business cycles. The same chapter also gives an insight into the importance of adequately designed economic policies that should account for rigidity in the adjustment mechanisms. The third chapter briefly describes the most commonly used methodological approaches to estimating potential GDP and its growth. The fourth chapter analyses the main issues that arise when estimating the impact of pandemic shock on potential output within the production function methodology. This chapter also gives a brief description of transmission channels through which the COVID-19 pandemic could have affected potential GDP. Chapter five compares the proposed potential GDP estimate calculated using production function methodology with capacity utilization rate. The last chapter summarizes the main findings and concludes with implications for economic policy.

2 CONCEPTUAL FRAMEWORK AND IMPLICATIONS OF POTENTIAL GDP AND ITS GROWTH

2.1 BUSINESS CYCLES

Potential GDP is a theoretical construct. In other words, potential GDP cannot be observed directly. In essence, estimating potential GDP comes down to separating the long-term trend of GDP from the business cycle. It is this separation of the long-term trend from the business cycle that allow economists to think about the existence, causes, and methods of managing the fluctuations to which the economy is exposed (Cerra, Fatas and Saxena, 2020).

Before describing in detail the conventional view of potential GDP, we give a brief historical overview of the practical estimation of potential GDP. With the development of different views on business cycles, different methods of estimation have been established to separate the trend and the cycle of GDP (output gap).[1]

Although economists referred to the concept of the business cycle even before the mid-20th century, we begin our historical review with a book by Burns and Mitchell (1946) that is considered the originator of today's standard understanding and identification of business cycles.[2] The main idea of the approach developed by Burns and Mitchell (1946) was to identify turning points, which they defined as points at which the trend of a number of economic indicators changes direction from positive to negative and vice versa.[3] The National Bureau of Economic Research (NBER) used this methodological approach to identify the periods of recession and expansion (Beveridge and Nelson, 1981).[4] Burns and Mitchell (1946) developed a method to identify business cycle turning points that was completely devoid of any

[1] For a detailed overview of the ideas and development of the methodology related to the separation of the trend and cycle of GDP, see for example Cerra, Fatas and Saxena (2020).
[2] Earlier thoughts on economic cycles and fluctuations did not address their practical identification in a modern sense (see in more detail in Beveridge and Nelson, 1981).
[3] One of the main purposes of the book was to list the methods of measuring the cyclical behaviour of the economy developed by the NBER and their practical application in identifying the turning points of the business cycle.
[4] Despite the fact that business cycle identification today uses methods that over time deviated from the approaches proposed by Burns and Mitchell (1946), the conceptual framework they developed can still be recognized today in various methods of identifying business cycle turning points. One of the first researches in which the turning points of the business cycle in Croatia were identified, using three different methods, was conducted by Krznar (2011a).

theoretical basis and focused on statistical data properties and was therefore criticized not only theoretically and conceptually, but also from a practical point.

For example, Koopmans (1947) dubbed the book Burns and Mitchell (1946) wrote "Measurement without theory." However, although Koopmans expressed his appreciation of the authors for their empirical contribution, he also criticized them for not using economic theory to test the practical relevance of the proposed identification method. In other words, Koopmans was critical of the absence of any explanation of the causes of economic fluctuations, which (according to him) limited the value of the results from the perspective of economic science and politics. In addition, from a conceptual point of view, it is not clear why the cyclical decline should be accompanied by a decline in economic indicators. That is, Beveridge and Nelson (1981) warned that "if the trend of a time series is strictly positive, then the decline of the cyclic component can occur without any negative change in the data series itself."

Despite the criticism, until the work of Kydland and Prescott (1982), little attention was paid to understanding the trend determinants of the GDP time series. Until the emergence of stagflation in the late 1970s, cycles were seen as fluctuations around an (unexplained) long-term trend. At the same time, short-term fluctuations around the trend were explained by factors on the demand side. This explanation of short-term fluctuations around an (unexplained) trend was consistent with the dominance of the Keynesian view of economics. However, Keynesian explanations were severely shaken during the period of major oil shocks (Cerra, Fatas and Saxena, 2020) during which decline in economic activity was accompanied by rising prices, which was inconsistent with the explanation of fluctuations solely on the demand side of the economy. The missing ingredient is precisely the explanation of the trend, i.e., changes in potential GDP.

The explanation was first offered by Kydland and Prescott (1982). Over the period from the publication of Burns and Mitchell (1946) to the work of Kydland and Prescott (1982), which is a kind of methodological antipode to the Burns and Mitchell method (Cerra, Fatas and Saxena, 2020), several alternative methodological approaches were developed and used.[5] However, most of these methods, according to Beveridge and Nelson (1981), were essentially based on *ad hoc* assumptions about the statistical properties of the trend and, consequently, *ad hoc* numerical measurement of business cycles.

[5] According to Beveridge and Nelson (1981), one of the popular methods identified cycles as output deviations from a deterministically determined trend where the trend was most often shown as (most commonly polynomial) function of time (see for example Fellner, 1956), which is a very strong assumption. Although in Friedman (1957) when dividing income into permanent and transient components, the permanent (trend) component was not deterministic, it implied "fairly strong initial assumptions about the stochastic properties of the permanent component" (Beveridge and Nelson, 1981). Two alternative cycle measurement methods were developed by Mintz (1969; 1972), one of which defined the trend using a centred 75-month moving average, and the other focused on the analysis of fluctuations in rate of change. On the technical side, the problem arises towards the end of the sample in which future observations of the series under observation are not available (for a more detailed critique, see Beveridge and Nelson (1981).

In contrast to such approaches, Kydland and Prescott (1982) offered a theoretical basis for understanding the movement and statistical properties of long-run equilibrium, or trend. Kydland and Prescott (1982) defined cycles as fluctuations around a long-term equilibrium that were determined by the neoclassical Solow model of long-term growth (see Solow, 1956). Based on this equilibrium (trend, potential) GDP, the authors formalized the idea that the trend component itself could be a stochastic process, which meant that short-term fluctuations in output around the trend did not have to be solely the result of fluctuations on the demand side of the economy. On the contrary, technology shocks can also play a significant role in short-term fluctuations in GDP. It was this idea that led to the development of the well-known models of real business cycles (RBC).[6] In short, the cyclical movement of the economy is the result of shocks on the demand side, as well as of shocks on the supply side (technology shocks) where shocks on the demand side are temporary in nature, while technological shocks (supply shocks) are permanent and affect potential GDP.[7] Based on this theoretical basis and the implicit statistical properties of the trend component, new econometric techniques were developed to assess the trend, and thus the business cycle. One of these methods still in use today was popularized by Beveridge and Nelson (1981). Also, the popular method based on the Hodrick-Prescott filter has remained in frequent use (see Hodrick and Prescott, 1981; 1997).

It should be emphasized that the mentioned methods for estimating potential GDP are devoid of any theoretical framework despite the basic theoretical concepts related to the statistical properties of the trend component of GDP. In other words, they give a statistical estimate of potential GDP based on assumptions about the statistical properties of the cyclical and trend component of GDP. Therefore, the mentioned methods do not take into account the economic relations and determinants of the trend component of GDP as assumed by Solow's growth model used by Kydland and Prescott (1982).

2.2 STABILIZATION POLICIES

Although the methods of estimating potential GDP mentioned in the previous chapter are theoretical, the conceptual framework that motivated statistical estimation of the trend component of GDP within these methods is still the dominant way economists think about potential GDP and business cycles. According to this view, potential GDP is determined by supply-side factors – factors of production (capital and labour) and factor productivity[8], while temporary deviations of GDP from potential (output gap) are generated by the demand side of the economy. Thus, at times when real GDP is close to potential, high/low demand will lead to an increase/decrease in GDP above/below potential, which will result in the opening of a positive/negative output gap.

[6] Arčabić (2018) analyses theoretically and empirically the separation of trend and cycle components of GDP in order to identify the nature of shocks (supply or demand) in selected post-transition countries. The paper shows how demand shocks are dominant in explaining the business cycles of almost all post-transition countries, which is in strong contrast to the conclusions of the real business cycle theory.

[7] See for example Blanchard and Quah (1989).

[8] Although this is the dominant conceptual view of potential GDP, different estimation methods often start from different definitions of potential GDP (see chapter 3).

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

Knowing the output gap allows monetary and fiscal authorities to identify the business cycle phase the economy is in and to prevent, or at least mitigate, undesirable deviations of GDP from its natural level. Specifically, both positive and negative output gaps are accompanied by undesirable economic consequences in the short run. The negative GDP gap is most often accompanied by rising unemployment rates, slower growth or declining incomes, and potential disinflationary pressures that, in the absence of a monetary policy response, could lead to rising real interest rates and a slowdown in investment and personal consumption. On the other hand, a positive output gap can lead to inflationary pressures and the accumulation of macroeconomic imbalances that can result in crises.

Therefore, if output gap opens, monetary and fiscal policies should demonstrate their stabilizing role by implementing countercyclical measures. The implementation of countercyclical measures implies monetary and fiscal expansion in periods when GDP is below potential and restrictive monetary and fiscal measures in periods when GDP growth is above potential (overheating of the economy). Obviously, the assessment of potential GDP and the implicitly determined output gap in real time, when decisions on the nature of monetary and fiscal policy are made, is crucial for the successful stabilization of the economy.

However, as demonstrated by Jovičić (2017) and by a brief analysis conducted in the next chapter of this paper, all commonly used methods of estimating potential GDP are uncertain[9] in real-time because estimates at the end of the sample can change significantly with the release of new data (end-of-sample bias). This can result in significant revisions of current, but also historical, potential GDP as new information arrives. To partially alleviate the end-of-sample bias, the relevant series needed to estimate potential GDP are extended by projections, posing a major challenge for forecasters in times of economic crisis. It follows that information on the output gap is least certain at the very moment when it is most important to economic policymakers. Furthermore, unreliable estimates of the output gap can lead to wrong decisions by monetary and fiscal authorities.

Another problem closely related to the latter is that estimates of potential GDP are almost without exception pro-cyclical. The combination of these two statistical properties of potential GDP estimates can significantly affect the ability of economic policymakers to respond "in a timely and appropriate manner" to cyclical fluctuations in the economy. The problem is easiest to describe with an example in which there is a significant decline in GDP in the last quarter/year for which potential GDP is estimated. Due to the previously mentioned statistical properties of potential GDP estimation methods (end-of-sample bias and pro-cyclicality of potential GDP estimates), such observation at the end of the sample will significantly reduce potential

[9] Depending on the estimation method, this problem may be more or less pronounced. The problem is most pronounced with (often symmetrical) two-sided filters such as HP filters (Jovičić, 2017) in which variable shifts (e.g., GDP in the case of univariate filter estimation) are used forward and backward to estimate potential GDP (historical and future data) where no data on future trends are available at the end of the sample.

GDP at the time of real GDP decline, which will result in an output gap significantly lower than implied before the arrival of this new information.[10]

The question is whether this new estimate is a realistic reflection of the phase of the business cycle. No matter what specific definition of potential GDP we have in mind, and thus whatever popular method of estimating potential GDP we use, potential GDP should not be (too) sensitive to cyclical changes caused by excessive or insufficient demand.[11] However, the properties of statistical methods for estimating potential GDP in practice generate estimates that are sensitive to cyclical developments.

For example, if an estimate from a period preceding a significant decline in GDP were taken into account as a relevant estimate of potential GDP, it would suggest a significant negative output gap that would in turn signal the need for expansionary monetary and fiscal measures. On the other hand, an estimate of potential GDP with the latest data included would indicate a lower potential GDP, and thus a smaller output gap, and the need for weaker expansionary economic policy measures.[12] The problem arises if a new estimate of potential GDP significantly underestimates the real negative output gap, so that economic policy responses are not sufficient for countercyclical action. Consequently, that could lead to an unfavourable economic situation that could have been avoided if the policy response had been stronger.

This problem is particularly pronounced in the context of European fiscal rules, which take into account the cyclically-adjusted budget balance when assessing a country's fiscal position.[13] In times of economic crisis, a cyclically-adjusted budget balance will signal a more favourable fiscal position of the country than an unadjusted budget balance. A more favourable fiscal position will enable the country to pursue an expansive fiscal policy even when the cyclically unadjusted (real) budget deficit rises above the threshold set by fiscal rules. If the estimated potential GDP after the arrival of the new unfavourable data underestimates the negative output gap, the cyclically adjusted budget balance will indicate a worse fiscal position of the country, which can significantly narrow the fiscal space for countercyclical measures due to fiscal rules. Moreover, a poorer assessment of the fiscal position may require fiscal consolidation that may act pro-cyclically and may intensify further adverse economic developments.[14]

[10] The consequences of these two problems for the conduct of economic policies are beyond the scope of this paper.

[11] Also, these new data cause (sometimes significant) revisions of historical estimates of potential GDP, which is certainly not a desirable feature of potential GDP estimates from the perspective of theoretical assumptions and desirable properties of potential GDP estimates (see chapter 4).

[12] For a more detailed explanation and demonstration of these properties, see chapter 3.

[13] See Jovičić (2017) for a detailed overview of differences in estimates of the cyclically-adjusted budget balance depending on the method used to estimate potential GDP.

[14] Some authors (see for example Heimberger, 2020) believe that the underestimation of the negative output gap has contributed to the deepening and prolongation of the consequences of the 2008/2009 global financial crisis due to excessive emphasis on the need for fiscal consolidation in countries with unfavourable fiscal position (indicated by the cyclically-adjusted budget balance).

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

Although pro-cyclicality of potential GDP is a statistical, rather than a fundamental, feature of potential GDP estimates, one should bear in mind Keynesian arguments that may explain how temporary cyclical developments can have implications for potential GDP due to different rigidities and hysteresis effects (see Cerra, Fatas and Saxena, 2020). According to this alternative interpretation, the state of the economy and the level of GDP depend on their historical trends, which is called hysteresis.[15] According to Cerra, Fatas and Saxena (2020), there is ample empirical evidence that GDP fluctuations (shocks) are persistent and that the effects of these fluctuations remain present for years after the time of the shock. The persistence of the effects of recessions implies that the cyclical movements that we consider to be temporary deviations from the trend themselves affect this trend, which is in line with the pro-cyclical movement of potential GDP.

Although it is traditionally considered that monetary and partly[16] fiscal policy have no impact on GDP in the long run, untimely and insufficiently strong reactions of monetary and fiscal policy could leave scars (the scarring effect), and have an impact on GDP in the medium- and long-term (meaning they can have an impact on potential GDP). As Cerra, Fatas and Saxena (2020) point out, the existence of hysteresis changes the way we think about the drivers of business cycles and long-term growth, as well as the way we think about optimal responses from fiscal authorities and central banks in cyclical state of the economy. If cyclical deviations leave permanent scars, economic policy makers should be more strongly opposed to low aggregate demand during recessions and thus have a positive effect on GDP in the long run.

However, despite these plausible explanations of the pro-cyclicality of potential GDP and the effects of economic policies on potential GDP in the medium and long term, it should always be borne in mind that pro-cyclical estimates of potential GDP obtained by popular methods are purely a statistical artefact. Therefore, the pro-cyclicality of potential GDP cannot be used as evidence in favour of the existence of different rigidities in the adjustment mechanisms. However, one thing is certain, for economic policymakers to be able to demonstrate their stabilization potential they need timely and adequate information on the output gap.

3 METHODOLOGICAL APPROACHES TO ESTIMATING POTENTIAL GDP

There are four commonly used approaches to estimating potential GDP: (1) univariate filters such as HP or BN filters, (2) production function method, (3) simple multivariate filters, and (4) multivariate filters combined with production function method.[17]

[15] Hysteresis is easiest to explain by the impact of crises on the labour market. As the unemployment rate rises during the crisis, part of the labour force becomes inactive and human capital deteriorates during inactivity period. The longer the period of inactivity, the more difficult it is to return to the labour market, which leads to an increase in structural unemployment, and thus to a long-term loss of productive resources that reduce potential GDP. In addition, numerous rigidities in the labour market can also slow down adjustment towards equilibrium in this market. Due to slow adjustment, changes in the unemployment rate become persistent and may have long-term consequences for potential GDP.

[16] In that part in which it does not distort the economic balance.

[17] Appendices 1-4 give a more detailed description of all four methodological approaches for estimating potential GDP.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

In this chapter, we compare historical estimates of potential GDP and the output gap using all of the above approaches and briefly comment on the results to point out the differences in potential GDP estimates based on different methods.[18] We use data up to the end of 2019 and the official projections of the Croatian National Bank (CNB) from the same year. In the next chapter, we also include data for 2020 with the corresponding projections from that year in order to explain more clearly the effect of a new observation on potential GDP. This particular example is interesting because in this case the new observation includes the beginning of the COVID-19 crisis.

The first approach based on univariate statistical filters that decomposes a given time series into its trend and cyclical component without using any economic relations between the data and is, therefore, the simplest.

The benchmark estimation of potential GDP in the CNB, European Commission[19] and other institutions such as the IMF and the OECD, are based on the second-mentioned approach, i.e., the production function method. This method implicitly defines potential GDP as the level of production that can be achieved over a long period without excessive or insufficient utilization of existing production capacity.

The third approach is based on simple multivariate filters that can take different forms. In this paper, we use the model and code developed by Alichi et al. (2015).[20] The methodological framework by Alichi et al. (2015) is based on Okun's definition of potential GDP, which defines potential GDP as the maximum level of output that an economy can maintain without creating inflationary pressures. The authors emphasize that this definition is particularly useful to monetary policymakers, as it allows them to communicate the nature of their policy in the context of a short-term trade-off between output and inflation.

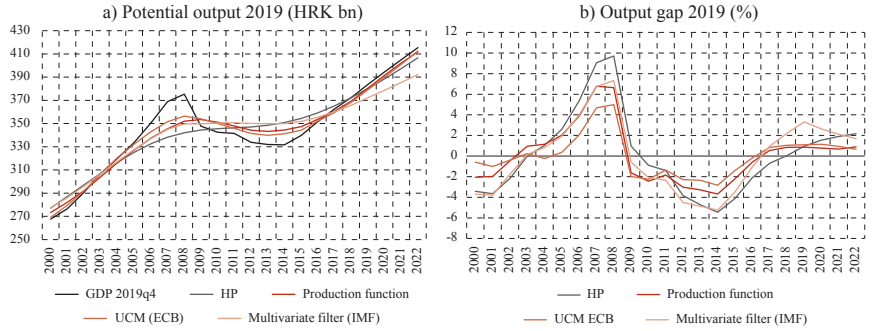
The fourth approach is a combination of the second and third approaches and is the most complex of all the mentioned methods. In this paper, we use the multivariate unobserved components model developed as part of the ECB's Working Group on Forecasting, which was described in detail by Tóth (2021). The advantage of this model is that it contains an economic structure similar to that in production function method, but also retains the possibility of growth accounting. The model uses the Kalman filter within the state space methodology to decompose the six main observable variables (real GDP, unemployment rate, participation rate, working hours, core inflation, and wage growth) into trend and cycle components. The richer economic structure of the model is reflected in the fact

[18] A similar analysis of different ways of estimating potential GDP was conducted by Jovićić (2017).
[19] Although both institutions use the production function method, estimates of potential GDP differ. The differences arise from the way the trend and cycle components of production factors are estimated (primarily those related to labour), from using different indicators (data) for production factors of production and finally from using different projections of production factors in the long run (see appendix 5).
[20] Alichi et al. (2015) showed that, although real-time estimates of potential GDP are quite uncertain, this approach gives more adequate estimates of potential GDP compared to univariate statistical filters.

that the cyclical components of some variables can be connected with economic relations such as the Phillips curve (although we do not include it in our analysis, see footnote 39) and Okun's law. The model is estimated by the Bayesian approach.

Figure 1

Comparison of different methodological approaches to estimating potential GDP and output gap



Source: Authors' calculations.

Figure 1 confirms the sensitivity of estimates of potential growth and the output gap with regards to the selected methodological framework. The estimate obtained by the benchmark method (production function method) is mostly in the entire observed period in the middle of the estimation range. Additionally, the range of estimates is somewhat wider in times of economic crisis (global financial crisis, euro area public finance crisis) than is the case in normal times. It is also interesting that the resulting output gap as defined by most methodological approaches has turning points in the same years (2003, 2009 and 2017). All these methodologies indicated an overheating of the economy just before the outbreak of the COVID-19 crisis, which was more or less pronounced depending on the chosen methodological framework. However, with the arrival of the new data for 2020, there was a major structural break in the GDP series and the methodological framework needs to be adjusted not only for the end-of-sample bias[21] but also for this structural break, which will be discussed in the next chapter.

4 IMPACT OF THE SHOCK CAUSED BY THE COVID-19 PANDEMIC ON POTENTIAL GROWTH

4.1 POTENTIAL GROWTH REVISIONS

The previous chapter pointed to the uncertainty of potential GDP estimates even in stable economic conditions given that different methodological frameworks most often give different estimates. In this part of the paper, we demonstrate how the macroeconomic shock caused by the coronavirus pandemic further complicates this assessment. In doing so, each method has its advantages and

[21] See Jovičić (2017) for a more detailed analysis of the sensitivity of different potential GDP estimates to the end-of-sample bias based on Croatian data.

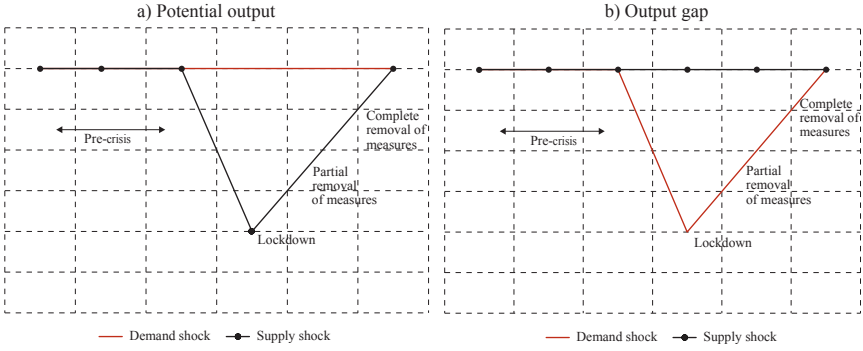
disadvantages, and as potential GDP is an unobservable variable, it is almost impossible to determine which estimate should be preferred. Therefore, the most that one can do is to analyse the estimate of potential GDP from different angles and carefully, based on the relevant criteria, select the benchmark estimate.

The key question to be answered when estimating potential GDP in the context of the corona crisis is the breakdown of the shock into permanent (supply shock), the part directly caused by containment measures (temporary supply shock), and the temporary part (demand shock).[22] However, with one year of data at our disposal, and taking into account the properties of the most commonly used methods for estimating potential output, we cannot answer this question with certainty.

Figure 2 shows the two extreme decompositions of the overall decline of GDP in 2020 and the consequences of these decompositions on the output gap. The illustrative example shown in figure 2 is taken from the ECB (2020) analysis. The black line shows potential GDP and the output gap assuming that the macroeconomic shock caused by the coronavirus pandemic is fully attributed to supply-side constraints (temporary and permanent supply shock). In this case, the decline in GDP in 2020 is fully reflected in the same decline in potential GDP, and the output gap remains at the pre-crisis level (in this illustrative example, we assume that the output gap before the crisis was zero, that is, that real GDP was equal to potential GDP). On the other hand, the red line shows the potential GDP in the case when the total decline in GDP in 2020 is fully attributed to insufficient demand (demand shock). In this case, the estimate of potential GDP is identical to that in the pre-crisis period, so due to the record fall in GDP a huge negative output gap opens up.

Figure 2

Illustration of the impact of pandemic shock on potential GDP and the output gap given the different nature of the shock



Source: ECB (2020).

[22] Arčabić (2018) gives a detailed overview of theoretical concepts and methodological approaches for separating the cycle and trend component of GDP, in the context of supply and demand shocks. The analysis includes Croatia, and the author shows that in Croatia, fluctuations in GDP in the past were dominated by demand shocks.

