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Recovery Paths from COVID-19 and the Impact of Policy Interventions

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Thomas Conefrey, Niall McInerney, Gerard O'Reilly and Graeme Walsh[1]

Abstract

The COVID-19 pandemic and the measures put in place to control its spread have resulted in a collapse in economic activity around the world. The long-term recovery path from this deep economic shock is uncertain. In this article we explore different potential recovery scenarios over the medium term and the economic mechanisms that will influence the shape of the recovery. In the baseline scenario, output rebounds strongly but the recovery is incomplete by 2025, with output still below the level that could have been achieved had COVID-19 not occurred. A severe adverse scenario could see persistently high unemployment until the middle of the decade. Policy interventions by governments and central banks will play an important role in ensuring the economy recovers within a reasonable timeframe. We estimate that domestic and international policy responses announced to date could reduce the fall in output in Ireland by almost 4 percentage points in 2020.

[1] The authors work in the Irish Economic Analysis Division. The views expressed in this article are those of the authors only, and do not necessarily reflect the views of the Central Bank of Ireland or the European System of Central Banks. We thank Dawn Holland for sharing the calibration of the fiscal shocks in NIESR (2020). The authors would like to thank Mark Cassidy, Sharon Donnery, John Flynn, Sarah Holton, Matija Lozej and Caroline Mehigan for helpful comments and suggestions.

1. Introduction

The coronavirus pandemic is set to inflict a considerable toll on economies around the world, the exact magnitude of which is still uncertain. In the space of less than three months, the outlook for the global economy in the short run changed drastically. While the ultimate economic effects of the pandemic are highly uncertain, the virus and the locking down of economies to control its spread will clearly have a substantial economic cost in 2020. The latest IMF projections point to a fall in global GDP this year of 4.9 per cent (IMF, 2020). For comparison, the worst fall in global GDP during the financial crisis was 0.1 per cent in 2009. According to the National Institute for Economic and Social Research (NIESR) in the UK, the prospective fall in global GDP in the first half of this year could be five times larger than that experienced in the financial crisis a decade ago (NIESR, 2020).

As a small open economy, the spillovers from this sharp decline in the international economy on their own would result in a significant slowdown in Ireland. On top of the effects from the contraction in global demand, the domestic economy is also experiencing a deep recession. The clearest indication of this is from the labour market where as of end May, over 1.1 million people, or around 45 per cent of the labour force, were in receipt of unemployment and other COVID-19- related income supports.[2]

The outlook for the economy has seldom been more uncertain. This is because the current economic crisis stems from a health crisis caused by a new virus whose epidemiological properties are not fully understood. Important questions remain unanswered at present such as the possibility of a second wave of infections after containment measures are eased or whether an effective vaccine treatment can be developed. These issues will have a key bearing on the progress of tackling the virus and therefore on its economic impact.

In relation to the economic effects of the virus, the closure of some businesses that may not reopen and the possibility of some workers enduring extended periods of unemployment can lead to hysteresis effects that persistently lower the output path of the economy (Blanchard and Summers, 1986). At the household level, an elevated level of uncertainty about future income growth or employment prospects can lead to a corresponding rise in precautionary savings and the postponement of durable consumption and house purchases. At the firm level, uncertainty about future demand raises the real option value of waiting so that

[2] See https://www.cso.ie/en/releasesandpublications/er/lr/liveregistermay2020/ and Byrne, Coates, Keenan and McIndoe-Calder (2020) for further details.

investment with high fixed or sunk costs is deferred until business confidence returns.

The strength and persistence of these effects will determine whether the recovery trajectory of the Irish economy can be characterised by some variant of a V, U, or L shape. Accordingly, one of the contributions of this *Article* from an analytical perspective is the illustration of different possible recovery paths and some of the economic mechanisms that will influence the trajectory of the economy over the medium term. The Central Bank's *Quarterly Bulletin* (Quarterly Bulletin 3, 2020) shows the prospects for the economy in the short term under two potential scenarios: *baseline* and *severe*. In this *Article* we extend the analysis in the *Quarterly Bulletin* to illustrate how the recovery paths for the economy under these scenarios might evolve over the longer term beyond 2022.

As well as the path of the virus itself, the prospects for the economy will also be influenced by the fiscal and monetary policy interventions of governments and central banks around the world. For the euro area, the ECB has announced a wide-ranging package of monetary policy measures designed to preserve the flow of credit to households and firms and to ensure the transmission of monetary policy to bank lending rates for households and firms in all sectors across the euro area (Holton *et al*., (2020), Lane, (2020) and Makhlouf, (2020)). In Ireland, the Government has implemented a range of fiscal measures that aim to protect the incomes of workers affected by the economic crisis. Supports to businesses have also been announced to help ensure that firms can survive through the crisis and are in a position to restart their operations when the virus passes. In this paper, we carry out a preliminary assessment of the extent to which these global and domestic policy measures may mitigate the economic losses from the coronavirus pandemic.