According to a survey conducted by the Czech National Bank (2021), various monetary policy reports published last year by central banks in England, Japan and Canada suggested that these institutions accounted for about fifty percent of the economic downturn in the second quarter of 2020 to the supply shock and fifty percent to the demand shock. On the other hand, in September 2020, the European Central Bank still largely interpreted the decline in euro area GDP as a negative demand shock that suggested opening a significant negative output gap. However, estimates of potential GDP and the output gap in a May 2021 reported by the Czech National Bank suggest that the coronavirus pandemic largely reflects the negative supply shock, which implies a smaller negative output gap in the countries analysed.[23]

Given the importance of estimating the output gap for economic policymakers, it is clear that the decision to decompose the corona shock in 2020 to supply and demand shock will imply significantly different optimal responses from economic policymakers. The first decomposition would signal to economic policymakers that it is not necessary to act countercyclically because GDP is at its natural level. The second decomposition suggests that a large negative output gap has opened and that a strong countercyclical response is needed. Of course, these extreme decompositions are only illustrative and in reality, the potential GDP and the output gap will lie somewhere between the two lines shown. Although both decompositions are unrealistic, they still vividly demonstrate the problem of decomposing the macroeconomic shock caused by the coronavirus pandemic to supply and demand shocks and the implications of different decompositions on optimal policy recommendations.

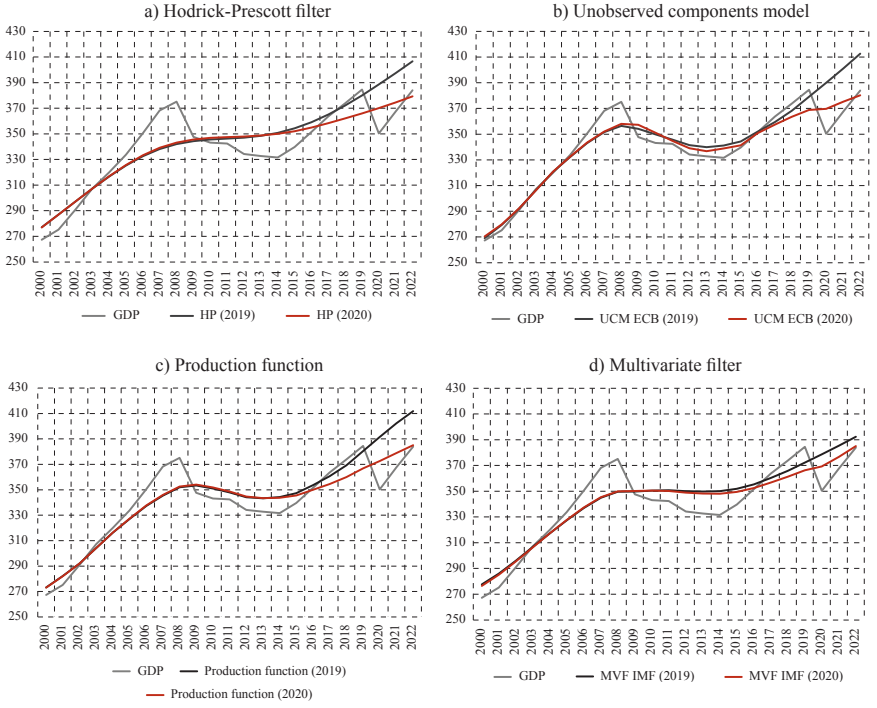
The following figure shows an estimate of potential GDP under normal conditions before and after the publication of the latest data on a sharp decline in GDP in 2020, using the official CNB projected GDP growth rates in 2020.

All the charts show that the estimation of potential GDP after the publication of GDP data in 2020 results in a significant revision of the level of potential GDP from 2016 to 2019[24], which implies a significantly larger output gap in the period from 2016 to 2019 in the 2020 estimate relative to the 2019 estimate.[25] However, such a large revision of potential GDP in the past (and the output gap) is not in line with conventional definitions of potential GDP and the ECB (2020) recommendations that the estimation of potential GDP should ideally not be subject to historical revisions nor should it be too sensitive to the business cycle. More specifically, according to the ECB (2020) recommendations, some of the main desirable features of potential GDP estimates are the consistency of estimates with the key role that potential GDP plays in explaining (core) inflation trends, and simplicity and transparency of the estimation method. Furthermore, according to the same recommendations, estimates of potential GDP should ideally not be too sensitive to the business cycle.

[23] The authors conducted the analysis for the US, UK, euro area and Japan.
[24] The red and black lines start to diverge from 2015, but their differences become significant after 2016.
[25] The same thing happened with the estimate of potential GDP published by the European Commission when comparing estimates of potential GDP in autumn 2019 (see European Commission, 2019) and autumn 2020 (see European Commission, 2020). The EC's estimates are compared with the estimates in this paper and presented in appendix 5.

FIGURE 3

Estimation of potential output before and after the GDP 2020 data release (HRK bn)



Source: Authors' calculations.

The issue with large revisions of potential GDP arises due to the methodological limitations of the univariate and/or multivariate filters traditionally used to assess the long-term trend of GDP and/or each factor, which in principle do not take into account potential structural breaks. Because of the distrust in new estimates of potential GDP, which caused this significant revision, below we first explain the transmission mechanisms through which pandemic shock could have affected potential GDP in the short- and medium-term. After that, we propose what is in our opinion the best methodological framework to account for this structural break. The described transmission mechanisms and explicit modelling of the pandemic shock are primarily based on the production function method. However, in chapter 5 we compare our selected benchmark estimate of the output gap with the capacity utilization rate in order to evaluate our results.

4.2 TRANSMISSION CHANNELS OF THE PANDEMIC SHOCK

When trying to estimate potential GDP accounting for the pandemic shock using the production function method one should ask: "What part of the pandemic shock is the supply shock, and what part is the temporary demand shock?" The answer to this question will depend on the effects of the pandemic on the three main factors of production (labour, capital, and total factor productivity) in the short and long term.

PUBLIC SECTOR ECONOMICS 45(4) 459-493 (2021)

The first question to be answered is: how did the pandemic affect the labour market in the short (cycle) and long term (trend), i.e., the natural unemployment rate, potential labour force, participation, and working hours? The transmission mechanism of pandemic shock can be manifested through hysteresis in the labour market, increasing unemployment, especially unemployment of vulnerable groups (young, older workers, and the long-term unemployed).[26]

Another question requiring an answer is how the pandemic affected capital accumulation in the short and long term. The possible transmission mechanism of a pandemic shock is primarily reflected through reduced investment due to high uncertainty and accelerator effects (ECB, 2018). Additionally, the reduced use of existing capacity may reduce the need to upgrade existing equipment due to lower depreciation rate during containment measures (ECB, 2020).

The third question is how the pandemic affected total factor productivity in the short (cycle) and long term (trend). The possible transmission mechanism is through the negative impact of the pandemic shock on the growth rate of TFP due to, for example, disruptions in distribution chains, deglobalisation, increased costs of new projects due to greater uncertainty, less investment in R&D, erosion of human capital due to less investment in human resources. In addition, the quality of formal education decreases, as well as worker mobility among sectors (ECB, 2020). A particularly significant negative impact can be seen in the services sector, such as tourism. The study by Mischke et al. (2021) that takes in the US, the UK, and five EU countries (France, Germany, Italy, Spain and Sweden) (2021) highlights the positive effects of the pandemic on productivity and suggests that productivity growth could increase by one percentage point per year by 2024. The authors argue that the pandemic has forced companies to become more efficient. Companies forced to make sudden and prolonged shutdowns had to optimize business processes and reduce operating costs. They also had to become more innovative and digitize and automate business processes. At the same time, teleworking has been introduced in many companies, and some have established online sales for the first time. As with other major economic crises, the pandemic crisis could direct the redistribution of resources in favour of the most productive companies and sectors.[27] Looking at human capital, COVID-19 has accelerated the adoption of fully digitized approaches to learning. Finally, the effects of the pandemic on total factor productivity are various and it is difficult to assess which effects (negative or positive) will prevail in the short and which in the long run.

Although the first two questions cannot be answered with certainty (especially in the long run), according to labour market data, the pandemic did not affect the labour market in the short run to the extent that a record decline in GDP in 2020 would suggest. This is not surprising if we have in mind the government support measures intended to preserve employment. In addition, according to official

[26] In the crisis of 2008/2009 this transmission mechanism has been strong in European Union countries (see, for example, the ECB, 2012).
[27] See for example Caballero and Hammour (1994).

CNB projections, there have been no significant revisions of labour market trends in the long run (paid working hours, NAWRU, participation rate, working-age population). Accordingly, the potential output should not be significantly affected by labour market trends in either the short or long term.

The answer to the second question is similar to that to the first. Except for the fall in investment in 2020, which slows down the accumulation of physical capital in the short term, investment could begin to recover more rapidly as early as 2021 according to official CNB projections. A strong recovery in investment in the fourth quarter of 2020 suggests that the reconstruction of earthquake-affected areas (especially Zagreb) and a more efficient use of EU funds could have a positive effect on investment in the short to medium term. It can therefore be concluded that neither physical capital should play a significant role in explaining changes in potential output caused by the pandemic shock.

Thus, in the COVID-19 crisis, the observed factors of production (labour and capital) remained relatively stable in relation to the fall in GDP, and the long-term assumptions of their movement were not significantly different from those preceding the outbreak of the crisis. Therefore, the movements of these two factors of production do not have the potential to explain changes in the estimate of potential GDP in either the short or long run.[28] Such trends in observable factors of production imply that the COVID-19 crisis had the most significant impact on unobservable (residual[29]) total factor productivity (TFP). Therefore, the answer to the key question largely lies in the effect of pandemic shock on the trend and cycle component of TFP.

In the case of Croatia, the path of total factor productivity in the short and long run predominantly determines the new path of potential output. As this is also an unobservable variable, it is necessary to find a way to model pandemic shock in estimating the TFP level and growth rate in the short and long term. However, all the problems demonstrated in the previous chapter, concerning the methodological limitations of univariate or multivariate filters after the publication of atypical data, are now mirrored in the problem of estimating TFP level and growth rate.

We should emphasize that major economic crises may affect the growth rate of potential GDP in the long run. According to a study by the ECB (2011a), part of the stock of physical and human capital may depreciate faster or become obsolete during serious negative economic disruptions, while institutional weaknesses may fully or partially limit the recovery of productive resources. This suggests that the rate of potential growth may change significantly over time after such a macroeconomic shock. However, estimating potential growth over the longer horizon is best

[28] As explained earlier, this is a consequence of the introduced government support measures in the labour market, while in the case of capital the effect is reduced due to investments in earthquake-affected areas.

[29] Given that this is a residual category, the estimated TFP, among other things, contains errors in measuring production factors and the degree of utilization of existing capacity in the economy. However, we do not have a sufficiently long reference measure for the degree of capacity utilization in Croatia that we could use to estimate potential GDP. Also, this is why the greatest short-term effect of the pandemic shock can be attributed TFP, because measures to combat the spread of the pandemic have had the greatest impact on the degree of utilization of existing physical and human capacity in the economy.

approached agnostically and, for the sake of transparency, with no interventions to the calculations obtained by standard methods for estimating potential GDP.

4.3 MODELLING THE PANDEMIC SHOCK USING THE PRODUCTION FUNCTION METHOD

Because pandemic shock is completely exogenous and we know the exact time it occurred, we can treat it as a structural break in the trend and cycle level of that production factor on which the pandemic had a significant impact. It is clear from the previous chapter that in the case of Croatia this variable is TFP. It is the calibration of this structural break, i.e., the calibration of the effect of the COVID-19 crisis on the trend and cycle component of TFP, which determines the decomposition of the fall in GDP in 2020 into the supply and demand shocks. However, since there is an infinite number of possible calibrations (two of which are shown in figure 2), we explain below the criteria we followed when selecting the preferred calibration.

We decompose the structural break in TFP into a trend ($\overline{TFP_t}$) and cycle ($\widetilde{TFP_t}$) component by adding the dummy variable in 2020 in the equations of trend TFP level ($\boldsymbol{c_1}\mathrm{d}_{2020}$) and cycle ($\boldsymbol{c_0}\mathrm{d}_{2020}$) within a univariate HP filter written in the state-space representation and estimated by the Kalman filter.

Measurement equation
$$TFP_t = \overline{TFP}_t + \left(\widetilde{TFP}_t + \boldsymbol{c}_0 d_{2020}\right) \tag{1}$$

Transition equations
$$\overline{TFP}_t = \overline{TFP}_{t-1} + \beta_t + \boldsymbol{c}_1 \mathrm{d}_{2020}$$

$$\beta_t = \beta_{t-1} + \varepsilon_t$$

Errors
$$\widetilde{TFP}_t = \nu_t$$

$$\left[\varepsilon_t, \nu_t\right]' \sim NIID(0, diag(\sigma_\varepsilon^2, 100\sigma_\varepsilon^2))$$

By adding the dummy variable to the first transition equation, we assume that the macroeconomic shock caused by the coronavirus pandemic affected the trend level of TFP ($\overline{TFP_t}$) in 2020 (level shift). On the other hand, by adding the dummy variable to the measurement equation we take into account the effects of containment measures on the level of TFP that are temporary, i.e., the result of temporary supply constraints related to epidemiological measures.

The parameters with the dummy variables (c_0 i c_1) were calibrated in such a way that the revised estimate of potential GDP meets the following criteria[30]: (1) historical estimates – we preferred calibration in which revisions of historical

[30] The criteria are in line with the ECB's (2020) recommendations on the desirable features of estimating potential GDP.

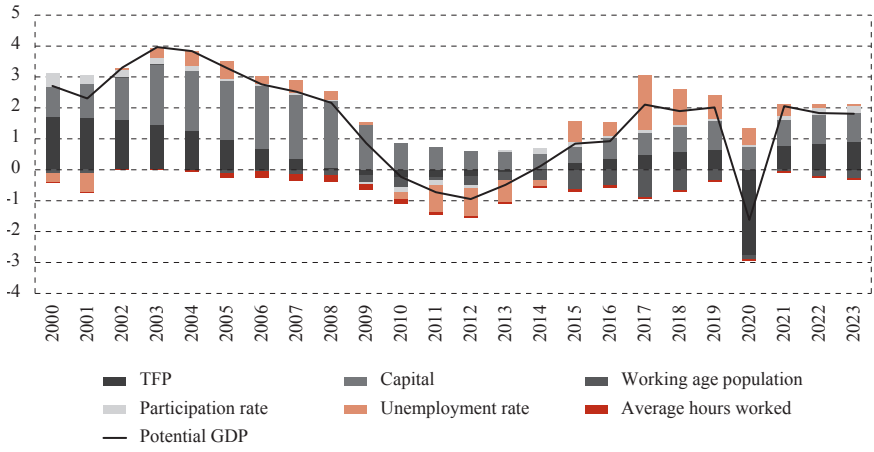
potential output and total factor productivity were as small as possible (see figures 1 and 3), (2) the output gap is decomposed into demand and supply shock using the PACMAN semi-structural macroeconomic model[31] and the Phillips curve taking it into account that the implied output gap should be a major factor in explaining core inflation developments[32], and (3) the TFP growth rate returns to pre-pandemic levels in the long run. Namely, due to the uncertainty about the effects of the pandemic shock on the growth rate of potential GDP in the long run (which is significantly influenced by the estimated TFP growth rate in the long run), we preferred a calibration in which the long-run TFP growth rate converges to its pre-pandemic average (which amounts to 1% in the period from 2000 to 2019). [33]

The potential GDP estimate which accounts for a structural break in the trend and cycle of TFP component is shown in figure 4. Data from the official CNB projection from December 2020 is based on relatively optimistic assumptions in terms of labour market and investment after the fall in 2020.

According to these estimates, potential GDP in 2020 will temporarily fall by about 1.6%, primarily due to a sharp decline in TFP caused by the coronavirus pandemic, whose negative contribution is estimated at 2.8%. This decline in potential GDP implies a negative output gap of 4.8%. In addition, this estimate implies that approximately 40% of the total decline in GDP in 2020 can be explained by supply shock, while the rest is attributed to a negative demand shock.

FIGURE 4

Production factor contributions to potential output growth (in percentage, percenatage points)



Source: Authors' calculations.

[31] See Nadoveza Jelić and Ravnik (2021).

[32] The adjustment was performed using the PACMAN macroeconomic model and projections of headline and core inflation with respect to alternative output gap sizes in the Phillips curve. The ultimate goal was for the selected calibration to result in an output gap that would align the 2020 inflation with the CNB's official December 2020 inflation projection.

[33] Data on TFP for 2009 was not included due to an extremely high drop of approximately 8%.

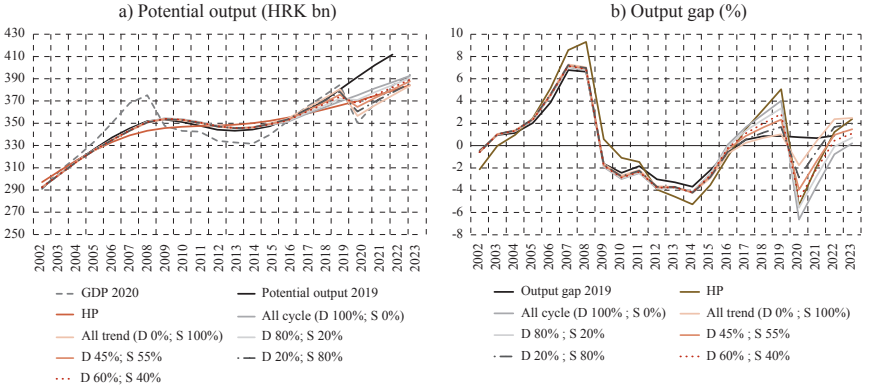
The results suggests that the positive contribution to potential growth comes from labour and capital, with the positive contribution of capital in 2020 being lower than the positive contribution in 2019 primarily due to the contraction of investments in 2020. The positive contribution of labour to potential growth is comparable to that of the pre-pandemic year and is the result of still optimistic estimates related to the natural rate of unemployment.

In the long run, it is assumed that the potential growth rates of GDP and TFP will converge to their long-term average and amount to about 1.8% and 1%, respectively. The largest contribution to potential GDP growth could stem from capital due to optimistic forecasts of investments in the coming years related to EU funds and the reconstruction of Zagreb. On the other hand, the contribution of labour could be neutral in the long run, where the decline in working age population and working hours could be offset by a positive contribution to the decline in the natural unemployment rate and higher labour market participation.

As mentioned earlier, these are the results of one possible calibration of dummy variables (c_0 i c_1) from equation (1), in which we explained 40% of the total GDP decline in 2020 by supply shock and the rest by demand shock. However, by different calibration of these dummy variables, we were able to obtain significantly different estimates of potential growth and the output gap, as shown in figure 5.

FIGURE 5

Potential growth and output gap estimated using different calibrations of the effect of the COVID-19 crisis on the trend and cycle component of TFP



Note: The letter D denotes a demand shock and the letter S a supply shock.

Source: Author's calculations.

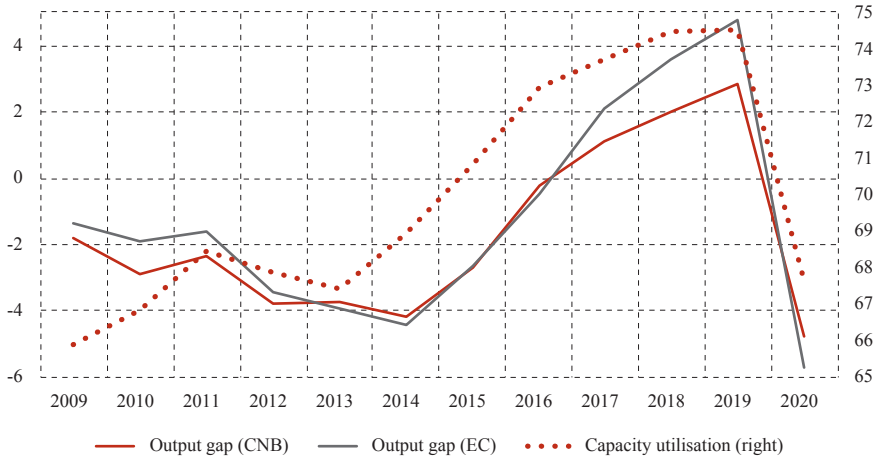
5 OUTPUT GAP AND CAPACITY UTILIZATION RATE

The previous two chapters have dealt with different potential GDP and the output gap estimation strategies, with special emphasis on adjustments made in the presence of an unprecedented structural break. It was shown that the results (i.e. estimates of potential growth and gap) are very sensitive to the choice of estimation

strategy. Therefore, the obtained estimates should be continuously re-evaluated to make adequate real-time policy decisions. In that context, it will be useful to compare our preferred (benchmark) estimate with an alternative measure of the output gap such as capacity utilization rate, which is an indicator of the amount of economic slack in the industrial sector. Data are based on a survey of the firms within the manufacturing industry conducted and published by the European Commission. In this survey, manufacturing companies answer the question at what level of capacity they currently operate, expressed as a percentage of their total capacity, the ECB (2011b). Data for Croatia are available quarterly from the third quarter of 2008.

Figure 6

Output gap and capacity utilization rate in Croatia (percentage)



Note: The output gap is expressed as a share of potential GDP, and the capital utilization rate as a share of total production capacity of the manufacturing industry.

Source: European Commission (2020); authors' calculations.

Figure 6 shows that the capacity utilization rate and the estimate of the output gap using the production function method are similar in their identification of the Croatian business cycle phases during the period 2009-2020. The European Commission's November 2020 GDP gap estimate, which is also presented, shows similar behaviour.[34] After the prolonged period dominated by economic and public finance crises, the capacity utilization rate in Croatia began to grow significantly in 2013, indicating a somewhat faster start to the economic recovery than the output gap estimates suggested at the time.[35] Also, the European Commission's assessment and capacity utilization rate signal a significant "overheating" of the economy just before the outbreak of the crisis. The CNB's estimate points to somewhat milder "overheat" due to the estimation strategy, which aimed at minimal historical revisions. All three indicators recorded a sharp decline in 2020, with both output gaps

[34] The differences from the CNB's estimate are explained in more detail in appendix 5.

[35] This indication of the earlier beginning of the economic "overheating" would signal to policymakers the need to introduce restrictive measures quicker due to the potential inflationary pressures.

hitting historic low levels, while the capacity utilization rate remained above the levels recorded during the last recession.

It should be noted that the capacity utilization is never revised, as is the case with most survey based indicators, while model estimates of the output gap are regularly revised (ECB, 2011b). An additional disadvantage of this indicator is that it applies only to the manufacturing sector, while the output gap applies to the whole economy. In addition, general problems with surveys are that firms may interpret questions differently and that most surveys have a limited base of answers (see Christiano, 1981). Regardless of these shortcomings, there is a high correlation between the capacity utilization rate and the output gap estimates in Croatia. Additionally, it seems that the adjustment of the potential GDP for structural break (which is described in detail in chapter 4.3) resulted in an output gap estimate that is in line with the capacity utilization indicator in 2020.[36]

6 CONCLUDING REMARKS AND IMPLICATIONS ON ECONOMIC POLICY

Measures imposed by governments to curb the spread of coronavirus are a unique example of temporary supply-side constraints. The question arises as to what extent these measures have affected potential GDP (ECB, 2020). Namely, as the potential GDP is an unobservable variable whose estimate is uncertain even in stable economic conditions, such a shock made the estimate of the potential GDP very challenging.

This paper describes and models the possible effects of the COVID-19 pandemic on Croatia's potential GDP. The paper presents a conceptual framework for estimating potential GDP and points out the importance of potential GDP estimation for economic policy makers, especially concerning their stabilizing role in the economy. The paper points out the problems of estimating potential GDP in conditions of unprecedented macroeconomic shock and demonstrates these problems using four frequently used approaches to estimating potential GDP. The assessment of the effects of the pandemic crisis on potential GDP was followed by an analysis and explanations of the transmission channels through which epidemiological measures affected (and continue to affect) potential GDP within the production function-based approach. The paper pays special attention to the identification of the nature of the shock, i.e., the decomposition of the pandemic shock to the supply shock and the demand shock. In addition, the paper describes the implications of uncertainty regarding this decomposition because the latter has important implications for the output gap estimation.

[36] Nelson (2008) and Morley and Panovska (2020) argue that the correlation between the appropriately estimated output gap and the one-year-ahead real GDP growth rate should be negative. The intuition behind this argument is that as the economy returns to its long-term trend when the output gap is positive, we should expect future GDP growth rates to be below average. Correlations between output gap measures presented in figure 6 and the one-year-ahead real GDP growth rate were calculated to verify if these measures satisfy this intuition. The correlations obtained verified that all three measures of the output gap are negatively correlated with the future GDP growth rate.

Finally, the paper proposes a benchmark estimate of potential GDP in Croatia and addresses several possible ways[37] in which to estimate potential output in the context of the COVID-19 crisis. The benchmark estimation takes into account the ECB's (2020) recommendations on the desirable properties of estimating potential GDP and the economic implications of the calibrated decomposition of the 2020 shock to supply and demand shock.

In addition, the paper presents an alternative estimate of the output gap in Croatia using alternative methodological approaches to estimate potential GDP and capacity utilization rate. Although our benchmark estimate of potential GDP is aligned with alternative business cycle indicators, it should be emphasized that the proposed estimate is preliminary given that the duration of the pandemic and pandemic-related government measures to combat the spread of the virus remains unknown.

Additionally, the paper indicates that measuring potential GDP is far from perfect. Whichever method is used, the results depend significantly on implicit assumptions that may or may not be valid. Some authors, such as Fontanari, Palumbo and Salvatori (2020) advocate a revision of the conceptual framework within which potential GDP is analyzed and measured. Namely, the most commonly used methods of estimating potential GDP generate results that are in line with the view of the cycle as short-term fluctuations in GDP around potential. However, the authors show that if the estimate of potential GDP is thought of as the level of GDP that can be achieved with full employment, then real GDP can remain below potential for decades. The authors assume that full employment is implicitly determined by the lowest unemployment rate ever achieved, which is in line with Okun's proposals related to the target unemployment rate (Fontanari, Palumbo and Salvatori, 2020). Therefore, the authors believe that conventional methods generally underestimate potential GDP. If this is true, conventional methods also underestimate the negative output gap, i.e., overestimate the positive output gap. The implications for economic policies are clear. Economic policy makers will either underestimate the necessary expansion in bad economic times, either due to fiscal rules or fear of inflation, and overestimate the necessary restriction in (seemingly) better economic times.

In any case, the data on Croatian economy suggest that in 2020 there was a significant decline in potential GDP accompanied by a record large negative output gap. Developments related to the pandemic are uncertain, but a timely response from monetary and fiscal authorities is crucial at this time. Strong expansionary measures are a necessary condition for stabilizing the economy and its faster recovery, not only in the short, but probably also in the medium term.

Disclosure statement

All authors state that they do not have any financial or other substantive conflict of interest.

[37] That is, we propose and argue one basic calibration of the possible countless calibrations of the decomposition of GDP decline in 2020 to supply and demand shock.

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PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

APPENDIX 1
HODRICK-PRESCOTT FILTER

The univariate statistical filter introduced by Hodrick and Prescott (1981) separates the time series into a long-term trend ($\overline{y}$) and a short-term cyclical component ($\tilde{y}$) minimizing the following function:

$$\min \sum_{t=1}^{T} (y_t - \overline{y}_t)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(\overline{y}_{t+1} - \overline{y}_t \right) - \left(\overline{y}_t - \overline{y}_{t-1} \right) \right]^2 \qquad \text{A1.1}$$

where the parameter λ determines the smoothness of the long-term trend component.

APPENDIX 2
PRODUCTION FUNCTION METHOD

The estimation of potential growth and the output gap based on the production function method implicitly defines potential GDP as a level of production that can be achieved over a long period without excessive or insufficient use of existing production capacity, which implies the absence of price pressures. We define the production function as Cobb-Douglas with constant returns to scale:

$$Y_t = TFP_t * L_t^{\alpha} * K_t^{1-\alpha} \qquad \text{A2.1}$$

where aggregate production measured by GDP is shown as a combination of two observable production factors; labour (L) and capital (K); and unobservable total factor productivity (TFP). The parameter α is the share of the labour factor in GDP, which we estimate at 0.65.

To estimate the potential GDP, it is necessary to estimate the potential, i.e., long-term trend level of individual production factors and total factor productivity, and then the estimate of potential GDP is obtained from the equation of the production function.

The labour factor is defined as the number of paid working hours in the economy and is calculated using the following identity:

$$L_t = \textit{average hours worked per employee}_t * (1 - NAWRU_t) * \textit{participation rate}_t * \textit{working age population}_t$$

The output gap is calculated as the difference between actual and potential GDP, expressed as a percentage of potential GDP.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

APPENDIX 3
MULTIVARIATE FILTER

The structure of a simple multivariate filter used to estimate potential GDP in Croatia is based on Alichi et al. (2015).[38] The model includes three core variables (real GDP, CPI inflation and unemployment rate). The annual data for Croatia are taken from Eurostat and the Croatian Bureau of Statistics. The model also includes real GDP growth forecasts five years ahead and one-year-ahead CPI inflation forecast. The forecasts should help identify the nature of the shocks (supply or demand).

Therefore, the complete database includes the Croatian National Bank's published or unpublished GDP growth and CPI inflation forecasts. When no official CNB projections are available, GDP and inflation are projected using a simple autoregressive model. We assume that the last available GDP growth projection reflects the long-run growth rate of Croatia. Therefore, the last (three years ahead) CNB forecast is used as a four- and five-years-ahead forecast.

The following equations link the model's core and the unobservable variables, the most important of which is potential GDP. The notation and equations presented here are identical to those in Alichi et al. (2015). The values of the parameters and the variances of the shocks are estimated using Bayesian techniques.

Output gap is defined as the deviation of the logarithm of the real GDP (Y_t) from the potential GDP ($\overline{Y}_t$):

$$y_t = Y_t - \overline{Y}_t: \qquad \text{A3.1}$$

The output (real GDP) is a stochastic process comprised of three equations, each of which defines one shock type – potential output-level shock ($\varepsilon_t^{\overline{Y}}$), potential output growth shock (ε_t^{G}) and output gap shock (ε_t^{y}).

$$\overline{Y}_t = \overline{Y}_{t-1} + G_t + \varepsilon_t^{\overline{Y}} \qquad \text{A3.2}$$

$$G_t = \theta G^{SS} + (1-\theta)G_{t-1} + \varepsilon_t^{G} \qquad \text{A3.3}$$

$$y_t = \phi y_{t-1} + \varepsilon_t^{y} \qquad \text{A3.4}$$

The level of potential output evolves according to potential growth (G_t) and potential output-level shock. Potential growth is affected by the steady-state potential GDP growth rate (G^{SS}) and by the potential output growth shocks, which, depending on the value of θ, fade faster (low θ) or slower (high θ). GDP gap (y_t) is autoregressive process that is subject to output gap shocks which are perceived as demand shocks (ε_t^{y}).

[38] The code is available on the personal page of the co-author of the paper Douglas Laxton: http://www.douglaslaxton.org/potential.html.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

To help identify the three output shocks, a Phillips Curve equation for inflation is added, which links the evolution of the unobservable output gap (y_t) to observable data on inflation (π_t) according to the following process:[39]

$$\pi_t = \lambda E_t \pi_{t+1} + (1-\lambda)\pi_{t-1} + \beta y_t + \varepsilon_t^{\pi} \qquad \text{A3.5}$$

Equations describing unemployment developments have been added to the model as these provide additional information for the output gap estimation:

$$\bar{U}_t = (\tau_4 \bar{U}^{SS} + (1-\tau_4)\bar{U}_{t-1}) + g\bar{U}_t + \varepsilon_t^{\bar{U}} \qquad \text{A3.6}$$

$$g\bar{U}_t = (1-\tau_3)\, g\bar{U}_{t-1} + \varepsilon_t^{g\bar{U}} \qquad \text{A3.7}$$

$$u_t = \tau_2 u_{t-1} + \tau_1 y_t + \varepsilon_t^{u} \qquad \text{A3.8}$$

$$u_t = \bar{U}_t - U_t \qquad \text{A3.9}$$

In equation A3.6 $\bar{U}_t$ is time varying non-accelerating inflation rate of unemployment (NAIRU) which is subject to shocks ($\varepsilon_t^{\bar{U}}$) and variation in the trend ($g\bar{U}_{t-1}$) which is itself also subject to shocks ($\varepsilon_t^{g\bar{U}}$). This specification allows the natural unemployment rate (NAIRU) to deviate persistently from its equilibrium (steady-state) level.

The most important equation in this block specifies Okun's law (equation A3.8) which links deviations of the observed unemployment rate (U_t) from NAIRU ($\bar{U}_t$) i output gap (y_t).

Core model equations are represented by equations A3.1 – A3.9, and these are enough to estimate potential GDP. However, extended version of the model allows us to make use of expected GDP growth ($g^{CNB}{}_{t+j}$) and inflation ($\pi^{CNB}{}_{t+j}$) (forecasts) which help to identify shocks and improve model's forecasting performance at the end of the sample.

$$\pi^{CNB}{}_{t+j} = \pi_{t+j} + \varepsilon_{t+j}^{\pi^{CNB}}, j = 0,1 \qquad \text{A3.10}$$

$$g^{CNB}{}_{t+j} = g_{t+j} + \varepsilon_{t+j}^{g^{CNB}}, j = 0,\ldots,5 \qquad \text{A3.11}$$

Alichi et al. (2015) emphasize that in practice the estimated variances of errors ($\varepsilon_{t+j}^{g^{CNB}}$, $\varepsilon_{t+j}^{\pi^{CNB}}$) in equations A3.10 and A3.11 allow forecasts to influence, but not

[39] Several studies question the existence of the Phillips curve in Croatia; see for example Krznar (2011b), Botrić (2012), Jovičić and Kunovac (2017). When estimating the potential GDP in Croatia using a simple multivariate filter based on Alichi et al. (2015), we also try it with the inactive mechanism of the Phillips curve. In this case, equation A3.5 is simply given by: $\pi_t = \pi_{t-1}$. However, since the results do not differ significantly in the two alternative model specifications, we present the results with the active Phillips curve. On the other hand, when estimating potential GDP using the unobserved components model the results differ significantly and, therefore, we presume an inactive mechanism of the Phillips curve.

completely replace, model expectations (especially at the very end of the sample). However, the authors suggest that this information can significantly influence historical estimates of potential GDP and the output gap.

Table A3.1

Data sources

Variable	Source
CPI inflation forecasts	Unpublished and published (Macroeconomic Developments and Outlook) CNB's forecasts
GDP forecasts	Unpublished and published (Macroeconomic Developments and Outlook) CNB's forecasts
Real GDP	Eurostat (2015=100)
CPI inflation	Croatian Bureau of Statistics
Unemployment rate	Croatian Bureau of Statistics (Labour Force Survey)

Source: Authors.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

APPENDIX 4
MULTIVARIATE FILTER COMBINED WITH PRODUCTION FUNCTION

The structure of the multivariate unobserved components model used in this paper was described in detail by Tóth (2021). It is a state-space model based on the production function and on some well-known economic relations such as Okun's law and the Phillips curve (the latter can be turned on or off arbitrarily). In the model, the six underlying observable variables are decomposed into their trend and cycle component (real GDP, unemployment rate, participation rate, working hours, core inflation, and wage growth). The trend components of these variables serve as input variables for the production function. In addition, the model uses three additional observable variables (capital, working age population and long-term unemployment rate) that are not decomposed into trend and cycle, as it is standard in the literature. The equations of the observed values – measurement equations – are given as follows:

Real GDP $$y_t = \overline{y}_t + \hat{y}_t \quad \text{A4.1}$$

Unemployment rate $$u_t = \overline{u}_t + \hat{u}_t \quad \text{A4.2}$$

Inflation $$\pi_t = \overline{\pi}_t + \hat{\pi}_t \quad \text{A4.3}$$

Wage growth $$w_t = \overline{w}_t + \hat{w}_t \quad \text{A4.4}$$

Participation rate $$lfpr_t = \overline{lfpr}_t + \widehat{lfpr}_t \quad \text{A4.5}$$

Average hours worked $$ahw_t = \overline{ahw}_t + \widehat{ahw}_t \quad \text{A4.6}$$

Working age population $$wap_t = \overline{wap}_t \quad \text{A4.7}$$

Capital $$k_t = \overline{k}_t \quad \text{A4.8}$$

Long-term unemployment rate $$ltu_t = \overline{ltu}_t + \varepsilon_t^{ltu} \quad \text{A4.9}$$

The GDP gap is defined as a second-order autoregressive process, while the GDP trend is derived from the Cobb-Douglas production function.

Output gap $$\hat{y}_t = \alpha_1 \hat{y}_{t-1} + \alpha_2 \hat{y}_{t-2} + \varepsilon_t^{\hat{y}} \quad \text{A4.10}$$

GDP trend $$\overline{y}_t = \overline{y}_{t-1} + \Delta\overline{tfp}_t + \iota\left(\Delta\overline{wap}_t + \Delta\overline{lfpr}_t + \Delta\overline{ahw}_t + \Delta\ln\left(1-\overline{u}_t\right)\right) + (1-\iota)\Delta\overline{k}_t \quad \text{A4.11}$$

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

The participation rate trend, the average working hours trend, the total factor productivity trend and the long-term unemployment trend rate are defined endogenously in the model:

Participation rate gap $\widehat{lfpr}_t = \varepsilon_t^{\widehat{lfpr}}$ A4.12

Participation rate trend $\overline{lfpr}_t = \overline{lfpr}_{t-1} + \widetilde{lfpr}_t$ A4.13

$\widetilde{lfpr}_t = \widetilde{lfpr}_{t-1} + \varepsilon_t^{\widetilde{lfpr}}$ A4.14

Average hours worked gap $\widehat{ahw}_t = \varepsilon_t^{\widehat{ahw}}$ A4.15

Average hours worked trend $\overline{ahw}_t = \overline{ahw}_{t-1} + \widetilde{ahw}_t$ A4.16

$\widetilde{ahw}_t = \widetilde{ahw}_{t-1} + \varepsilon_t^{\widetilde{ahw}}$ A4.17

Total factor productivity trend $\Delta\overline{tfp}_t = \Delta\overline{tfp}_{t-1} + \varepsilon_t^{\Delta\overline{tfp}}$ A4.18

Working age population trend $\overline{wap}_t = \overline{wap}_{t-1} + \widetilde{wap}_t$ A4.19

$\widetilde{wap}_t = \widetilde{wap}_{t-1} + \varepsilon_t^{\widetilde{wap}}$ A4.20

Long-term unemployment trend $\overline{ltu}_t = (1-\lambda)ltu0 + \lambda\overline{ltu}_{t-1} + \varepsilon_t^{\overline{ltu}}$ A4.21

The unemployment rate, as mentioned earlier, is also decomposed into its trend and cycle component, and then its cycle is linked to the output gap under Okun's law. The unemployment trend (i.e., NAIRU) is not a stationary time series and takes into account changes in the long-term unemployment rate.

Okun's law $\hat{u}_t = \gamma_1\hat{u}_{t-1} - \gamma_2\hat{y}_{t-1} + \varepsilon_t^{\hat{u}}$ A4.22

NAIRU $\overline{u}_t = \overline{u}_{t-1} + \kappa\Delta\overline{ltu}_t + \varepsilon_t^{\overline{u}}$ A4.23

Inflation is also decomposed into a cyclical and a trend component. The Phillips price curve links the inflation gap to the output gap, while the inflation trend is assumed to be a first-order autoregressive process anchored with a country-specific constant that may correspond to inflation targeting or the historical average of core inflation.

Inflation gap $\hat{\pi}_t = \beta_1\hat{\pi}_{t-1} + \beta_2\hat{y}_{t-1} + \varepsilon_t^{\hat{\pi}}$ A4.24

PUBLIC SECTOR ECONOMICS 45(4) 459-493 (2021)

Inflation trend $$\overline{\pi}_t = (1-\varphi)\pi^* + \varphi\overline{\pi}_{t-1} + \varepsilon_t^{\overline{\pi}}$$ A4.25

Wage growth (compensation per employee) is disaggregated in a similar way. The Phillips wage curve links the wage growth gap with the unemployment gap, and the wage growth trend is assumed to be the sum of the inflation trend and the labour productivity growth trend.

Wage growth gap $$\hat{w}_t = \beta_3\hat{w}_{t-1} - \beta_4\hat{u}_{t-1} + \varepsilon_t^{\hat{w}}$$ A4.26

Wage growth trend $$\overline{w}_t = \overline{\pi}_t + \overline{\Delta y}_t - (\Delta\overline{wap}_t + \Delta\overline{lfpr}_t + \Delta\ln(1-\overline{u}_t)) + \varepsilon_t^{\overline{w}}$$ A4.27

The model is evaluated in its state-space form using the Bayesian approach. The evaluation of model parameters and unobservable variables is performed using a Kalman filter.

Table A4.1

Data sources

Variable	Source
Real GDP	Croatian Bureau of Statistics, CNB's forecasts
CPI excl. food and energy	Croatian Bureau of Statistics, CNB's forecasts
Compensation per employee	Eurostat, CNB's forecasts
Unemployment rate	Croatian Bureau of Statistics (Labour Force Survey), CNB's forecasts
Total employment	Croatian Bureau of Statistics (Labour Force Survey), CNB's forecasts
Average hours worked	JOPDD, CNB's forecasts
Long-term unemployment rate	Eurostat, CNB's forecasts
Capital	Authors' calculations using PIM method (perpetual inventory method)
Working age population	Croatian Bureau of Statistics – forecast of the working age population 15-74, CNB's forecasts

Source: Authors.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

APPENDIX 5
COMPARISON OF OUR BENCHMARK ESTIMATE OF THE POTENTIAL GDP WITH THE EUROPEAN COMMISSION'S

Differences in the estimates of potential GDP growth provided by the European Commission and those in this paper arise from different technical assumptions related to the potential GDP components systematically shown in table A5.1. The majority of differences arise from differences in the TFP and labour market-related variables. The contributions of individual components to potential GDP growth are shown in figure A5.1. and quantify these differences. The estimate of the contribution of the TFP to the growth of the potential GDP of the EC (left side of figure A5.1) is significantly lower than our estimate (right side of figure A5.1). On the other hand, we assess the neutral contribution of labour factors to the potential GDP growth rate in 2022 and 2023, while the European Commission implies a positive contribution of labour to potential GDP growth in 2022, followed by a negative 2023.

TABLE A5.1

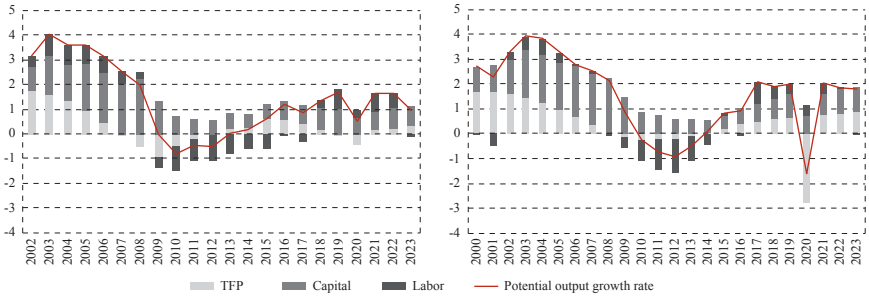
Assumptions used to calculate potential GDP

	CNB	European Commission
Total factor productivity	In the medium term, the average growth rate from the period before the COVID-19 crisis is 1% (excluding 2009 when the decline was extremely large and amounted to about -8%).	In the medium term, we do not know what the projection is based on, because the average TFP rate in the whole period is around 1%, and the current long-term projection is 0.4%.
Investments	In the medium term, investment growth of 5.5% is assumed.	Calculated from the investment / output ratio, investment growth rates towards the end of the projection period are negative.
Working age population	CBS – projection of working age population 15-74 (medium fertility variant with medium migration).	Eurostat – projection of working age population 15-74.
Total employment	CBS (LFS) and the CNB projection, which suggests an increase in the number of employees in the projection period.	National Accounts; in the projection period, they suggest a milder increase in the number of employees than the CNB in 2021 and 2022, and a decrease in the number of employees in 2023.
Unemployment rate	CBS (LFS) and the CNB projection, which suggests a decrease in the unemployment rate in the projection period.	In the projection period, the unemployment rate is assumed to fall in relation to CNB projection.
Average hours worked	A decrease in working hours (JOPDD) is assumed.	Source unknown. In 2020, potential working hours are higher than in 2019. In the long run, EC forecasts slight growth.

Source: Authors.

Figure A5.1

Comparison of contributions to potential GDP growth, EC – left, authors – right (in percentage, percenatage points)



Sources: European Commission, authors' calculations.

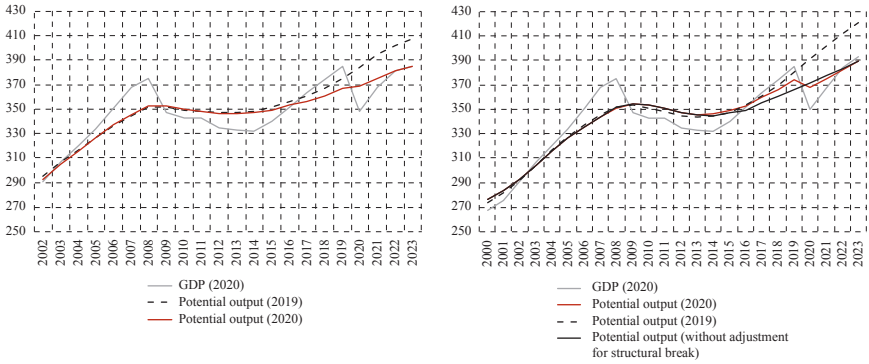
At the same time, the estimates of the European Commission from December 2020 show large historical revisions of the total factor productivity and labour factors in relation to the estimate from December 2019, which is difficult to explain. The right-hand graph in figure A5.2 shows the effect of the adjustment for structural break in 2020 on our estimate of potential GDP in that year (red line shows the estimate with structural break, and the black solid line without structural break), as well as the previous estimate of potential GDP from 2019. It can be seen that our estimate of potential GDP would have the same undesirable features (significant revision of potential GDP, and thus the output gap, shown in the past in figure A5.2.) if it were not adjusted for structural fracture in 2020 (black solid line and black dashed line begin to diverge as early as 2015).

In figure A5.3 estimates of the growth rates of potential GDP given by the European Commission and those in this paper are compared. The traditionally more pessimistic estimate of the potential growth of the European Commission in the long run is clearly visible (0.4% vs 1.8%). The European Commission's estimate of potential growth is also seen to be significantly lower (0.4% vs. 1.1% from the 2019Q4 estimate), while ours has not significantly revised potential long-term GDP growth rate. The reason for this is the difficulty in assessing the effect of the COVID-19 crisis on growth in the long run, with arguments presented for both lower and higher potential growth rates in the long run. In the short run, it can be seen that estimates of potential growth in the past have been less revised in our estimate of structural break in 2020 (red line in the right-hand chart of A5.3). In 2020, it can be seen that our estimate attributes most of the decline to a temporary supply shock, which also results in smaller revisions of potential GDP in the past. Of course, the same conclusions apply to the revision of the historical output gap shown in figure A5.4.

PUBLIC SECTOR ECONOMICS
45(4) 459-493 (2021)

FIGURE A5.2

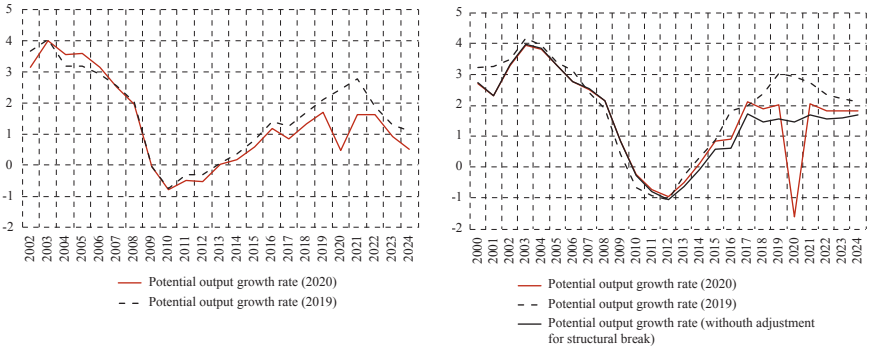
Comparison of the potential GDP estimate from December 2020 and December 2019, EC – left, authors estimate – right (HRK bn)



Sources: European Commission, authors' calculations.

FIGURE A5.3

Comparison of the potential growth estimate from December 2020 and December 2019, EC – left, authors estimate – right (percentage)

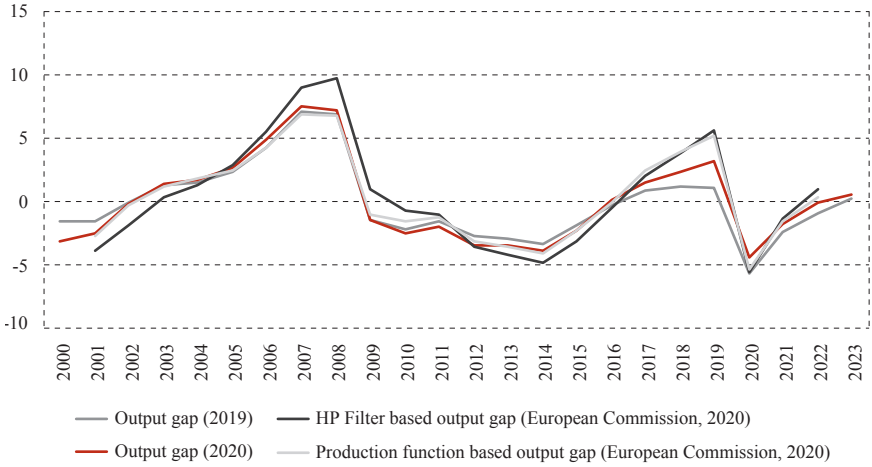


Note: The revision of the potential GDP growth rate in 2016 on the right chart follows from the revisions of data related to the labour market and is not a consequence of the problems related to the estimation of potential GDP in the context of the corona crisis.

Sources: European Commission, authors' calculations.

FIGURE A5.4

Comparison of the output gap (percentage)



Sources: European Commission, authors' calculations.

Fiscal (un)sustainability of the Croatian healthcare system: additional impact of the COVID-19 crisis

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Abstract

The main goal of this policy paper is to provide an overview of the basic problems that have impact on healthcare in Croatia and tend to make it unsustainable. The paper points out that the COVID-19 crisis has deepened and exacerbated the already existing problems of financing the health system. The analysis shows that Croatia swept under the rug systemic problems in financing healthcare and ultimately paid the price through frequent financial bailouts. Thus, in the period from 1994-2021, a total of HRK 23.9 billion was spent on bailing out the health service. On the other hand, the COVID-19 crisis can be seen as a chance to start solving the problem and implement certain reforms, both on the revenue and expenditure side of the health system.

Keywords: healthcare financing, financial bailouts, hospital debt, COVID-19, Croatia

1 INTRODUCTION

The fiscal sustainability of the healthcare system is a prerequisite for the long-term fiscal sustainability of every modern welfare state. Croatia's healthcare financing system has evident problems that are most often expressed through frequent recoveries of hospital debts, most often for pharmaceuticals. Wholesalers and pharmacies regularly recover debts only after threats to suspend the delivery of medicinal products and other medicinal goods. Although the Croatian Health Insurance Fund (CHIF) shows balanced financial operations in its reports, the Government is forced to cover part of the healthcare debt almost every year. So far, there have been 27 such bailouts in the period 1994-2021. On average, there is one bailout annually.

The debt of the health system is layered. The debt of hospitals to wholesalers for pharmaceuticals is the most important, but there are also other suppliers of medical equipment, materials, and diagnostics. An important component of the debt is liabilities to health care employees and numerous union lawsuits, which are either due or awaiting their moment in court. The big problem is that there are no official statistics on the amount and structure of healthcare debt, no clear documentation.

Despite numerous bailouts and reforms of the healthcare system, its debts continue to grow, and there are no indications of changes likely to prevent the emergence of new debts. During the COVID-19 crisis, several partial bailouts were undertaken. This indicates a problem with the (long-term) fiscal sustainability of the healthcare system. The systems for monitoring, cost management, and revenue and expenditure planning (budgeting) are obviously failing. Considering the circumstances of the COVID-19 pandemic, it can be expected that the financial challenges of the health system will be even more pronounced.

This paper aims to provide an overview of the basic problems that bring about the fiscal lack of sustainability of health care in Croatia. The article's main thesis is that the COVID-19 crisis is not the cause of financial problems in healthcare but only exacerbated them. The financial problems are a consequence of the already

existing deep and systemic problems of Croatian healthcare. Indeed, the COVID-19 crisis can serve as an opportunity to start reforms that will contribute to the long-term fiscal sustainability of the health system.

After the Introduction, the second part of the paper gives a short analysis of the concept of fiscal sustainability, with special emphasis on the Croatian case. In the third part, the sources of the fiscal unsustainability of the healthcare system in Croatia are analyzed. The fourth part discusses the impact of the COVID-19 crisis as an accelerator of financial health problems, but it can also be used as a spur for positive changes and reforms. The fifth part provides the conclusion.

2 FISCAL SUSTAINABILITY OF HEALTHCARE

2.1 CONCEPT AND DEFINITION OF FISCAL SUSTAINABILITY IN HEALTHCARE

In general, fiscal sustainability can be defined as the ability of a debtor to meet their financial obligations to creditors in the long term, with an acceptable balance of revenue and expenditure. Otherwise, debt becomes unsustainable if it grows faster than the debtor's ability to repay it.[1] It is also assumed that fiscal sustainability exists if the existing public policies, especially those in the domain of fiscal policy and taxation, remain unchanged, as does the level of public debt (European Commission, 2014).

The above definition can be applied to narrower segments of the public sector and to the healthcare system as well. Although, due to the specificity of the public health system, the problem of fiscal sustainability should be viewed in a slightly different way. For the healthcare system, fiscal sustainability should not be seen as a goal but as a constraint that needs to be taken into account permanently. In order not to disrupt the level of healthcare and so compromise the health of the society, simple solutions for reducing healthcare debts, such as increasing revenues or cutting costs horizontally, should not be the primary focus. The system needs to be improved primarily by reducing cost-inefficient health interventions (OECD, 2015; Thompson et al., 2009).

2.2 FISCAL UNSUSTAINABILITY OF THE CROATIAN HEALTHCARE SYSTEM: CONSTANT REFORMS AND CONSTANT DEBT ISSUES

The Croatian healthcare system is continuously in debt. In view of the above definitions of fiscal sustainability and the fact that healthcare debts are continuously having to be repaid in Croatia, the Croatian healthcare system can reasonably be considered to be fiscally unsustainable. The problem is that there are no publicly available data on the amount and structure of the healthcare system's debt. In general terms,

[1] Fiscal sustainability is a narrower concept than financial sustainability. Since the Croatian health system is financed predominantly by public sources, the focus of the paper will be on fiscal sustainability and strengthening Croatian Health Insurance Fund (CHIF) revenues. However, there is a huge potential in increasing health care institutions' own revenues from private funds (e.g. clinical studies), which goes beyond the narrower "fiscal" framework and enters the domain of financial sustainability.

the amount and structure of the debt can be found in various press releases or explanations of the Government or the Ministry of Health in Parliament.

The Minister of Healthcare reported in the Croatian Parliament that at the end of 2020, total healthcare debt was around HRK 13.83 billion. Of that, HRK 11 billion refers to debts to wholesalers (Croatian Parliament, 2020). Furthermore, the Government in the State Budget revision reported that Croatian healthcare generates around HRK 220 million in additional liabilities per month (Government of the RC, 2020a). Because of the threat of wholesalers to partially suspend the supply of pharmaceuticals and other medical goods, the Government implemented another healthcare system bailout. In a revision of the state budget in October 2020, an additional HRK 1.3 billion was earmarked for the bailout of health care institutions (Government of the RC, 2020b). Also, during March 2021, a so-called accelerated transfer of HRK 900 million to pharmacies and hospitals was agreed.

It is evident that the Government is prepared to cover a significant part of the overdue healthcare debt and underwrite its financial stability in the long term. The budget revision includes the fiscal effects of healthcare recovery and the economic crisis caused by COVID-19. The fact is that the budget deficit will be covered by debt, which is supported by the favorable situation on the financial market and historically low interest rates. It is an ideal time to take advantage of both the situation in the financial market and the social readiness for substantial reforms of healthcare, as well as to ensure long-term stabilization of the Croatian healthcare system.

From 1994 to 2021, Croatia spent HRK 23.9 billion on healthcare bailouts.[2] Despite numerous reforms and financial bailouts, the healthcare system is experiencing constant financial difficulties, as pointed out by a number of other authors. Reforms implemented in the last 25 years have focused mainly on cost containment and less on inefficiencies that have been causing these financial problems. Reforms failed to address the crucial issues of financing, accessibility, and quality of health protection, although such actions managed to cope with the most acute financial problems in the short run. There are a number of papers the conclusions of which are in line with the previous statements (Vončina, Džakula and Mastilica, 2007; Zrinščak, 2007; Švaljek, 2014; Broz and Švaljek, 2014; Smolić, 2016; Radin, 2019).

2.3 FUTURE OF HEALTHCARE EXPENDITURE AND IMPACT OF COVID-19 CRISIS

The challenges of fiscal sustainability of healthcare will be even greater in the future. In the past, health spending has typically outpaced economic growth (Blecher et al., 2015). Certainly, the growth of healthcare expenditure cannot be held back in the long term, but the financing of the healthcare system can and must be more efficient (Mihaljek, 2014).

[2] Calculation is available later in this paper. See table 3.

Although the growth of healthcare expenses has slowed down during the recent economic crisis, it is still higher than GDP growth. It is expected that this somewhat slower growth of healthcare expenses, compared to the historical average, will continue until 2030, but it will still be higher than the growth of GDP (Lorenzoni et al., 2019).

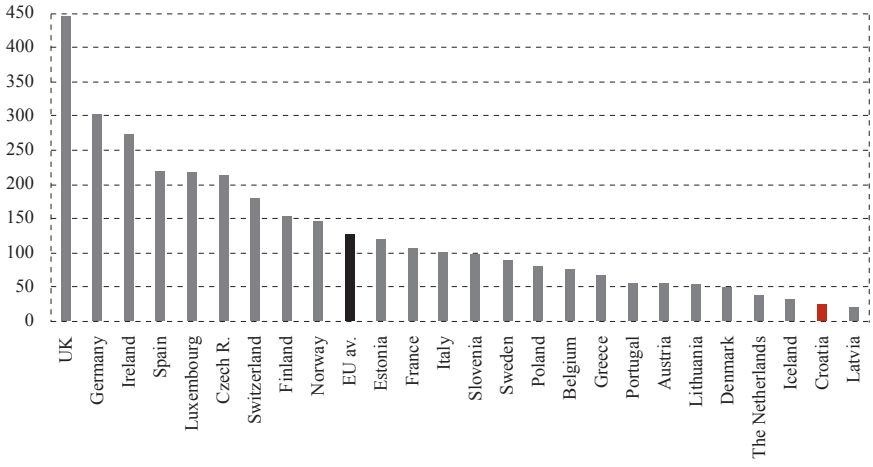
The above-presented projections were made prior to the COVID-19 pandemic. The COVID-19 crisis is expected to cause a drop in healthcare expenditure during 2020. Although significant resources (direct cost of COVID-19) are being invested in the fight against coronavirus, other non-urgent health care segments are underperforming. Patients avoid hospitals and clinics for fear of infection or placing an additional burden on health care professionals and the healthcare system in general (EIU, 2020; OECD/EU, 2020).

In Croatia, this decline was most felt in the operations of hospitals, which in 2020 generated 7% less revenue compared to 2021. To facilitate health care institutions' process, the Croatian Health Insurance Fund (CHIF) paid hospitals around HRK 2 billion more than stated in their costs (CHIF, 2021).

On the other hand, the health sector was among the first recipients of additional government financial resources. Standard COVID-19-related budget measures in the health sector include: financing the procurement of specialized medical and personal protective equipment (PPE), expanding testing capacities, hiring of the additional workforce and bonus payments, support to hospitals and subnational governments, and contributions to vaccine development (OECD/EU, 2020; Blazey et al., 2021).

Figure 1

Central government additional COVID-19 health spending commitments per capita (between March and September 2020; EUR)



Source: OECD/European Union (2020: 44), for Croatia authors' calculations.

PUBLIC SECTOR ECONOMICS
45(4) 495-515 (2021)

The health sector was naturally among the first recipients of additional financial resources. Figure 1 shows that central government budgetary commitment to health system responses to COVID-19 ranged from almost EUR 450 per capita in the UK to around EUR 20 per capita in Latvia.

In the observed period between March and September 2020, Croatian commitments were around EUR 25 per capita, i.e., 766 million HRK (or 101 million EUR). In the last quarter of 2020, the cost of its large wave of infections doubled to HRK 1.24 billion HRK (164 million EUR) by the end of January 2021 (Krnić, 2020; 2021).

Healthcare expenditure is expected to recuperate at the end of the pandemic, i.e., in 2021. However, the corona crisis has also caused an economic crisis, which is reason enough to put additional fiscal pressure on the already limited public healthcare financing funds. It is to be expected that maintaining previous levels of funds allocated for healthcare will not be sufficient to meet the growing health needs resulting from the corona crisis (the so-called indirect or hidden costs of COVID-19). Namely, in the post-pandemic period, additional indirect healthcare costs are expected, resulting from postponed or canceled treatments, delayed detection of (especially oncological) diseases due to failures to visit a doctor, long-term and unknown health effects in those recovering from the coronavirus, and the consequences of prolonged staying indoors on both physical and mental health (Gheorghe et al., 2020; Coe et al., 2020).

Regardless of the COVID-19 health and economic crisis, healthcare expenditures are expected to increase in the future. The reasons are explained by demographic trends, new (and expensive) technologies in health care, income growth in society, and the institutional characteristics of health systems (Blecher et al., 2015).

Demographic trends, especially population aging, are often highlighted as the most important driver of rising healthcare costs.[3] The elderly population is more prone to chronic diseases and multiple morbidities, which ultimately increases treatment costs. New technologies improve the scope and quality of health care services. This primarily relates to the provision of better but more expensive treatment for complex diseases.

Furthermore, with the growth of income in society, expectations from the (public) healthcare system also grow, and so does the scope of health care provided as part of mandatory health insurance. Lastly, healthcare systems' institutional characteristics have proven to be extremely important in explaining health spending growth. This primarily refers to the so-called Baumol effect or Baumol's cost disease: since the healthcare sector is a service sector and a predominantly labor-intensive

[3] Economic growth, specifically GDP per capita, has a positive effect on the efficiency of the health care sector, while the growing proportion of the elderly population reduces the coefficient of efficiency (Buljan, Deskar-Škrbić and Šimović, 2019).

sector, it tends to increase the prices of its services even when the growth of prices is not associated with a growth in productivity.[4]

The above-listed are the general and specific (COVID-19) causes of the future growth of healthcare expenses that apply to most public healthcare systems across the world. Croatia's position is particularly challenging due to the healthcare system's existing large debt and its fiscal unsustainability. Because of that, the characteristics and problems of healthcare financing in Croatia should be analyzed in more detail.

3 SOURCES OF FISCAL UNSUSTAINABILITY OF THE HEALTHCARE SYSTEM IN CROATIA

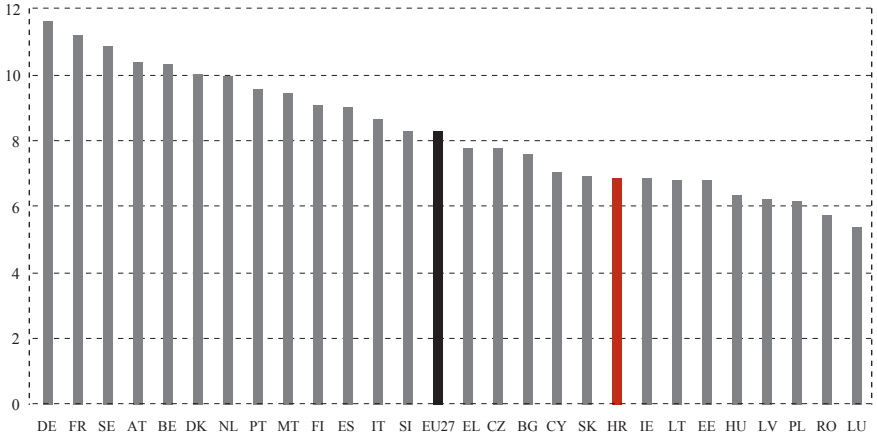
There are several causes of financial problems in Croatian healthcare. In the following, we state the crucial problem that presents the genesis of the existing fiscal unsustainability.

3.1 SIZE OF HEALTH EXPENDITURES AND THE DOMINANT ROLE OF PUBLIC FUNDING

Expenditures for health services and healthcare of countries reflect the degree of their economic development as well as the development of their healthcare systems. Figures 2 and 3 show expenditures for healthcare in the EU as a percentage of GDP and per capita. These are the two most commonly used measures to show healthcare expenditure in a country. In general, more developed countries direct a larger part of their expenses into healthcare.

Figure 2

Health expenditure as a share of GDP, 2019 (or nearest year)

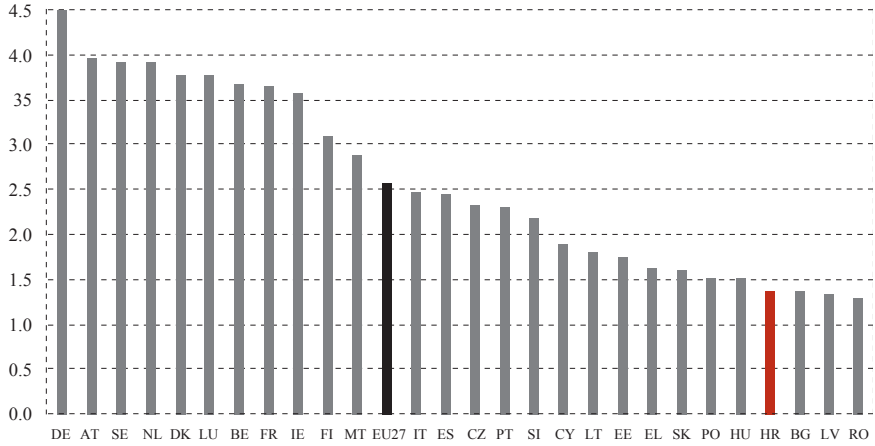


Source: OECD/European Union (2020).

[4] Precisely because such a conclusion is contrary to economic logic, it is called a "disease". Baumol (1967) came to this conclusion by analyzing why a sector of primarily public services, such as health and education, is experiencing a dichotomy of productivity and wages. He concluded that the service sector has low potential of generating innovation, as well as of improving productivity, because the substitution of labor by capital is almost impossible.

FIGURE 3

Health expenditure per capita in EUR, 2019 (or nearest year, in thousands)



Source: OECD/European Union (2020).

Funds allocated to healthcare in Croatia are below the EU average. In 2019, healthcare expenditure amounted to 6.88% of GDP, while the EU average was 8.25% of GDP. In terms of per capita expenditures, Croatia's position is even worse. Croatia is below the EU average, spending EUR 1,361 per capita as against the EU average of EUR 2,572. These data should be considered with reserve, since the official statistics do not include the costs of covering healthcare debts.

EU healthcare systems are funded through various schemes. Public healthcare financing systems are predominant in EU countries. They include the mandatory healthcare insurance model and/or direct budgetary transfers to health care institutions. In Croatia, the mandatory insurance system is predominant, but part of health care is financed from the state budget. It is a combination of the Bismarck model of insurance based on contributions from salaries and the Beveridge model based on budgetary transfers.

The share of public funding in total healthcare expenditure in Croatia is slightly higher than the EU-28 average (OECD/European Union, 2020), the share of private healthcare financing thus being lower. This suggests that the increase in healthcare expenditure in the future should be financed to a greater extent through voluntary healthcare insurance or direct private payments and less through public funds.

3.2 FAILURE TO COMPLY WITH THE LEGAL OBLIGATIONS OF THE STATE ITSELF IN FINANCING HEALTHCARE

The key institution for implementing mandatory healthcare insurance is the Croatian Health Insurance Fund (CHIF). CHIF is a public institution whose primary goal is to provide funds for healthcare so that insured persons have adequate access to health services.

The Mandatory Health Insurance Act (MHIA) (OG 80/13, 137/13, 98/19) (Art. 72, item 1) defines different mandatory health insurance revenues, i.e., CHIF revenue (table 1). The problem is that it is not possible to determine the analytics for all types of reported revenues following the MHIA.

Table 1

Overview of realized revenue of CHIF in the period from 2015 to 2020 (million HRK)

	2015	2016	2017	2018	2019	2020
Health insurance contributions	18,121.28	18,468.68	19,135.18	19,904.22	22,188.02	21,042.81
Budgetary income	2,400.00	2,588.95	2,629.76	3,100.00	2,600.00	3,769.21
Income under special regulations (mostly supplemental health insurance)	1,618.17	2,650.80	1,867.89	2,004.79	2,291.70	2,451.01
Property income	14.52	14.02	17.36	15.19	12.53	7.76
Foreign aid – EU projects	0.42	1.45	0.40	1.34	2.87	0.79
Income from CES (Croatian Employment Service), professional training without employment	0.62	0.43	0.91	0.48	0.00	0.00
Income from services provided	0.05	0.37	0.86	1.16	1.30	1.99
Income from sale of non – financial assets	0.75	0.50	0.65	0.72	1.90	3.11
Other income	0.28	0.70	0.34	0.36	0.44	0.25
Income from financial assets and liabilities	0.00	26.14	0.00	0.00	0.00	1,077.58
In total	**22,156.10**	**23,752.05**	**23,653.35**	**25,028.27**	**27,098.76**	**28,354.51**

Source: CHIF (various years).

The problem arises with budgetary income. Budgetary income in the observed period ranges between HRK 2.4 and 3.7 billion. This budgetary income is generated in accordance with Articles 72 and 82 of the MHIA and Article 14 of the Voluntary Health Insurance Act (VHIA), and consists of:

- revenues from budget users who pay contributions for unemployed persons and persons deprived of their liberty by a decision of a competent court,
- additional contributions for insured persons receiving pensions under regulations on pension insurance and according to the Act on the Rights of Croatian Veterans (OG 121/17, 98/19),
- income from a special tax on tobacco products,
- income from premiums for supplemental health insurance policies for policyholders whose policies are covered by the state budget, and
- funds to cover the costs of healthcare for policyholders who have exercised this right at the expense of the state budget (Article 82 of the MHIA).

When the Ministry of Finance transfers the mentioned funds, it fulfills the above-mentioned legal provisions. Still, the exact amounts (analytics) of budgetary income cannot be determined from the financial reports. Additional confusion is created by significant revenue fluctuations in the past several years.

Another major problem is that it is often questioned whether the state transfers the correct (sufficient) amount based on budgetary income. Table 2 gives an estimate of the amount and structure of the budgetary revenues in the period from 2015 to 2020.

Table 2

Estimates of the amount and structure of budgetary incomes (million HRK)

Budgetary income	2015	2016	2017	2018	2019	2020
Contributions for the unemployed	1,305.45	1,124.94	937.44	778.27	676.65	851.10
Contributions for persons deprived of their liberty	10.71	11.05	11.37	10.18	12.48	10.92
Additional contributions for pension beneficiaries	361.00	363.11	371.06	393.59	408.86	420.53
Income from special tax on tobacco	1,339.93	1,432.09	1,399.69	1,540.41	1,636.71	1,278.12*
Premium for supplemental health insurance policy at the expense of the State Budget	768.83	683.55	624.05	565.62	509.33	464.19
Funds to cover the costs of healthcare of insured persons at the expense of the State Budget	1,060.22	818.00	939.11*	939.11*	939.11*	939.11*
Total amount receivable from the State Budget (estimate)	**4,846.13**	**4,432.74**	**4,282.72**	**4,227.19**	**4,183.14**	**3,963.97**
Budgetary income (paid)	**2,400.00**	**2,588.95**	**2,629.76**	**3,100.00**	**2,600.00**	**3.769,21**
Difference	**-2,446.13**	**-1,843.79**	**-1,652.96**	**-1,127.19**	**-1,583.14**	**-194.76**

** Indicates estimated values.*

Source: Authors' calculation.

According to budgetary income, in 2019 the state was supposed to transfer about HRK 4.22 billion to the CHIF, but the transferred amount was HRK 2.60 billion. This is a deficit of HRK 1.62 billion in the budgetary income for 2019. This problem is obvious in the period 2015-2019, while in 2020 it is not so pronounced due to higher state transfers due to the COVID crisis.

Due to the proclamation of the COVID-19 disease pandemic in 2020, the multiannual growth trend in the number of active insured persons, due to positive macroeconomic trends in previous years, was interrupted. This resulted in changes in the structure of total CHIF revenues (table 1). The share of revenues from contributions decreased significantly (from 81.88% to 74.21%), and the share of budget

revenues increased (from 9.59% to 13.29%). To maintain the stability of the healthcare system, CHIF, in accordance with the Ministry of Health, accelerated the withdrawal of budget funds, which led to the planned annual limit of HRK 2.60 billion being reached in August 2020. Consequently, there was a temporary increase in CHIF obligations to pharmacies that were largely settled at the end of the year. This was enabled by an increase in revenue from the budget by HRK 0.5 billion in the last amendment to the CHIF plan and redistribution within the State Budget of Croatia, when an additional HRK 0.66 billion was remitted. These transfers, induced by the COVID-19 crisis, led to a decrease in the difference in total income that was supposed to be transferred to the CHIF according to Articles 72 and 82 of the MHIA and Article 14 of the VHIA.

The reason for obvious non-transparency in this segment remains unclear. The problem should be viewed from two sides. On the one hand, it is true that the state often financially bails out healthcare and that the amounts of the bailout exceed the legally prescribed funds by which mandatory health insurance should be supported. In recent years, the healthcare system has accumulated an average of approximately HRK 2.5 billion of new debt per year. On the other hand, if the state had allocated the total legal amount, the health system might not have been put in today's debt situation, which would have had a favourable effect on the many processes contributing to the quality of the healthcare system.

3.3 HOSPITALS AS A GENERATOR OF HEALTHCARE DEBT

Hospital costs and costs of medicines, including both particularly expensive drugs and prescription medicinal products, represent the two most significant healthcare items in Croatia. In most OECD countries, these hospital costs and costs of medicinal products should be focused on when establishing a system of controlling and budgeting healthcare expenditure, as opposed to other healthcare expenses (Vammalle et al., 2015).

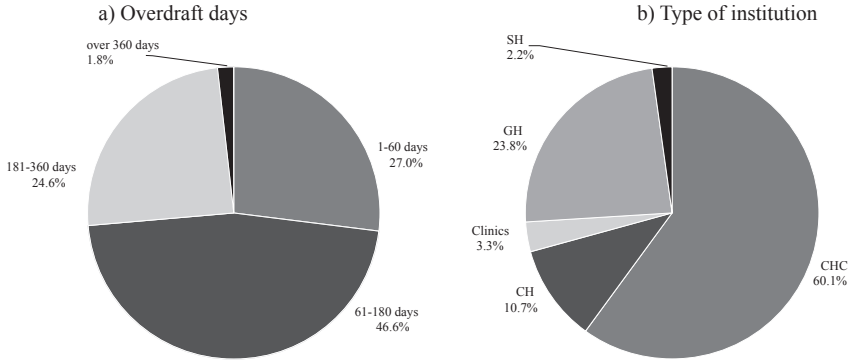
Hospitals are the leading generators of healthcare debt. Hospitals, as public institutions, are obliged to disclose their financial reports publicly. Such availability of data provides insights into the status of due liabilities. At the end of 2020, total unpaid liabilities for material expenses amounted to around HRK 3.44 billion. The majority of material expenses refer to pharmaceuticals, medical consumables, and blood or blood products.

Figure 4 shows the structure of overdue debt according to overdraft days and to types of hospital facilities. The data show that 73% of the debt exceeds the legal payment period of 60 days.[5] Clinical hospital centers (CHC) and general hospitals (GH) are the main generators of debt because they are the largest health care institutions. A closer look at the structure of overdue liabilities by type of institution (figure 5) reveals that the main generators of overdue liabilities are general hospitals (GH) and clinical hospitals (CH), in which debts of over 360 days are dominant.

[5] According to the Act on Financial Operations and Pre-Bankruptcy Settlement (OG 108/12, 144/12, 81/13, 112/13, 71/15, 78/15).

FIGURE 4

Structure of due liabilities of hospitals for material expenses at the end of 2020

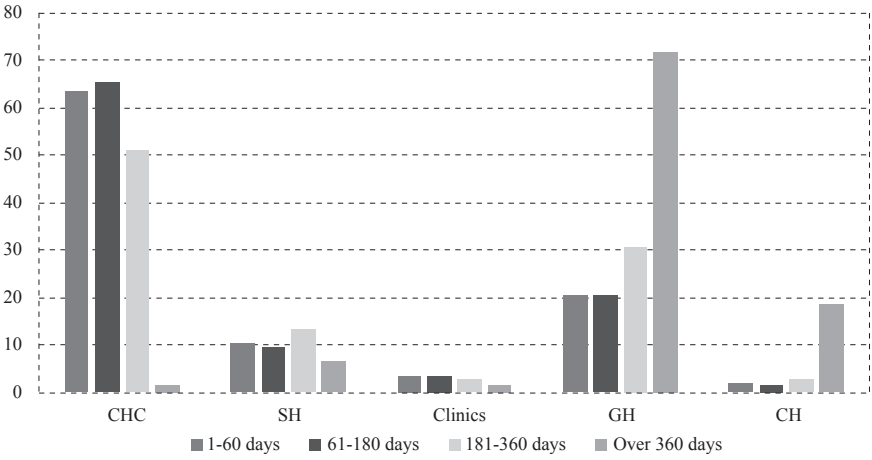


Note: CHC – Clinical Hospital Center, CH – Clinical Hospital, GH – General Hospital, SH – Special Hospital. Health resorts, health care centers, and institutes are omitted from this part of the analysis. At the time of this analysis (May 2020), the CHC Sestre Milosrdnice and the Clinic for Children's Diseases did not make public the data on due liabilities for 2020, so the data for 2019 was used in analysis.

Source: Authors' work according to the Reports on liabilities of individual hospitals, hospital websites.

FIGURE 5

Structure of due liabilities by type of institution (2020), in percent



Note: CHC – Clinical Hospital Center, CH – Clinical Hospital, GH – General Hospital, SH – Special Hospital. Health resorts, health care centers, and institutes are omitted from this part of the analysis. At the time of this analysis (May 2020), the CHC Sestre Milosrdnice and the Clinic for Children's Diseases did not make public the data on due liabilities for 2020, so the data for 2019 was used in analysis.

Source: Authors' work according to the Reports on liabilities of individual hospitals, hospital websites.

3.4 HOSPITAL LIMIT POLICY, THE ROLE OF THE CROATIAN HEALTH INSURANCE FUND, AND THE LACK OF STANDARDS

In addition to medicinal product consumption and better coordination of primary and hospital health care, fiscal sustainability of healthcare includes better management of, in particular, hospital spending in terms of increasing the quality and efficiency of the hospital system. Hospital spending makes up the largest segment of healthcare spending and generates the majority of its debt. Accordingly, there is a perception that the crucial problems of health care are in the system of hospital health care. This problem, however, cannot be solved only through the hospital healthcare system reform without reforming other subsystems, such as primary health care. Nevertheless, the hospital system has a problem in the context of financing because it cannot significantly impact the level of current revenues and expenditures of business activities. As independent business subjects, hospitals enter contracts with CHIF, and in this manner, by conducting their business activities, they achieve revenues and expenditures.

On the other hand, hospitals have no influence on the pricing of services or programs (limits), which the Administrative Council of CHIF unilaterally determines. CHIF primarily determines prices based on the available financial resources, not on cost price, or economic price, of a certain health service. After considering the costs of medical devices, implants, and medical transport of patients, a hospital is often forced to operate with a loss because many of the services cost more than the limits determined by CHIF.

Moreover, there are elements on the expense side of hospitals and other health care institutions that increase exogenously, and that are, on the other hand, not accompanied by adequate growth of hospital limits or correction of the prices of health care services. This primarily refers to personnel costs (salaries) and other material rights comprising the majority of the total expenses of health care institutions, which are the subject of negotiations between the Government and the union(s) through collective agreements. For example, in UHC Zagreb, personnel costs in 2019 increased by 8.1% vs. 2018. This growth trend was also noticeable in 2020, and additional growth of salaries has been announced due to extra engagement during the COVID-19 crisis.

The agreement between CHIF and hospitals defines a unique price for the programs (a limit) for each hospital.[6] The limit includes all the hospital activities, i.e., there are no sub-limits for individual activities. Efficient management is not possible because it is not possible to assess business success per individual activity (cost center).

One of the healthcare system reform priorities should be better definitions of (economic) prices of health services. This includes several associated reforms, such as

[6] The methodology of calculating the maximum amount of funds is unknown, which does not improve the transparency of this system.

a revision of prices of health services, the definition of centers of excellence, the description of standard treatments, and a good connection with the public procurement system. In a relatively short term, a task force can be formed at the level of the Ministry of Health, which would revise the prices of health services (DRG, HDs)[7], taking into account the real input costs expressed through the prices of medical products and material obtained through the process of public procurement.

Ultimately, in order to define a realistic economic price for health services it is necessary to specify a standard of treatment for individual diagnoses.[8] This is closely connected to introducing the concept of above-standard care into the healthcare system, which was explained among the measures for increasing healthcare revenue. The Ministry of Health (specifically, the former Agency for Quality and Accreditations in Health and Social Care) can assist in defining both standard and above-standard care. The question remains as to why, as with medicinal products, we do not have lists A and B for medical devices and implants. The basic standard (A) would be entirely covered by mandatory health insurance, while above-standard care (B) could be realized through direct payment or supplemental health insurance policy. It is neither necessary nor suggested that the lowest price criteria be used to define the basic standard. The medical profession is very familiar with trends in treating certain diseases and physical defects. The point is that the defined standard does not increase the patient's health risk, i.e., at the same time, we optimize the ratio of the quality and price of services.

4 COVID-19 PANDEMIC AS AN ACCELERATOR OF FISCAL UNSUSTAINABILITY AND REFORMS

The COVID-19 crisis can be observed in two ways. First, it has undoubtedly accelerated the financial problems of the healthcare system. The focus is on healthcare debt, which has been growing for years. Second, any crisis is a chance for reform. The COVID-19 crisis has contributed to a better understanding of the financial problems of the health system. The public increasingly emphasizes the need for long-term solutions to the problem and the need for systematic reforms.

4.1 FINANCIAL BAILOUTS AS A MODEL OF SWEEPING PROBLEMS UNDER THE RUG

We mentioned earlier that the existing concept of the lack of fiscal sustainability in the health system is being addressed through regular financial bailouts. Table 3 shows the history of financial bailouts of the Croatian healthcare system. In the period 1994-2021, HRK 23.9 billion of debt was repaid through different bailout models. In recent years, the recovery model was implemented predominantly through state budget transfers, either to the CHIF or health care institutions (mainly hospitals). Thus, the dominant debt generator is the outstanding liabilities to drug wholesalers.

[7] Diagnostic Related Grouping, Hospital Days.
[8] For example, what is the standard hip replacement during hip surgery or the standard synthetic mesh for hernia surgery, or the standard stent for treating blockage or narrowing of cardiac arteries.

Table 3

Financial recoveries of the Croatian healthcare system, 1994-2021 (million HRK)

Year	Financial bailouts	Amount
1994	Financial bailout agreement with health institutions	214.84
1994	Agreement with wholesalers – paid obligations for pharmaceuticals	62.13
1998	Settlement of due obligations towards health care institutions – from the Budget	593.00
1999	Commitments of hospital suppliers	845.37
1999	Budget transfer for suppliers	792.02
1999	Short-term loan from a bank	120.00
1999	Promissory note issued for pharmacy debt (debt older than 90 days)	244.98
1999	Pliva takes over CHIF debt to pharmacies	375.21
2000	CHIF issues bonds	1,668.67
2000	Short-term loan	115.00
2001	Collection of receivables from CHIF	750.37
2001	Short-term loan	108.00
2002	Loan	820.00
2003	Loan	410.00
2004	Transfer to hospitals from the Ministry of Finance (State Budget) for suppliers	533.01
2005	Agreement with Zagrebačka banka on taking over overdue receivables for pharmaceuticals	808.70
2007	Sale of shares owned by CHIF through the Privatization Fund – paid orthopedic devices and aids	90.00
2007	Obligations to suppliers – CHIF	1,200.00
2008	Liabilities of hospitals to suppliers of pharmaceuticals and medical supplies	500.00
2012	Assignment agreement	465.03
2013	Assignment agreement	3,062.06
2014	Assignment agreement	3,200.00
2017	Budget transfer to hospitals to settle debt to wholesalers	200.00
2019	Extraordinary payment of CHIF to wholesalers for overdue debt	500.00
2020	Budget transfer to CHIF for wholesalers debt	500.00
2020	State Budget amendment (additional revenues for CHIF)	1,300.00
2021	Budget transfer to CHIF (600 million for pharmacy debt and 300 million for hospitals)	900.00
2021	Budget transfer to CHIF for pharmacy debt and hospital debt (installments of 900 million in April, May and June, plus a state budget amendment of an additional 895 million)	3,595.00
Total		**23,973.39**

Source: Authors for the period after 2017 and Jurković (2018) for the period until 2017.

It should be noted that various reforms were continuously implemented in the observed period, and were supposed to contribute to the fiscal sustainability of healthcare. For example, since 2015 CHIF has not been in the State Treasury system. No reform has contributed to the financial sustainability of the system. In fact, in recent years, financial bailouts have become more frequent and more generous.

Furthermore, official statistics do not show expenditures for healthcare bailouts. This means that Croatia allocates more funds than indicated by official statistics (figures 2 and 3). On average, the state bails out healthcare with an additional 0.65% of GDP annually while at the same time generating new outstanding debts.

4.2 POSSIBLE REFORMS AND SOLUTIONS TO THE PROBLEM

The problem can be solved through either the revenue or the expenditure side. An increase in income (taxes or contributions) can be implemented in a relatively short time. Expenditure-side reforms require a more extended period. It should be emphasized that – even though the potential possibilities of increasing income are listed and explained below – it is imperatively necessary to reduce the expense side of the healthcare budget. The healthcare system must change internally in terms of organization and management. No new debts should be generated. Eventually new debts should be considered only if they increase the efficiency of the healthcare system in the context of the quality and availability of health care.

Furthermore, increasing the revenues of the healthcare system is more in the domain of the Ministry of Finance and less in the domain of the Ministry of Health. As the strengthening of health income is mainly in the domain of the Ministry of Finance, re-allocating expenses and increasing the efficiency of healthcare is the sole responsibility of the Ministry of Health and other segments of the public healthcare system, such as CHIF and health institutions.

Increasing contributions, especially in the context of the COVID-19 crisis, is not a prudent measure. The current contribution rate of 16.5% is already high. Increasing the health contribution rate would further contribute to the increase in labor costs. An increase in other CHIF revenues is a more apparent measure. One possibility is to increase the share of excise duty on tobacco. Currently, 35% of the excise tax on tobacco revenue belongs to CHIF as part of "budgetary income". According to the World Health Organization, the tobacco tax is the most common form of sin tax or public health tax (Cashin, Sparkes and Bloom, 2017: 24). Also, it is generally considered that the cost of treating smokers is much higher than the financial benefits that the state derives from tobacco taxes. Inclusion of other excise duties (e.g., alcohol) and/or introduction of new special sin taxes (e.g., sugar, fats, etc.) as CHIF income may be considered.

Furthermore, it is necessary to find new ways to increase income from supplemental health insurance. The emphasis should be on increasing the number of people with additional health insurance and not raising policy prices. In particular, it is necessary to encourage 1.87 million insured persons who do not have SHI to take out a supplemental health insurance policy. The possible change refers to an increase of the HRK 2,000 limit per one issued invoice for provided health care. This would encourage people to take out supplemental insurance.

Public sources of healthcare financing are limited, and it is necessary to increase health care institutions' revenues. R&D and clinical trials are often mentioned as

an essential alternative source of health system financing. Croatia lags behind other EU countries in the number of clinical trials. The number of studies indirectly reveals the amount of investments. In Croatia, only EUR 40 million, or EUR 9.81 per capita, is annually invested in R&D. For comparison, in Slovenia, EUR 86 per capita is invested in R&D, in Hungary EUR 24 per capita, whereas Denmark invests EUR 280 per capita, and Belgium as much as EUR 311 per capita annually (EPFIA, 2020). It is indisputable that there is room to strengthen our own revenues through R&D, clinical trials, and more.

The measures on the expense side are restricted by the fact that most of the positive fiscal effects can only be realized in a longer time frame and that a fiscal effect assessment is not possible in most cases. Various measures have been proposed that can positively impact fiscal sustainability, such as strengthening prevention and primary health care and optimizing pharmaceuticals consumption and payment according to treatment outcome. An important segment with the potential for significant results is the coordination of hospital treatment and primary health care, where health care digitalization plays a significant role. [9]

The most critical segment associated with the expense side refers to establishing a partnership between health care institutions and CHIF, so that health care institutions have more say in managing their own incomes and expenses. This means a more straightforward definition and implementation of payment per economic price of health care services, the definition of treatment standard, and centers of excellence in the hospital system.

There is a whole range of measures and areas based on which the healthcare system can be improved, and its fiscal sustainability ensured. Some of these measures were recognized in the *National Strategy for Health Care Development for 2012-2020* and national plans for hospital development (Government of the RC, 2012; Ministry of Health, 2018). Furthermore, "dual" financing should be implemented for the survival of regional hospitals that operate in a political and social dimension. Dual financing involves co-financing of operative expenses by the founder, i.e., the county or the city/town. Currently, funding is exclusively in the domain of CHIF.

5 CONCLUSION

The problem of the fiscal sustainability of the Croatian healthcare system is evident. For a healthcare system to provide efficient and high-quality health care, it requires adequate financing, i.e., it must be fiscally sustainable.

Croatia is among the leading countries in the EU in terms of health care availability. A large part of the population is covered by mandatory health insurance and has the right to health care. But only a third of insured persons are actively insured

[9] For general measures see Blecher et al. (2015). For specific measures for Croatia see Šimović and Primorac (2021).

PUBLIC SECTOR ECONOMICS
45(4) 495-515 (2021)

people, upon whose work contributions for health insurance are paid. Furthermore, a range of factors influences the growth of healthcare costs, such as demographic trends, population aging, advancements in medical technology, and medicinal products requiring significant investments and generating high costs. The current impact of the COVID-19 pandemic should also be noted. We can expect COVID-19 to have an additional impact on the growth of healthcare costs through various hidden and indirect costs.

The amounts paid for financial bailouts should be turned into regular income. In relative terms (as a percentage of GDP), and excluding private health expenditures, resources allocated for healthcare in Croatia are below the EU average. Furthermore, Croatia is among the EU countries with the lowest allocations for healthcare, in terms of allocation per capita. This picture, however, is not entirely accurate because the official statistics do not include the costs of covering healthcare debts. Considering that the allocated amount is higher than the one recorded in the official statistics, there are legitimate demands for restructuring the healthcare system on the inside in terms of organization and management to achieve much better results with the resources received.

In addition to analyzing the present condition and identifying key problems, this paper indicates some measures to strengthen the fiscal sustainability of the Croatian healthcare system on both the revenue and the expenditure side. Some of the measures are already known. In addition to the political will, education and raising awareness about the importance of this problem are also necessary. Resolving this problem requires better understanding and cooperation between the Ministry of Finance and the Ministry of Health regarding objective budgetary restrictions and the financing of this complex and necessary healthcare system.

Disclosure statement

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The impact of the COVID-19 crisis on income distribution under different protection schemes: the case of Spain

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PUBLIC SECTOR ECONOMICS
45(4) 517-541 (2021)

Abstract

I use household survey data to microsimulate the impact of the COVID-19 crisis on income distribution in Spain. I estimate the cost of potential lockdowns under three different low-income public protection schemes. Results show that although the COVID-19 shock has reduced income for all deciles of the income distribution, the losses are not uniformly distributed. The worst economic effects of the pandemic are not on the poorest, but on individuals in the middle and wealthy groups of the ex-ante income distribution. Low-income benefits help to moderate income losses and to curb poverty and inequality at various levels. It might be necessary to raise taxes and to resort to expenditure reducing policies to maintain protection in the context of contraction and lower government revenues.

Keywords: fiscal incidence, inequality, poverty, social spending, COVID, Spain

1 INTRODUCTION

This paper examines the effects of low-income benefits on income distribution, inequality, and poverty in the context of a deep economic contraction. Worldwide, gross domestic product (GDP) experienced a 3.3% fall in 2020. Advanced countries suffered a more profound recession than developing economies; GDP fell 4.7% for the former, and 2.2% for the latter. Within the group of advanced economies, Spain is the country with the deepest GDP fall: 10.8%. Under these unprecedented circumstances, consequences on income, inequality and poverty must be explored, and policies designed to alleviate the social effects tested.

Spain is a country with a relatively generous welfare state. Social spending accounts for almost 25% of its GDP, well above the average for OECD countries (20.4%). However, according to Ayala and Cantó (2020), in the last few years "inequality has shown some reluctance to fall, which indicates that it possesses a significant structural component". The two reasons behind this apparent paradox are the inefficient adjustment mechanisms of its labor market and the low redistribution capacity of fiscal interventions. These unique conditions are used to tackle the research question in this paper from the perspective of the Spanish case, but with the goal of drawing general lessons for advanced countries.

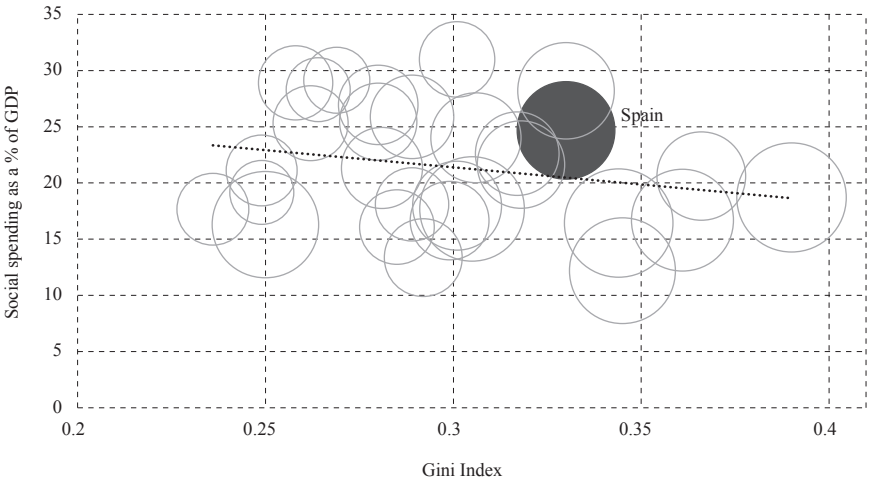
Figure 1[1] shows the relationship between social expenditure and the Gini Index. The size of the dots corresponds with the percentage of the population living under the national poverty line (60% of median income). Data shows that Spain is a country with a relatively high social spending to GDP ratio and a relatively low redistribution capacity. The Gini Index for disposable income is 0.33 (OECD average is 0.31) and the poverty rate using the national poverty line is 14.2% (OECD average is 11.6%).

[1] I have excluded Chile, Costa Rica, and Mexico for representation purposes. Their figures, as well as those of the other countries included in figure 1, are shown in table A1 at the appendix section.

I microsimulate the impact of different income contractions, mainly using data from *Encuesta de Condiciones de Vida, (ECV)*. I complement ECV data with other surveys, like *Encuesta de Presupuestos Familiares (EPF)*, and with information from fiscal-administrative sources. I construct all the income concepts contained in this article following Lustig (2013) approach.

Figure 1

Social spending as a percentage of GDP (vertical axis) and Gini Index (horizontal axis)



Note: OECD countries. 2019 or latest year with available data.

Source: OECD statistics.

Surveys like the ECV are produced almost globally on a yearly basis. Information provided by them offers a two-year delay from the moment in which the data were collected. This means that, to evaluate the impact of the COVID-19 crisis and of the different policies in effect, researchers and policymakers would need to wait until the moment in which data for the years 2020 and 2021 are published.

In this paper, I estimate different income contraction scenarios derived from lockdowns and their aftermaths in Spain. Spain is one of the countries most affected by the COVID pandemic (Pollán et al., 2020). Scenarios are simulated under three different low-income protection schemes. The first one acts as a benchmark since it does not include any specific low-income benefit. Throughout the article, I will refer to it as the NLIB (Not Low-Income Benefit) scheme. It considers all other transfers and subsidies in effect.

The second one includes a direct means-tested transfer from regional governments to households fulfilling each region's conditions (household size, health issues...). This protection scheme, also known in Spain as *Renta Mínima de Inserción (RMI)*, is a low-income benefit operative until the end of 2019. Finally, I

PUBLIC SECTOR ECONOMICS
45(4) 517-541 (2021)

simulate a national-wide means-tested program with the same conditions and regulation for all regions. This scheme is known as *Ingreso Mínimo Vital (IMV)* (BOE, 2020). It was established as a replacement for RMI from 2020 onward. Details on both schemes are provided in section 3.

The contribution of this article to the existing literature is twofold. First, I estimate the impact of the COVID crisis and its aftermath for the entire income distribution, and not only on aggregate or proportionally as is usual in the literature, using income and not spending data, as in Aspachs et al. (2020). Second, I provide an analysis of the protection provided by low-income benefits beyond the already existing articles on hypothetical Universal Basic Income (UBI) designs. My work also sheds light on the optimal design of low-income benefits under these extraordinary circumstances.

This article is structured as follows. In section 2, I present the theoretical framework and the literature review of fiscal incidence and of the COVID-19 impact on income distribution in Spain. Section 3 briefly summarizes the data and the methodology used to answer the research question. Section 4 shows the main results that I have obtained, and, in section 5, I discuss them and offer some policy recommendations. Finally, section 6 presents the conclusions of the article.

2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Fiscal incidence analysis is rooted in the field of public finance. Literature on this topic analyzes and measures the distributional impact of a country's taxes and public spending. Tax incidence literature was initially focused on the US tax system. Musgrave et al. (1951), Musgrave (1959), Musgrave, Case and Leonard (1974), and Pechman (1985) were the main contributors to this research line providing the first estimations of the distributional effects of the US tax system. On the expenditure side, early studies on its incidence can be found in Keid (1954) and in the work of the Tax Foundation (1967).

Fiscal incidence analysis consists of allocating taxes and public spending to households or individuals in order to compare incomes before taxes and transfers with incomes after taxes, transfers, and subsidies (Förster and Whiteford, 2009; Immervoll and Richardson, 2011). This allocation process is done through different methodological strategies, although microsimulations from survey-based data are the most to be found in the literature (Bourguignon and Spadaro, 2006; Lustig, Pessino and Scott, 2014; del Valle Navas and de la Cruz, 2018).

Fiscal redistribution is the process by which the state collects revenues from individuals and households (primarily through taxes) and spends these revenues on benefits (for example, cash transfers, price subsidies, and in-kind benefits such as education and health) intended for specific individuals and households (Lustig, Pessino nad Scott, 2014). The state modifies post-fiscal income for households and individuals and alters inequality and poverty rates.

PUBLIC SECTOR ECONOMICS
45(4) 517-541 (2021)

As Lambert (1992) shows, "the redistributive effect of the net fiscal system is equal to the weighted sum of the redistributive effect of taxes and transfers, where the redistributive effect of the tax system is defined as the difference between inequality of post-tax and Market Income"; income distribution changes before and after public interventions.

Equation 1 summarizes this process.

$$Y_h = I_h - \Sigma_i T_i S_{ih} + \Sigma_j B_j S_{jh} \quad (1)$$

Where:
Y_h = post-fiscal household income.
I_h = pre-fiscal household income.
T_i = total taxes levied on households.
S_{ih} = share of tax i paid by unit h.
B_j = total transfers to households.
S_{jh} = share of transfer j received by unit h.

The so-called accounting approach dominates the literature on fiscal incidence. It considers what is paid and received without assessing the behavioral responses that taxes and public spending may trigger. This methodology starts from an income concept and depending on the fiscal intervention under study, allocates the proper amount of a tax or a transfer to each household or individual.

Given the nature of the research question addressed in this article, I will consider only the transfer element of equation 1. In particular, I will focus on the effect of low-income benefits on inequality and poverty rates during and in the aftermath of the COVID-19 crisis, as stated above.

All income concepts in this article have been produced using the methodology originally developed in Lustig (2018) and in Gómez-Bengoechea and Quan (2019), for the Spanish case. The analysis contained in this article is focused on gross income, which is the result of adding contributory pensions and direct transfers to market income minus the contributions to the social security for retirement pensions.

For the case of Spain, research estimates either the impact of COVID-19 on income, assuming that income losses are proportional across the entire distribution (Lustig and Pabon, 2020), or the particular case of a city or region, which is too narrow from the geographical point of view. An example of the former can be found in Clark, D'Ambrosio and Lepinteur (2020), where authors find that relative inequality increased, decreased, and grew again in a hump-shaped way in 2020 for France, Germany, Italy, Spain and Sweden. The latter can be found in Baena-Díez et al. (2020), who show that income reductions have affected the most deprived areas, for the city of Barcelona.

Existing aggregate results for Spain are consistent with those found globally (Han, Meyer and Sullivan, 2020; Deaton, 2021). Both papers find that per capita incomes fell more in higher-income countries than in developing nations, even if the former had better protection schemes. The uneven impact of health crises in each region seems to be behind this counter-intuitive result.

An exception to those approaches can be found in Aspachs et al. (2020), which shows that public transfers and unemployment insurance schemes have been very effective at providing a safety net for the most affected segments of the population and at offsetting most of the increase in inequality. They show that in the absence of government intervention, spending inequality would have increased dramatically. In section 4, I will confirm those results and will separate the part of that safety net that can be attributed to low-income benefits.

From the income protection point of view, research on COVID's impact has been primarily focused hypothetical UBI strategies as a response to the crisis. That is the case for Johnson et al. (2020) and Johnson and Roberto (2020), which document how UBI may be suited to address these challenges as opposed to, or in conjunction with, other relief measures. For the pre-COVID period, there is a huge literature analyzing the role of both RMI and IMV in addressing income inequalities (Ayala et al., 2021; Aguilar-Hendrickson and Arriba González de Durana, 2020; Hernández, Picos and Riscado, 2020).

A low-income benefit is different from a universal basic income (UBI; beneficiaries of the former often face eligibility conditions, while the latter is granted for all citizens regardless of their wealth or family situation. The concept of a universal basic income (UBI), an unconditional flat-rate transfer paid to everyone, is rooted in the literature (Widerquist, 2013) and in the public debate. Policymakers (Horvarth and Wignaraja, 2020) support its use as a response to the magnitude of and the vulnerability generated by the COVID-19 crisis.

As has been already mentioned, this article contributes to the existing literature by providing income contraction results for the entire distribution and not only from a proportional or aggregate perspective. Furthermore, I provide an analysis of low-income benefits that goes beyond the already existing UBI analyses and suggest some policy alternatives that could be explored to enhance current protection mechanisms.

3 DATA AND METHODOLOGY

I use microdata from the ECV Survey (2018) to build the main income concepts necessary to estimate the impact of the COVID-19 crisis on poverty and inequality. ECV is an income-based survey. It gathers information from almost 35,000 individuals and 13,000 households and offers data both nationally and regionally. It does not include consumption-related questions. Regarding household data, it offers information on the composition, income, social exclusion and material needs of the unit, as well as of the current state of the dwelling place. With respect

to individuals, ECV contains information on education, health, labor conditions, income and material needs.

Microsimulations allow us to relax the equal loss assumption for the entire population often found in the literature. I use techniques analogous to non-anonymous growth incidence curves (Bourguignon, 2011) to describe income losses across the ex-ante income distribution and to incorporate distributional changes into the analysis.

I use gross income per capita as the benchmark income indicator (Lustig et al., 2020). Gross income is obtained as the aggregate of labor income, capital income, other household transfers, contributory pensions and direct public transfers. Direct public transfers include unemployment benefits, non-contributory pensions, national and regional family-related transfers, and the low-income benefit: RMI or IMV; alternatively. I update gross incomes for Spain using the growth rate of per capita GDP for 2019 multiplied by a so-called "pass through" of 0.85. Ravallion (2003) and Lakner et al. (2019) recommend the use of this pass through to convert GDP changes into household disposable incomes variations.

Income losses are obtained by simulating potential impacts at the household level. I first identify individuals whose income is at risk because they work in sectors in which lockdowns have severely reduced activity. Second, I aggregate at-risk income to the household level and then simulate actual loses using a range of two parameters: the share of households with at-risk income that actually lose income, and the share of income lost for them. Both parameters vary from zero to one hundred percent.

The incomes of individuals are considered to be safe or at risk depending on the economic sector in which they work. I assume that income derived from work in sectors that are "essential" are not at risk. I use the International Labor Organization (ILO) definition of essential sectors (public services, health care and social services).

Following these criteria, I consider an economic sector to be at-risk if the aggregate variation of compensations paid to individuals fell more than the aggregate for all sectors (14.35%) between March and April 2020, when the lockdown was more strict in Spain, according to the Spanish Tax Office. Table 1 shows the aggregate variation in compensations by economic sector[2].

[2] Economic Sectors follow the classification of the Spanish Tax Office, while workers are categorized according to ILO rules. As a consequence, some regrouping is necessary to merge information. Complementary Professional Activities include logistics, telecommunications and other supporting services. Industrial Production includes all industries but manufacturing, i.e., extractive industries, energy production and waste management.

Table 1

Aggregate variation in total compensations March-April 2020 by economic sector (in percent)

Economic sector	Aggregate variation in total compensations
Agriculture	6.46
Other professional activities	-9.60
Industrial production	-11.45
Total for all sectors	**-14.35**
Arts & education	-14.37
Financial services	-14.90
Retail	-14.99
Manufacturing	-20.20
Construction	-20.20
Real-estate	-22.62
Hospitality	-75.80

Source: Author's estimations based on Spanish Tax Office statistics.

Exposed economic sectors are the following: manufacturing, construction, retail, hospitality, financial services, real-estate sector, education, and arts and recreation. Agriculture, industrial production (other than manufacturing: extracting industries, energy, and water supply...) and the so-called complementary professional activities (such as logistics, information and telecommunications...) are safe economic sectors, following this identification strategy.

The impact on income derived from this categorization and from the subsequent simulations is analyzed under three different low-income protection schemes. In the first protection scheme (Non Low-Income Benefit, NLIB), I consider gross income without any additional low-income protection transfer. That includes market income plus pensions and direct transfers (unemployment benefits, national family benefits, regional family benefits, non-contributory pensions and regularization from personal income taxes).

Renta Mínima de Inserción (RMI) scheme includes all the transfers in the NLIB simulation, as well as the regional minimum income protection operating in Spain until the year 2020. RMI is a non-contributory transfer for residents between 25 and 65 years with no sufficient income. It is managed at the regional level and amounts, duration and conditions for elegibility vary across territories. For example, in Andalusia, Madrid or Valencia benefit was established as the 70% of the legal minimum wage, while in Murcia or Castilla y León it was 70% of the benchmark indicator used by the Spanish administration for the allocation of all other social benefits (IPREM). All regions in Spain provided this benefit with different particularities (Gómez-Bengoechea, 2020).

In the IMV scenario I substitute RMI for the newly approved, and still in its early operating phase, low-income state benefit. IMV centralizes the management of the transfer and establishes the same conditions and rules for the whole country, with no regard for households' regions. Its regulation is very similar to the RMI in terms of eligibility, but the duration and the amount of the benefits are higher in almost all cases.

Conditions for the identification of IMV beneficiaries are also means-tested. They include other limitations, such as age (between 23 and 65 years old), residence, household size and being actively looking for a job. There are some exceptions to these conditions due to reasons of social concern, such as being a victim of a sex crime or of gender-based violence.

Income limits and the amount of the benefit vary depending on the size and composition of each household. For a one-individual household, the benefit amount would be 5,538 euros, for incomes below 16,614 euros per year. For a two adults and one child household, the benefit amount would rise to 8,861 euros, for those incomes below 29,905 euros per year. Table A2 in the appendix section shows the benefit amounts for the national IMV and for the regional RMI schemes.

4 RESULTS

In this section, I present the composition of pre-crisis incomes and the impact of the COVID-19 economic shock on poverty, inequality, and the distribution of post-crisis income under the different low-income protection schemes.

4.1 COMPOSITION OF PRE-CRISIS INCOME

Figure 2 shows the composition of pre-crisis incomes across the entire distribution for each protection scheme. Income distribution is obtained from the original data in the ECV survey. I consider 5 income categories: public transfers, contributory pensions, government salaries (the three of them are public sector related), "safe" labor income and "at risk" labor income.

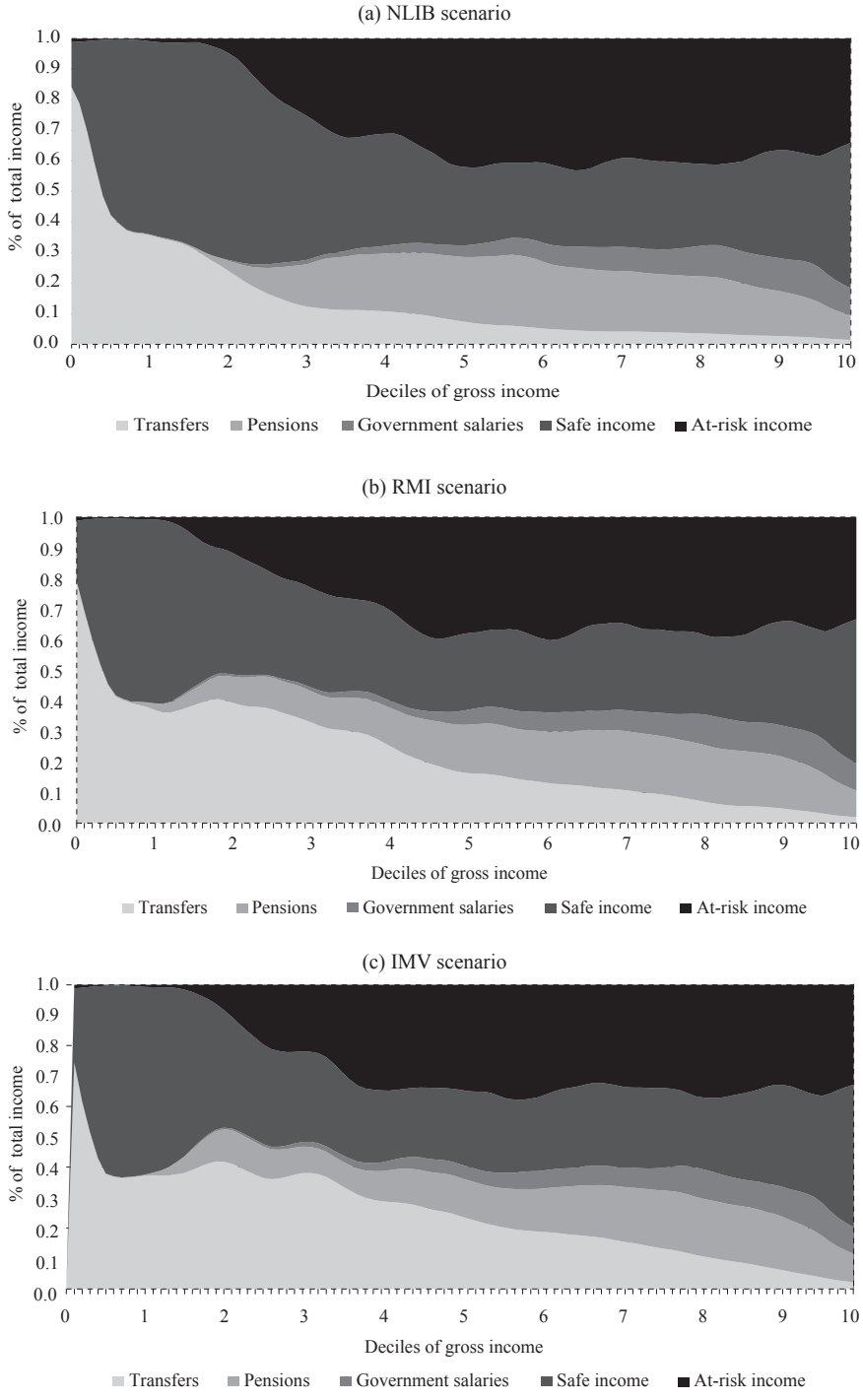
Data for the three protection schemes show the important role that public transfers play for the first deciles of the income distribution; they represent as much as 80% of the total income distribution for decile 1. The public sector, through transfers, contributory pensions, and salaries, generates around 30% of total income for deciles 2 to 8.

At-risk income represents around 40% of total income for deciles 3 to 10. Safe income behaves in a similar way, but it grows significantly for the first and last deciles. Initial deciles include incomes derived from essential low-skilled jobs, like agriculture or logistics (see table A3 in the appendix section for further details on each decile composition by individuals in each economic sector). The final deciles group workers whose income comes from positions in which remote working is more feasible (financial sector, for example) and with an available at-home internet connection (Brussevich, Dabla-Norris and Khalid, 2020).

PUBLIC SECTOR ECONOMICS
45(4) 517-541 (2021)

FIGURE 2

Income composition under different protection schemes



Source: Authors' estimations based on ECV data.

The impact of RMI and IMV can be appreciated in deciles from 0 to 3 where there is a higher concentration of public transfers in comparison with NLIB. For the IMV scheme, public transfers represent a higher percentage of income than for RMI. Transfers fall below 20% of total income after deciles 2, 4 and 6 in the NLIB, RMI and IMV simulations.

4.2 STRESSING INCOMES

To simulate the impact of the COVID-19 crisis on household income and the resulting evolution of inequality, poverty and minimum income guarantee schemes I stress at-risk incomes following Lustig et al. (2020). Table 2 shows the range of possible income losses when I increase the share of households that lose their at-risk income and the share of income lost for those households.

Cells in table 2 show the range of possible per capita household gross income losses (as a proportion of ex ante gross income) as we vary both the probability that households lose at-risk income (down the rows) and the share of that at-risk income they lose (across the columns). I vary both parameters from 0 to 100%. The possible outcomes represent the variation of total per capita income; they range from near zero to almost 15% of pre-crisis income.

For example, the 10%-10% cell of this matrix shows the fall in income corresponding to the case in which 10% of the households (with at risk income) lose 10% of their income each; that cell corresponds with a 0.2% decrease in per capita gross income.

TABLE 2

Scenarios for income losses as a percentage of total household income

		% of at-risk income lost									
		10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
% of at-risk households losing income	10	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5
	20	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
	30	0.5	0.9	1.4	1.9	2.4	2.8	3.3	3.8	4.2	4.7
	40	0.6	1.2	1.9	2.5	3.1	3.7	4.3	4.9	5.6	6.2
	50	0.8	1.5	2.3	3.1	3.9	4.6	5.4	6.2	6.9	7.7
	60	0.9	1.8	2.8	3.7	4.6	5.5	6.4	7.4	8.3	9.2
	70	1.1	2.1	3.2	4.3	5.3	6.4	7.5	8.5	9.6	10.7
	80	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0
	90	1.3	2.7	4.0	5.4	6.7	8.1	9.4	10.7	12.1	13.4
	100	1.5	3.0	4.4	5.9	7.4	8.9	10.4	11.8	13.3	14.8

Source: Author's estimations based on ECV data.

I narrow the focus of the article on those cells that have income losses similar to Spain's GDP contraction in the year 2020 (-10.8%). I have highlighted them in table 2. They form an "iso-loss" curve that runs diagonally through the table. I choose the two results where either the smallest proportion of households lose much income (upper right, 90% of at-risk income lost for 80% of the households

with at-risk income), or the largest proportion of households lose smaller amounts of income (lower left, 80% of at-risk income lost for 90% of the households with at-risk income).

I will refer to them as the "concentrated" and "dispersed" losses scenarios. My analysis is focused on those two scenarios for the three different protection schemes already explained. The matrix in table 3 summarizes the contraction scenarios and protection schemes under which I present the results in this section.

Table 3

Low-income protection schemes and income contraction scenarios

	Income contraction scenarios	
Low-income protection schemes	Concentrated losses under NLIB	Dispersed losses under NLIB
	Concentrated losses under RMI	Dispersed losses under RMI
	Concentrated losses under IMV	Dispersed losses under IMV

4.3 IMPACT ON POVERTY AND INEQUALITY

Tables 4 and 5 show the incidence on poverty of concentrated and dispersed losses scenarios using four poverty thresholds: the US $1.9, $3.2 and $5.5 a day international poverty lines (in 2011 purchasing power parity), as well as for the national poverty rate. National poverty rate line is defined as the percentage individuals living below 60% of the median income. I test the evolution of those magnitudes both for the concentrated and dispersed losses scenarios under the three aforementioned protection mechanisms.

Table 4

Concentrated losses scenarios, incidence on different poverty lines (percentage of population living under each line)

	Concentrated losses (90-80)			
NUBI	**Pre-COVID**	**Post-COVID**	**Change**	**New poor**
1.9 $ / day	0.75	0.89	0.14	67,682
3.2 $ / day	0.80	1.01	0.21	101,286
5.5 $ / day	0.86	1.19	0.34	159,502
National poverty line	6.70	8.06	1.36	643,688
RMI	**Pre-COVID**	**Post-COVID**	**Change**	**New poor**
1.9 $ / day	0.43	0.56	0.13	61,529
3.2 $ / day	0.46	0.65	0.19	88,507
5.5 $ / day	0.48	0.80	0.32	152,876
National poverty line	6.49	8.01	1.52	719,416
RMV				
1.9 $ / day	0.45	0.53	0.08	37,391
3.2 $ / day	0.49	0.58	0.09	42,124
5.5 $ / day	0.51	0.67	0.16	74,781
National poverty line	6.18	7.69	1.51	716,103

Source: Author's estimations based on ECV data.

Table 5

Dispersed losses scenarios, incidence on different poverty lines (percentage of population living under each line)

	Dispersed losses (80-90)			
NUBI	**Pre-COVID**	**Post-COVID**	**Change**	**New poor**
1.9 $ / day	0.75	0.85	0.10	48,750
3.2 $ / day	0.80	0.93	0.13	59,162
5.5 $ / day	0.86	1.02	0.16	74,781
National poverty line	6.70	8.13	1.43	678,712
RMI				
1.9 $ / day	0.43	0.53	0.11	50,643
3.2 $ / day	0.46	0.58	0.12	58,689
5.5 $ / day	0.48	0.64	0.16	77,621
National poverty line	6.49	8.08	1.59	753,493
RMV				
1.9 $ / day	0.45	0.50	0.05	22,245
3.2 $ / day	0.49	0.55	0.06	29,345
5.5 $ / day	0.51	0.58	0.08	35,497
National poverty line	6.18	7.76	1.58	747,814

Source: Author's estimations based on ECV data.

Absolute poverty rates are higher for concentrated than for dispersed losses under the three protection schemes. For the RMI scheme, poverty rates range from 0.56% of the population for the $1.9 a day line to 0.8% at $5.5 a day. For dispersed losses, those same rates are 0.53% and 0.67%. Similar patterns can be observed for the NLIB and IMV cases, with higher poverty rates for the concentrated losses scenario. Poverty rates under the national poverty line show a similar behavior for concentrated and dispersed losses scenarios.

RMI and IMV reduce poverty significantly compared to the absence of any minimum income guarantee scheme. For the RMI scheme under the concentrated losses simulation, the number of new poor individuals would be 61,529 for the $1.9 line. There would be 37,391 new individuals falling behind that same poverty line under the IMV scheme.

IMV shows a better performance than RMI under all simulations. This suggests that the changes in eligibility conditions and amounts generated by the centralization of the benefit improve aggregate results. Poverty increase is lower without any protection than under the RMI scheme for the national poverty line, as well. This counterintuitive result can be explained by the fact that many households may not get access to the benefit due to non-income related conditions (potential beneficiaries must prove they have applied and been rejected for all possible benefits before asking for IMV or RMI) or do not even apply for it, due to the disincentives generated by the bureaucratic costs attached to the whole process (Ayala et al., 2021; Natili, 2018) or the impossibility of gathering all the necessary documents.

Inequality, measured through the Gini Index, shows a better performance under IMV than under RMI for the three protection schemes. Table 6 shows that Gini Index rises from 0.45 before the COVID-19 shock to 0.51 under RMI, for concentrated losses, and to 0.493, for dispersed losses. For the IMV protection, Gini varies from 0.434 to 0.494 in the concentrated losses and to 0.477 for dispersed losses simulation, before and after the income shock.

Inequality is much higher under NLIB simulations. Gini Index would rise from 0.498 for pre-crisis income to 0.550-0.567 for the dispersed or concentrated losses post-crisis scenarios. These results are consistent with (Gomez-Bengoechea and Quan, 2019) for gross income, which coincide with those found by (del Valle Navas and de la Cruz, 2018) as well. Different methodological approaches make direct comparison with other available estimations non-informative. Further results on the Gini Index evolution under the different income-stress simulations can be found in figure 4 in the appendix section.

Table 6

Gini Index for concentrated and dispersed losses under different protection schemes

	Concentrated losses		
	Ex ante	**Ex post**	**% change**
NUBI	0.498	0.567	13.9
RMI	0.450	0.510	13.3
RMV	0.434	0.494	13.9
	Dispersed losses		
NUBI	0.498	0.550	10.5
RMI	0.450	0.493	9.6
RMV	0.434	0.477	10.0

Source: Authors' estimations based on ECV data.

4.4 IMPACT ON INCOME DISTRIBUTION

Figure 3 shows income evolution for each decile of the income distribution relative to gross income. Four big conclusions can be derived from it. The first one is that all individuals are worse off after the impact of the crisis for every decile, even if losses are not uniformly distributed through the entire distribution.

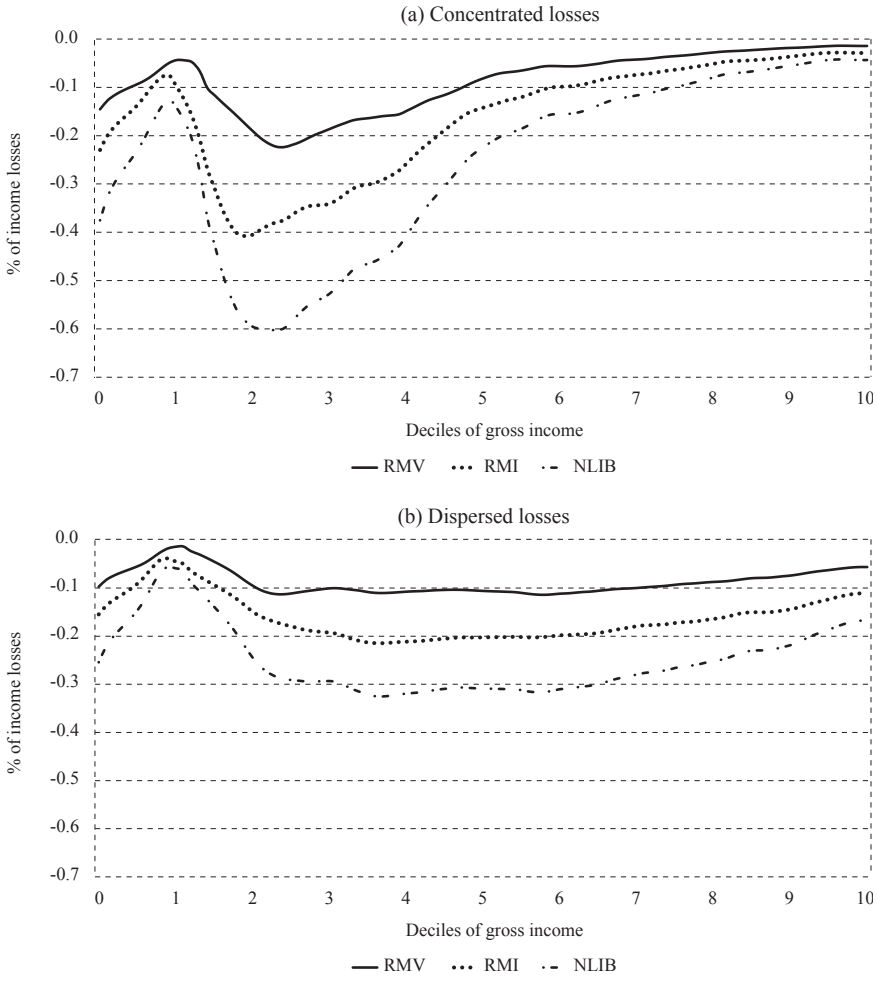
The second one is that income losses are much larger under the concentrated losses scenario. Income evolution captured in figure 3(a) shows that there is a group of individuals below decile 1 that do not get any benefit for different reasons, as already mentioned. For them, losses range from 15% to 40% on the three low-income protection schemes.

Around decile 1, income losses recover to 10% thanks to the role of public transfers and other social measures to alleviate income losses. Largest income falls can be found between decile 1 and decile 5. For those individuals, income contraction

would be between 40% and 20% under the RMI and IMV schemes. In the NLIB scenario, income would be reduced by 60% for individuals between decile 2 and 3. After decile 5, losses would moderate and almost converge beyond decile 9 under the three protection scenarios.

FIGURE 3

Incidence curves for at-risk incomes



Source: Author's estimations based on ECV data.

The third conclusion is derived from the dispersed losses simulation; income reduction is less profound and more evenly distributed. Under the NLIB scheme, income falls around 30% from decile 2 to decile 7. This contraction is half of the reduction experienced under concentrated losses. Both simulations show a similar evolution for the first deciles (0 to 2), but the reduction in losses recovers faster under the concentrated losses scenario.

Finally, results show that low-income benefits limit income losses. IMV is more effective than RMI but, in both cases, they curb the impact of income losses for potential beneficiaries. The relative homogeneity of at-risk and safe incomes for the entire distribution and the fact that contributory pensions and salaries earned in the public sector are spread along the entire income distribution explain the similar decrease in income for middle- and high-income groups. Results show a relatively small impact on high-skilled white-collar workers' that can better adapt to lockdowns through online work (Belzunegui-Eraso and Erro-Garcés, 2020), and whose income is in deciles 8 and 9 (see table A3 in the appendix).

From the point of view of income mobility between social groups, post-shock income evolution offers interesting results as well. Table 7 shows the downward mobility of high and middle classes caused by the COVID-19 crisis. Income groups are defined as follows: poor individuals are those living below $5.50 per day. Middle class captures income between $5.50 and $57.60 per day. High income is established above the $57.60 per day threshold. This identification strategy has been established following Lustig et al. (2020) criteria.

Almost 6% of high-income individuals would fall into the middle class in the concentrated losses scenario. 2%, 1.2% and 0.8% of individuals would decline from middle class to poverty under the three protection schemes considered. For dispersed losses, downward mobility is much lower: around 3.5% of individuals would move from high to middle income groups, and 1%, 0.6% and 0.4% would do it from middle to low income.

Table 7

Income mobility by income group (in percent)

	Concentrated losses		Dispersed losses	
	From high to middle	From middle to poor	From high to middle	From middle to poor
NUBI	5.7	2.0	3.7	1.0
RMI	5.9	1.2	3.6	0.6
IMV	5.9	0.8	3.3	0.4

Source: Author's estimations based on ECV data.

5 DISCUSSION AND POLICY IMPLICATIONS

This article tackles the impact of the COVID crisis on income distribution and the role played by low-income benefits to curb inequality and poverty increases. Results contribute to the literature showing how income falls are not evenly distributed along the entire distribution and bring lessons that should be taken into account for an optimal design of low-income benefits. The first implication derived from the results obtained is that higher amounts and a centralized design of benefits could help to lower poverty rates and inequality, under certain conditions and with some limitations, as will be explained in the following lines. The different simulations have shown that IMV is more pro-poor and pro-equality than RMI and the NLIB benchmark scheme.

The second one is that higher benefits will not fix the problems for the middle classes by themselves. Even if the most affected income groups in the simulations are roughly in the middle and higher middle classes (deciles 2 to 7, approximately), the literature shows the role played by globalization (Asha, 2018; Milanovic, 2012) and mechanization on the stagnation of labor income in advanced countries; this is a problem area that seems to go beyond traditional fiscal policies.

Third, it is necessary to establish mechanisms that can ease and evenly share the income adjustments that future crises may bring. Income contraction derived from the impact of COVID generates more new poor individuals for the concentrated than for the dispersed losses scenario. Inequality shows a similar pattern; the dispersed losses scenario shows lower inequality increases. Labor market adjustment, through wages and not necessarily through firms' downsizing (Kahn, 2012), should help in that regard. Remote work programs, when possible, would also reduce impacts on income of future crises like the one analyzed in this article, as the evolution and composition of incomes for the latest deciles suggests.

Finally, more than 60% of Spanish income depends on the public sector in one way or another. The public sector, through transfers, contributory pensions, and salaries generates around 40% of total income for deciles 2 to 8. At the same time, income composition reveals that at-risk income (thus, potentially in need of public help), represents around 30% of total income for deciles 3 to 10.

The original budget for the IMV program was 2,890 million euros for the year 2021 (AIREF, 2020). Results suggest an increase of its cost derived from the new poor individuals under the national poverty line (which is used as a reference for the IMV program) between 24.4% for the concentrated and 25.6% for the dispersed losses scenarios. The total cost of the IMV program would rise to 3,628 million euros for the concentrated losses scenario and to 3,594 million euros for the dispersed losses scenario. This extra pressure on public finance, also coming from other social programs, may require from tax rises that they maintain low-income protection policies in a context of weak revenues.

As a consequence of the previous implications, an improvement of the current design of low-income benefits in Spain would require, first, the same eligibility conditions and minimum benefit amounts at the national level, as in the IMV scheme. However, the particularities documented in the literature (see Gómez-Bengoechea, 2020; and del Valle Navas and de la Cruz, 2018) suggest the necessity of adapting the conditionality on income thresholds and on the amount of the benefit to each region's circumstances.

Some of the left-behind individuals fall below the means-tested conditions established for receiving low-income benefits, but do not get access to it due to bureaucratic costs, information barriers and other formal reasons. Without a careful policy implementation, increasing amounts may even generate higher inequality. It is

critical to make those benefits available for those individuals in need that do not receive the benefit (Ayala et al., 2021; Natili, 2018). A simplification of the bureaucratic process, the use of municipal agencies by the central government to reach potential beneficiaries and the establishment of offices to manage the submission and approval of applications for benefits would help in that regard.

6 CONCLUSIONS

The impact of COVID-19 on the whole world has been dramatic, both in terms of lives taken and income losses. Countries with a more developed welfare state should be able to cope better with this extreme situation through their structural and ad-hoc policies.

The case of Spain is a paradigmatic one for the study of this problematic. The recent approval of the IMV (a means-tested national transfer paid to lowest incomes) allows me to test its role on smoothing the impact of the crisis and its performance relative to previously existing RMI (like IMV, but at the regional level) and to the hypothetical absence of any minimum income state protection schemes.

Results show that the worst effects of the COVID-19 crisis and the potential lockdowns it could still bring are not on the poorest, but those in the middle and wealthy groups of the ex-ante income distribution. Under all microsimulations, IMV is more efficient in curbing poverty and inequality than RMI. Without any of these protection policies, inequality and poverty rates would be higher.

The paper has some caveats that should be tackled in the upcoming research on this topic. First, as has been mentioned, the microsimulations do not take into account behavioral responses or general equilibrium effects, so they yield first-order effects only. Second, the depth and duration of the crisis is still uncertain. Third, results depend on the specific assumptions we make about income sources that are "at risk" and the extent to which losses are concentrated or dispersed across households. Fourth, I am assuming that all individuals fulfilling the conditions to get the benefits are, in fact, receiving them. This is a limitation common to this kind of literature. Finally, I focus my analysis at the national level; regional and local differences could also be exploited in future articles.

The challenge for the Spanish state is twofold. First, it needs to fine tune IMV performance and design; preliminary government data show that the number of recipients is well below initial projections. Second, it may be necessary to raise taxes and to reduce expenditure under other policies to maintain protection schemes in the context of lower public revenues. Furthermore, low productivity and the current demographic dynamic could trigger an austerity debate in the aftermath of the COVID-19 crisis.

Disclosure statement

No potential conflict of interest was reported by the author.

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APPENDIX

TABLE A1

Gini Index, poverty rates and social spending

Country	Gini Index	Poverty rates	Social spending (% of GDP)
Austria	0.28	9.4	26.9
Belgium	0.26	8.2	28.9
Canada	0.30	11.8	18.0
Chile	0.46	16.5	11.4
Czech Republic	0.25	6.1	19.2
Costa Rica	0.50	19.9	12.2
Denmark	0.26	6.1	28.3
Germany	0.29	10.4	25.9
Estonia	0.31	16.3	17.7
Finland	0.27	6.5	29.1
France	0.30	8.5	31.0
Great Britain	0.37	11.7	20.6
Greece	0.31	12.1	24.0
Hungary	0.29	8.0	18.1
Ireland	0.29	9.0	13.4
Israel	0.25	16.9	16.3
Italy	0.33	13.9	28.2
Latvia	0.34	17.5	16.4
Lithuania	0.36	15.5	16.7
Luxembourg	0.32	11.4	21.6
Mexico	0.42	16.6	7.5
Netherlands	0.29	8.3	16.1
Norway	0.26	8.4	25.3
Poland	0.28	9.8	21.3
Portugal	0.32	10.4	22.6
Slovakia	0.24	7.7	17.7
Slovenia	0.25	7.5	21.1
South Korea	0.35	16.7	12.2
Spain	0.33	14.2	24.7
Sweden	0.28	8.9	25.5
Switzerland	0.30	9.2	16.7
United States	0.39	17.8	18.7

Note: OECD Countries, 2019 or latest year with available data.

Source: Author's estimations based on OECD statistics.

Table A2

Minimum and maximum benefit amounts: RMI regional and IMV national low income protection schemes (in €)

Protection scheme and region	Min. benefit amount	Max. benefit amount
RMI Andalucía	5,287.44	4,541.88
RMI Aragón	5,892.00	5,892.00
RMI Asturias	5,315.52	3,455.04
RMI Baleares	5,178.36	4,140.60
RMI Canarias	5,745.24	2,267.76
RMI Cantabria	5,163.24	2,904.36
RMI Castilla – La Mancha	5,357.40	4,079.76
RMI Castilla y León	5,168.40	3,221.88
RMI Cataluña	7,248.00	6,216.00
RMI Ceuta	3,600.00	1,440.00
RMI Extremadura	5,163.24	3,549.73
RMI Galicia	5,084.16	4,067.28
RMI La Rioja	5,163.24	2,904.36
RMI Madrid	4,800.00	5,722.20
RMI Melilla	5,503.68	3,669.12
RMI Murcia	5,163.24	4,517.88
RMI Navarra	7,329.60	7,329.60
RMI Valencia	3,090.84	6,623.04
RMI País Vasco	7,733.88	4,130.64
IMV National	5,544.00	6,636.00

Source: Author's estimations based on ECV data.

Table A3

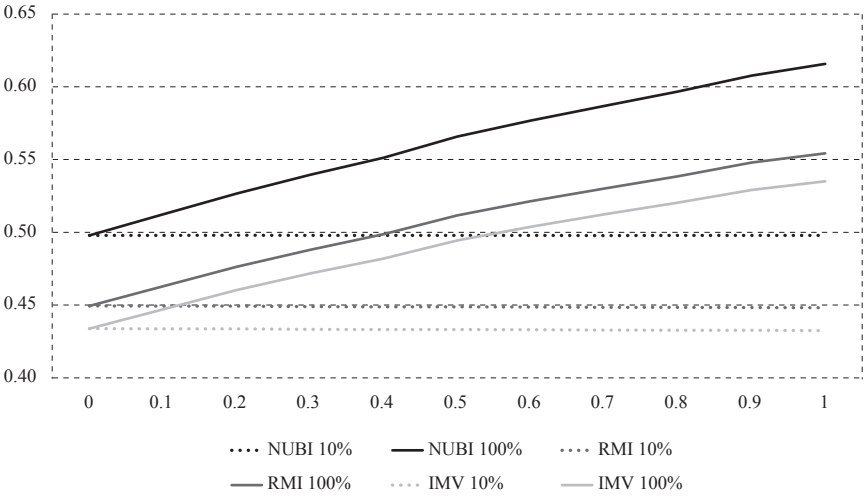
Percentage of individuals in each economic sector per decile of ex-ante gross income per capita

Economic sector	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Agriculture	13.2	13.4	16.0	11.2	6.3	3.8	3.2	2.8	1.8	0.7
Arts & education	7.9	9.1	5.5	5.3	5.3	6.8	8.3	10.8	11.7	14.1
Construction	5.3	7.7	7.8	7.8	8.8	7.9	6.8	5.2	6.3	4.2
Financial services	2.6	0.5	1.2	0.7	1.1	1.2	1.3	2.7	3.1	5.9
Hospitality	13.2	7.2	11.9	9.5	10.6	8.1	6.8	6.3	5.2	2.8
Industrial production	5.3	4.3	4.6	6.4	6.8	7.8	6.9	7.6	7.0	6.2
Manufacturing	0.0	9.6	8.2	10.5	12.8	15.3	12.8	15.7	16.8	15.0
Other professional activities	28.9	28.2	27.1	27.5	26.8	29.6	31.4	29.6	29.9	33.7
Real-estate	0.0	0.0	0.2	0.6	1.0	0.7	0.5	0.7	0.6	1.0
Retail	21.1	17.7	15.1	16.6	16.7	14.8	17.8	13.2	12.8	10.3

Source: Author's estimations based on ECV data.

FIGURE A1

Gini Index for 10% and 100% of households losing from 0% to 100% of at-risk income



Source: Author's estimations based on ECV data.

Asymmetric effect of government debt on GDP growth: evidence from Namibia

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PUBLIC SECTOR ECONOMICS
45(4) 543-558 (2021)

Abstract

This study investigates the asymmetric relationship between government debt and GDP growth in Namibia. The study applied the non-linear autoregressive distributed lag (NARDL) methods to determine the asymmetrical effect of government debt on GDP growth. The estimated long-run parameters for positive and negative shocks of government debt are -0.104 and -0.738, respectively. The results suggest that a 1% increase in debt will be followed by a 0.104 decrease in GDP growth and that a 1% decrease in debt will produce a 0.738 increase in economic growth. This shows that the responsiveness of GDP growth to positive values of debt is different to that of negative values of debt. The responsiveness of GDP growth to negative values of debt is greater than to positive value of debt. This implies that it is important for Namibia to have manageable debt and fiscal sustainability in order to increase its GDP growth.

Keywords: government debt, economic growth, nonlinear, fiscal policy, Namibia

1 INTRODUCTION

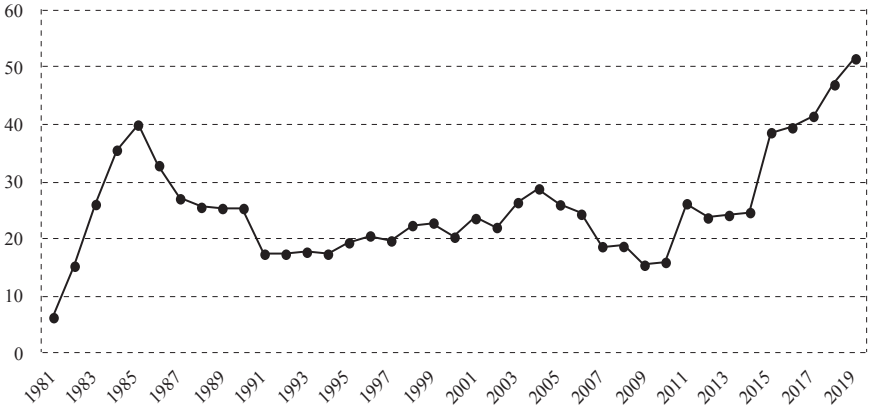
The term government debt can be described as how much a particular country owes to lenders outside of itself. These lenders may include private individuals, businesses, institutions, and even other governments. The term "government debt" in the literature is often used interchangeably with the term sovereign debt or public debt (Amadeo, 2020). The literature widely acknowledges that there are a number of channels through which public debt is likely to hamper long term economic growth. Channels through which government debt have an impact on economic growth are saving and investment, total factor productivity and interest rate. According to Checherita-Westphal and Rother (2011) the crucial channel through which government debt accumulation can affect growth is that of long-term interest rates. Higher long-term interest rates emanating from more debt-financed government budget deficits, can crowd out private investment, thus dampening potential output growth. This is stated by Égert (2012) who argued that the increase in taxation needed to service a higher government debt crowds out private investment through reduction of disposable income and saving and a rise in the distortionary costs of taxation. The other channel is the aftermath of high government debt to GDP ratio. This ratio of debt has often given rise to fears that the government will cancel its debt by printing more money to produce hyperinflation. However, it is clear from theoretical and empirical literature that this form of financing produces a decrease in the purchasing power of the domestic currency. Furthermore, borrowing or financing of government debt by means of printing money is not an option for the Namibian economy because the country has chosen to link its currency to the South Africa rand. According to Sherbourne, Nampila and du Preez (2002), this is within the framework of the Common Monetary Area (CMA).

Namibia's government debt has increased at a faster rate than GDP growth since its independence in 1990. In the year 2002, the Government of Namibia stipulated in

its National Development Plan (NDP) II and the Medium Term Expenditure Framework (MTEF) that government debt to GDP ratio should not exceed 25%. Figure 1 presents the trends in government debt of Namibia for the period 1981 to 2019.

Figure 1

Namibian government debt as a percentage of GDP, 1981-2019



Source: Own compilation using data from IMF.

Figure 1 shows that government debt increased sharply between 1980 and 1985. It reached a peak of 40% in 1985. It then decreased to 17.4% in 1991. Furthermore, figure 1 shows that government debt as percent of GDP steadily increased from 17% in 1993 to 28.4% in 2005. The debt ceiling of 25% to GDP as outlined in NDP II and MTEF was relaxed in order to take account of the development needs of the country. In 2005 the government of Namibia approved the Sovereign Debt Management Strategy (SDMS), which was aimed at curbing borrowing and ensuring that the debt ratio does not exceed 35% of GDP (AEO, 2012). The SDMS seems to have been successful in reducing government debt, for it fell from 28.8% in 2005 to 16.4% of GDP in 2010. The effect of SDMS in reducing government debt was negated by the effect of the global economic and financial crisis of 2009. The ratio of government debt to GDP increased rapidly from 16.4% in 2010 to 51.5% in 2019. According to ECORYS (2018) this sudden increase in public debt brought with it substantial increases in the cost of debt service, which is currently putting severe pressure on the government's budget. The growth in government debt shrinks the little surplus public debt capacity, and this raised concern that the government may not be in a position to stimulate growth through fiscal expansion (Deloitte, 2019). As expected, the interest payments have also increased due to increased government debt. Interest payment has increased significantly from 7% of total expenditure in 2015 to 14% in 2017 (ECORYS, 2018). Government debt is one of the critical components of growth effect in the long-run for Namibia.

Previous studies (such as Amwaama, 2018; Zaaruka, 2007; and Kaakunga, 2006) that investigated the role of government debt on economic growth in Namibia assumed a linear relationship between variables. They did not test the nonlinear

PUBLIC SECTOR ECONOMICS
45(4) 543-558 (2021)

relationship between government debt and economic growth in Namibia. Empirical studies on the nonlinear relationship between government debt and economic growth in Namibia are limited or nonexistent. Modelling the relationship between economic growth and government debt through the assumption of linearity might lead to biased results. This might lead to wrong inferences being made from the results. Hence, it important to test the nonlinear relationship between government debt and economic growth. Therefore, the objective of this study is to estimate the asymmetric relationship between government debt and GDP growth in Namibia. The study uses nonlinear autoregressive distributive lag (NARDL) for this purpose. This is contrary to previous studies conducted on Namibia. The NARDL approach also allows for testing whether government debt changes have symmetric or asymmetric effects on economic growth. In order to understand the nexus between government debt and GDP growth, two issues are addressed in this paper. The first one is whether the relationship between government debt and economic growth in Namibia is symmetrical or asymmetrical. The second is the responsiveness of GDP growth to positive and negative effects of government debt. The rest of the study is organized as follows. Section 2 presents a review of the literature. Section 3 discusses the empirical model, data and estimation technique. Section 4 presents estimation results. Section 5 concludes the paper.

2 LITERATURE REVIEW

There is an extensive literature on the relationship between government debt and economic growth. The relationship between these two variables has been investigated in both developed and developing countries. There are cross section or panel data studies on the relationship between government debt and economic growth in both developed and developing countries. Eberhardt and Presbitero (2015) investigated the relationship between government debt and economic growth in a panel of 118 developing, emerging and advanced economies over the period 1960 to 2012. The study found that the relationship between the two variables is negative. Bilan and Ihnatov (2015) examined the effect of government debt on economic growth for 28 European Union (EU) member states during the period 1990-2011. The study used a non-linear (quadratic) model. The study established that there is an ”inverted U” relationship between public debt and economic growth, with a maximum debt threshold of about 94% of GDP for the whole group of 28 European Union member states.

Reihnart and Rogoff (2010a; 2010b) investigated the relationship between debt and real GDP growth in 44 countries for a period of 200 years. The study used a dataset which has 3,700 observations. The period of estimation has different political systems. exchange rate arrangements, historical circumstances and institutions. The study finds that the relationship between debt and real GDP growth depends on the level of debt to GDP ratio. When debt to GDP ratio is below 90 percent, the relationship between debt and GDP growth is very weak. However, when debt to GDP ratio is more than 90 percent, the relationship becomes negative. This means that an increase in debt will cause real GDP growth to decrease. This is for advanced economies. Emerging economies have a threshold lower than

PUBLIC SECTOR ECONOMICS 45(4) 543-558 (2021)

that of advanced economies. The threshold for emerging economies is at 60 percent. The results indicate that for emerging economies, when debt to GDP ratio is above 60 percent, the relationship between the two variables is negative. At a debt to GDP ratio of above 60 percent, real GDP growth will be reduced by 2 percent. Reinhart and Rogoff (2011) investigated the relationship between economic growth and debt in advanced economies. Advanced economies have been experiencing a rise in debt since the period before the Second World War. Historical evidence suggests that a rise in debt is associated with low real GDP growth.

Hussain, Haque and Igwike (2015) examined the relationship between public debt and economic growth for 48 countries in Sub-Saharan Africa, using the dynamic Arellano-Bond panel data estimation for the period 1995 to 2012. The study found that there is a negative correlation between government debt and economic growth. There are also single country studies on the effect of government debt on economic growth in both developed, emerging and developing countries. For example, Misztal (2010) used an vector autoregression (VAR) model for individual countries in the EU for the period 2000-2010. The results indicate that the impact of public debt on economic growth is significantly different in the individual EU member countries. In some countries there is a negative and in others an insignificant relationship between the two variables. Checherita-Westphal and Rother (2011) examined the relationship between the two variables for 12 euro area countries using 2-stage least squares. The results show that a public debt threshold of 90-100% of GDP is an average for those euro countries.

Burhanudin et al. (2017) found that there is no evidence to conclude that the level of government debt had any adverse impacts on sustainable economic growth in Malaysia. However, Abd Rahman (2012) used quarterly data for the period 2000 to 2011. The results indicate that high domestic debt does have negative impact on economic growth in the long-run. Baaziz et al. (2015) examined the relationship between inflation rate, trade openness, public debt and real GDP in South Africa using a nonlinear smooth transition regression (STR) model. The results revealed that government debt becomes adverse to economic growth when it reaches the limit of 31.37% of GDP. Using the ADL test for threshold cointegration Cai (2017) shows that cutting public debt could obviously benefit China's economic growth in the long run. Pegkas (2018) examines the effect of public debt on economic growth in Greece. The results reveal that public debt has a negative impact on economic growth and that above the threshold of 105% of debt to GDP, the effect becomes more significantly negative. The empirical literature modelled the relationship between GDP growth and debt, showing that there is a direct relationship between debt and GDP growth. Although there could be channels through which debt impacts GDP growth, the empirical literature suggests a direct relationship between the two variables.

Despite the fact that public debt is one of the important variables in the determination of economic growth for most economies, empirical studies on Namibia are limited. However, there are five studies on the relationship between public debt and economic growth in Namibia. Sherbourne, Nampila and du Preez (2002) is

PUBLIC SECTOR ECONOMICS
45(4) 543-558 (2021)

the first empirical study that assessed fiscal policy trends for the period 1992/93 to 2001/02. It then analysed the sustainability of the government's current fiscal path. It concludes that the government in Namibia generally borrows because of difficulties in forecasting cash flows. Increasing public debt through borrowing enables the government to finance its expenditure. Zaaruka, Ndove and Tjipe (2004) was the second study to investigate whether the behavior of debt in Namibia is consistent with fiscal sustainability. It revealed that the Namibian government may find it difficult to service its debt in the near future. Therefore, it urged that government should try to remain below the targeted limits of public debt in order to leave room to maneuver in difficult times. Kaanguga (2006), the third study investigated the impact of fiscal policy on economic growth. The study used a simple Engle-Granger method to investigate the role of government on the economy. The findings of the study are that there is a negative relationship between fiscal deficit, total public debt and growth. The fourth study was that of Zaaruka (2007) who assessed the role of the threshold effect of public debt on economic growth in Namibia. The paper used linear and nonlinear regression to determine the threshold relationship between public debt and economic growth and the results indicate the threshold level for public debt to have an effect on economic growth is about 38%. Nakale, Sikanda and Mabuku (2015) evaluated growth determinants in Namibia applying the framework of growth accounting. The study indicated that fiscal reforms must be enforced to address the high level of government expenditure and debt, which can pose a threat to macroeconomic stability. Amwaama (2018) assessed the relationship between budget deficit and economic growth in Namibia. The paper employs the Auto Regressive Distributed Lag (ARDL) bounds test and used quarterly data spanning from 1993Q4 to 2015Q5. The results indicate that budget deficit negatively affects growth rate in both the short and the long run. This study differs from previous research conducted on the relationship between government debt and economic growth in Namibia. The current study makes its contribution in the following ways. Firstly, it applies current robust econometric methods to investigate the relationship between government debt and GDP growth in order to make informed policy recommendations. This approach is different from the study by Sherbourne, Nampila and du Perez (2002) and Nakale, Sikanda and Mabuku (2015), which were much more interested in analyzing the trends of fiscal sustainability in Namibia and did not apply robust econometric methods. Secondly, it investigates non-linearity between variables before applying any non-linear technique such as regression or NARDL. Such an approach is critical in ensuring that there is no wrong model specification. Zaaruka (2007) applied non-linear regression to investigate the relationship between fiscal policy (debt) and economic growth. However, the study failed to first test the presence on non-linearity among the variables. It also did not apply recent non-linear unit root tests to determine the order of integration. Such an approach may lead to inappropriate results. This current study, therefore fills the gaps and address the shortcomings of previous studies by assessing the effect of negative and positive values of government debt on GDP growth, which are assumed to be nonlinear in nature.

3 METHODOLOGY

3.1 EMPIRICAL MODEL

Following a review of the empirical literature, this paper adopts and modifies the empirical model that was applied by Amwaama (2018). The empirical model is written as follows:

$$GDP_t = f(DBT_t, LARG_t) \quad (1)$$

Where GDP_t, DBT_t and $LARG_t$ are gross domestic product, total government debt and share of agriculture in the economy. Equation (1) is transformed into natural logarithms as follows:

$$LGDP_t = a_1 + \beta_1 LDBT_t + \beta_2 LARG_t + \pi_t \quad (2)$$

Where π_t represents residuals, and all other variables are as previously defined. Economic theory suggests that as government debt rises, it increases the burden for the government of servicing the national debt. This will, in the long-run, reduce the available fiscal resources, which will ultimately reduce GDP growth prospects. Therefore the effect of government debt on GDP growth is expected to be negative. There is an expected positive relationship between the share of agriculture in the economy and economic growth. It is expected that as the agricultural share increases (especially for food importing countries such Namibia) it will strengthen domestic supply of food, which will ultimately increase income through a rise in consumption.

3.2 DATA

The study uses annual data and covers the period of 1980 to 2019. The data were collected from various sources in order to estimate equation (2). The estimation period is selected based on the availability of data. Economic growth (GDP) is proxied by percentage change in GDP at constant prices. The share of agriculture (AGRIC) is proxied by the share of agriculture, fishery and forestry in GDP, and the data for this variable was collected from the World Bank's World Development Indicators (WDI). The data for debt to GDP ratio (DBT) was sourced from the Ministry of Finance of Namibia.

3.3 ESTIMATION TECHNIQUE

This study applies the nonlinear autoregressive distributive lag model (NARDL) in order to investigate whether there is an asymmetric relationship between government debt and GDP growth in Namibia. The study follows Shin, Yu and Greenwood-Nimmo (2014) who developed the NARDL model where the variables in the equation (government debt and agriculture value added) can be decomposed into negative and positive partial sums. Therefore, equation (2) is specified in nonlinear form as follows:

PUBLIC SECTOR ECONOMICS
45(4) 543-558 (2021)

$$\Delta LGDP_t = \alpha_0 + \beta_1 LGDP_{t-1} + \gamma_1^- LDBT_{t-1}^- + \gamma_2^+ LDBT_{t-1}^+ + y_3 LARG_{t-1} + \gamma_5^- + \sum_{i=1}^{p-1} \theta_i \Delta LGDP_{t-i} + \sum_{i=0}^{q} \pi_1^+ \Delta LDBT_{t-i}^+ + \sum_{i=0}^{q} \pi_2^- \Delta LDBT_{t-i}^- + \sum_{i=0}^{q} \pi_3 \Delta LARG_{t-i} + \mu_t \quad (3)$$

Where q and p are lag orders in equation (3) and long run coefficients are computed as $\beta_2 = \gamma^- / \beta_1$ and $\beta_3 = \gamma^+ / \beta_1$. In addition, $\sum_{i=0}^{q} \pi_i^+$ captures the short run impact of government debt increase on GDP growth, while $\sum_{i=0}^{q} \pi_i^-$ captures the short run impact of government debt reduction on GDP growth. To determine the long-run cointegration between government debt and GDP growth, this paper uses the stepwise OLS procedure to estimate equation (3) which uses a general-to-specific method. To estimate the model using NARDL, the study performs a test for long-run cointegration using the bounds testing approach (Pesaran, Shin and Smith, 2001). The null hypothesis states that the effect is symmetrical if $y_1 = y_2 = y_3 = 0$. This implies that there is no asymmetric cointegration. The alternative hypothesis states that the effect is asymmetrical if $y_1 \neq y_2 \neq y_3 \neq 0$. This suggest that there is asymmetric cointegration. Then the study applies Wald F-test statistics to determine if there is asymmetric cointegration between government debt and GDP growth in Namibia. However, before determining whether a long run relationship among the variables does exist, the study needs to investigate whether the variables in the study are suitable for nonlinear modelling. The study uses the test of Brock et al. (1996) or BDS for that purpose. The purpose of the test is to determine the null hypothesis of linearity in the model. The study follows Breitung (2002) and Bierens (1997) to test for the nonlinear unit root of the variables.

4 EMPIRICAL RESULTS

4.1 DESCRIPTIVE STATISTICS

Descriptive statistics are the first step in empirical analysis. Table 1 presents the descriptive statistics of the variables used in the study. The results show that on average GDP growth between the years 1980 to 2019 is 3.03%. On the other hand, government debt and the share of agriculture have the mean values of 21.18% and 20.45%, respectively.

Table 1
Descriptive statistics

	GDP	DBT	LARG
Mean	3.03	21.18	20.45
Maximum	12.26	40.00	20.88
Minimum	-1.82	3.00	20.10
Standard deviation	2.96	6.63	0.21

Source: Computed by the authors.

To extend on the preliminary analysis, this study also computed the Spearman pairwise correlations. The results are presented in table 2, which shows the

PUBLIC SECTOR ECONOMICS 45(4) 543-558 (2021)

coefficients and p-values for each pairwise variable. It indicates that there is a positive pairwise correlation between GDP growth and agricultural share with a coefficient of 0.54. However, there is a negative pairwise correlation between government debt and GDP growth with insignificant coefficient of 0.06.

Table 2

Pair-wise correlation matrix

Correlation (probability)	GDP	DBT	LARG
GDP	1.00 –		
DBT	-0.06 (0.68)	1.00 –	
LARG	0.54 (0.00)	0.05 (0.77)	1.00 –

Note: p-values are in brackets.

Source: Computed by the authors.

4.2 NONLINEARITY TEST

Since the objective of this study is to determine the asymmetric relationship between government debt and economic growth in Namibia, it is important to investigate nonlinearity among the variables. The study used the commonly known test of BDS to investigate the nonlinearity in the variables. The results are presented in table 3. Table 3 shows that the null hypothesis of linearity is rejected. It is rejected in favour of nonlinearity. The results imply a non-normal distribution of the variables, which gives some evidence of nonlinearity.

Table 3

BDS test for nonlinearity

Variable	Dimension	BDS statistics
LGDP	2	0.188
	3	0.310
	4	0.390
	5	0.445
	6	0.480
DBT	2	0.144
	3	0.246
	4	0.323
	5	0.363
	6	0.383
LARG	2	0.124
	3	0.211
	4	0.261
	5	0.287
	6	0.297

Note: Probability for all dimensions is zero.

Source: Computed by the authors.

PUBLIC SECTOR ECONOMICS
45(4) 543-558 (2021)

The next step is to test for unit root in the variables. The study uses an unconventional test of unit root that is specifically suitable if the data depicts the non-normality over time. The study performs the test of nonlinear unit root using the Breitung and Bierens unit root tests. The results are presented in table 4.

Table 4
Nonlinear unit root test

Variables	Breitung test		Bierens test	
	t-statistics	p-values	Coefficient	t-statistics
LGDP	-0.386	0.200	-0.058	-0.110
LDBT	0.003	0.025	-0.263	-0.530
LARG	0.067	0.400	0.007	0.420

Source: Computed by the authors.

The results from the Breitung test indicates that LDBT is stationary at levels, but the levels in LGDP and LARG are nonstationary. This means that LGDP and LARG are integrated of order one. The results of the Bierens unit root test confirms that all variables are nonstationary in levels, which means that they have unit root. Therefore, the results of Bierens test confirm that all variables are integrated of order one $I(1)$ in the presence of nonlinearity. The next step is to determine the nonlinear ARDL cointegration among the variables.

This study applies the NARDL cointegration test on an unrestricted model. It uses the F-test on the joint hypothesis that the parameters of the lagged long run are jointly equal to zero. The results are presented in table 5. The results confirm statistically the evidence of long-run cointegration among the variables. The results indicate that the computed F-statistic of 13.513 is greater than the critical value of upper bound 5.61 at 1% significance level. The results imply that there is a long run relationship between government debt and GDP growth in Namibia.

Table 5
NARDL bounds cointegration results

Critical value (%)	Lower bound (0)	Upper bound I(1)
1	4.29	5.61
5	3.23	4.35
10	2.72	3.77
NARDL F-statistics	Wald F-stats – 13.513***	

*Notes: *** 1% significance level, **5% significance level, *10% significance level. Null hypothesis: no asymmetric cointegration. Alternative hypothesis: asymmetric cointegration.*

Rejection rule: reject null hypothesis if F-statistics is greater than the upper limit.

Source: Computed by the authors.

Since there is evidence of nonlinear cointegration, the next step is to present the long run parameters of NARDL regression. The results are presented in table 6. Empirically, the non-linear ARDL specification having lags 1, 3, 0, 2 are selected

based on the AIC. It shows that the decomposed positive effects of government debt (DBT_POS) are insignificant, whereas decomposed negative effects of government debt (DBT_NEG) are significant. The estimated long-run parameters for positive and negative shocks of government debt are -0.104 and -0.738, respectively. It is therefore clear from the results that the responsiveness of GDP growth to negative is stronger than to positive values of debt. The results show that a 1% increase in government debt will cause GDP growth to decrease by 0.104%, but this coefficient is statistically insignificant. A decrease in debt is associated with an increase in GDP growth by 0.738%. The results further show that there is a positive and significant effect of the share of agriculture on GDP growth. The results imply that a 1% increase in the agricultural share will result in an 18.4% increase in GDP growth. The estimated model has an acceptable adjusted R-squared value. After estimating the NARDL long run parameters, the study also estimates a short-run model and diagnostic tests were carried out to assess the robustness of the model. The short run results are presented in table 7.

Table 6

NARDL long-run parameter estimation

Exogenous variables	Parameters	p-values
DBT_POS	-0.104	0.557
DBT_NEG	-0.738	0.004***
LARG	18.456	0.000***
R-squared	0.638	
Adjusted R-squared	0.493	
Selected model: ARDL(1, 3, 0, 2)		

*Notes: *** 1% significance level, **5% significance level, *10% significance level. Dependent variable: D(GDP).*

Source: Computed by the authors.

Table 7 presents the short run and residual diagnostic results. The error correction term or Ect (-1) term determines the speed of adjustment to equilibrium. Table 7 shows that the coefficient of the error correct term is negative and statistically significant. It is greater than 1, which indicates that there is over-adjustment to equilibrium. Table 7 also indicates that the results passed diagnostic statistics. Furthermore, the study tested for the stability of the model estimated. The results in figure 2 shows that both the CUSUM and the CUSUM of squares confirm that the model is stable.

Table 7

Short run NARDL estimation

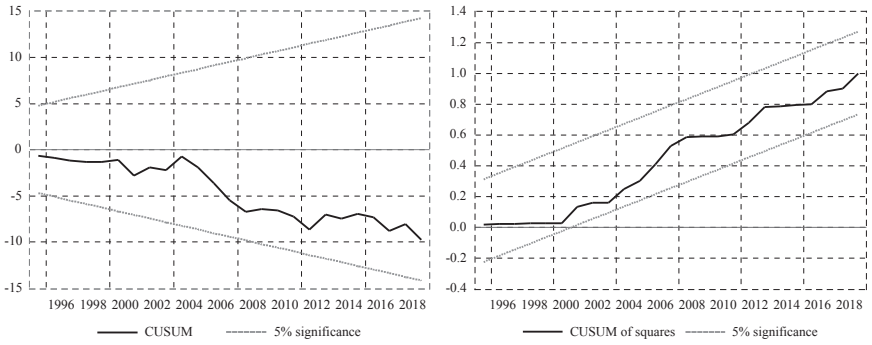
Exogenous variables	Parameters	p-values
C	-384.474	0.000**
@TREND	-0.950	0.000***
Δ (DBT_POS)	0.196	0.302
Δ (DBT_POS(-1)	-0.027	0.879
Δ (DBT_POS(-2)	0.672	0.000***
Δ (LARG)	11.351	0.002***
Δ (LARG(-1)	7.227	0.039**
Ect (-1)	-1.033	0.000***
R-squared	0.759	
Adjusted R-squared	0.699	
Heteroskedasticity Test: Breusch-Pagan-Godfrey		0.862 (0.435)
Jarque-Bera test		82.240 (0.000)
Breusch-Godfrey Serial Correlation LM Test		0.449 (0.906)

*Notes: *** 1% significance level, **5% significance level, *10% significance level. p-values are in brackets. Dependent Variable: D(GDP).*

Source: Computed by the authors.

Figure 2

Stability diagnostics



Source: Computed by the authors.

The study investigated further whether the coefficients in the long run and short run are symmetrical or asymmetrical. The results for an asymmetrical test are presented in table 8. It is evident from table 8 that decomposed positive and negative effects of government debt on GDP growth are significant at 1%. This implies that the study rejects the null hypothesis of no asymmetry. This suggests that there is inequality, and that the coefficients are not the same.

TABLE 8

Long-run and short run asymmetric test

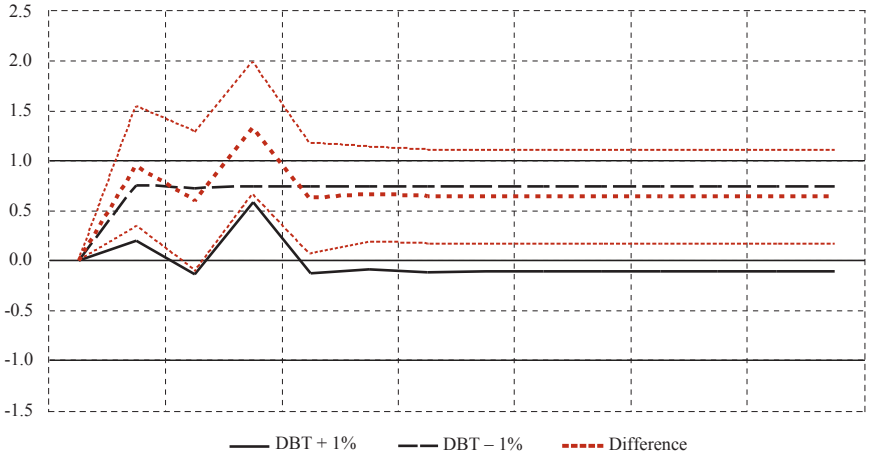
Asymmetric test	F-statistics	p-value
Long run $-\gamma_1^- / \beta_1 = -\gamma_2^+ / \beta_1$	7.011	0.0081***

*Note: *** 1% significance level, **5% significance level, *10% significance level.*

Source: Computed by the authors.

FIGURE 3

NARDL dynamic multiplier graph



Source: Computed by the authors.

Figure 3 presents the effect of the dynamic multiplier of negative and positive changes in government debt. The solid black line captures the positive changes, which means that it gives information about the asymmetric adjustment of GDP growth to positive government debt shock at a given time horizon. The dotted black line captures the negative changes, which means that it gives information about the asymmetric adjustment of GDP growth to negative government debt shock at a given time horizon. The red dotted line depicts the difference between positive and negative shocks. Figure 3 shows that that in the short run period positive shocks are unstable compared to negative shocks. However, these shocks do not last long and they become relatively stable throughout the period (in the long run). The results in figure 3 indicate that a reduction in government debt appears to have a larger impact on GDP growth in the long run than positive government debt shock.

5 CONCLUSION

The purpose of this study is to investigate the asymmetric effect of government debt on Namibian GDP growth. The study used annual data for the period 1980 to 2019 and applied nonlinear ARDL method for this purpose. The results indicate that negative values of government debt have a strong impact on GDP growth

compared to positive shocks or values. The results indicate than an increase in government debt is associated with a decrease in GDP growth. Decrease in government debt causes GDP growth to increase. The results suggest that Namibia's GDP growth responds significantly to a decrease in government debt. This is when it is compared to an increase in government debt. A reduction in government debt will therefore, result in a significant change in GDP growth in the long run. The results suggest that it is important for Namibia to keep its debt at manageable levels and achieve fiscal sustainability in order to accelerate GDP growth. Although there could be channels through which government debt impacts real GDP growth, the empirical literature suggests that there is direct causation between the two variables. Hence, this study focuses on the direct relationship between government debt and real GDP growth. An investigation of the channels through which government debt has an impact on GDP growth falls outside the scope of this study. Future studies should investigate the possible channels through which government debt affects GDP growth. We also suggest that future research should investigate and establish the debt threshold at which debt will start having an impact on real GDP growth.

Disclosure statement

The authors do not have any financial or other substantive conflict of interest that might be construed as influencing the results or interpretation of their manuscript.

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