The paper is organised as follows. In Section 2, we outline a series of stylised possible recovery paths from the COVID-19 crisis and discuss the economic mechanisms underpinning each. In Section 3, we present model-based estimates of the potential recovery in the economy over the medium term, extending the short-term projections for the *baseline* and *severe* scenarios in the Bank's latest Quarterly Bulletin. In Section 4 we present our analysis of the impact of domestic and international fiscal and monetary supports on the Irish economy. Section 5 concludes.

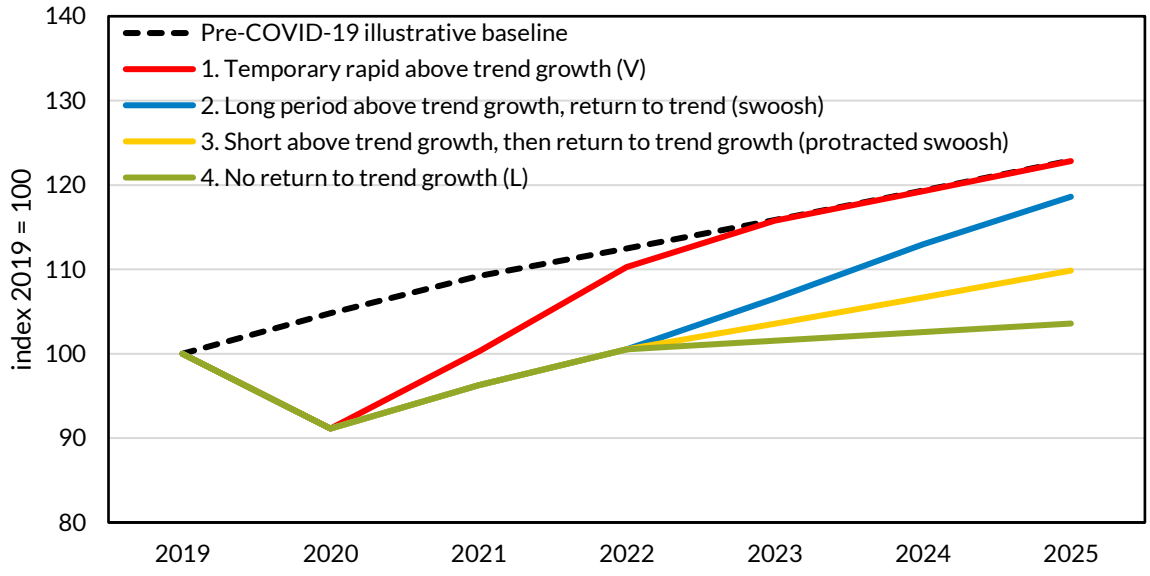
2. Illustrative Recovery Paths from COVID-19

Although the impact of COVID-19 on economic activity in 2020 is starting to become clearer, the shape of the recovery from the crisis in the longer term is uncertain and will depend on the prevalence of the virus. In this section we explore different hypothetical recovery paths from COVID-19 and examine what each implies for the scale of the loss from the crisis and whether output returns to the level that could have been achieved in the absence of the pandemic.

Illustrative Recovery Paths

Figure 1 shows a number of stylised paths for overall economic output after the COVID crisis. The paths are purely illustrative rather than model based and are designed to show the possible evolution of the economy over the medium term depending on the strength of the recovery. In each case the level of output in 2019 is set equal to 100.[3]

Figure 1: Stylised Illustrative Recovery Paths from COVID-19



Source: Own Calculations.

The most benign scenario (1) is shown in the red line and depicts a **V-shaped recovery**. In this scenario, there is rapid above trend growth in the economy from 2021-2023 with growth returning to trend thereafter. This scenario would see a resurgence in consumer confidence and business sentiment and demand would be boosted by the release of pent-up consumption. This period would see some unwinding of the exceptional increase in the savings rate observed in 2020 (FitzGerald, 2020). The initial period of rapid above trend growth brings the level of output back up to its

[3] See Bordo, Levin and Levy (2020) for a similar discussion for the US.

pre-COVID-19 baseline but the output lost in the crisis is never recovered. To avoid this permanent loss, an even more vigorous V-shaped recovery would be required whereby output would not only recover to baseline but would increase above the pre-crisis trend for a period.

The blue line (2) shows a scenario where output grows above the trend rate for a prolonged period from 2020, but the pace of growth is slower than in the V-shaped scenario. In this **swoosh-shaped** scenario, some of the consumption and investment postponed during the pandemic takes place in later years but not all of the lost output is recovered. A more benign version of this scenario would show **a U-shaped recovery** whereby more rapid growth in the early post-COVID phase would see output returning to baseline earlier than in the swoosh scenario, for instance in 2024/2025.

The yellow line (3) shows a more pessimistic version of the swoosh scenario. In this case, as in scenario (2), there is also a temporary period of above trend growth but it is much more short-lived with output growth returning to its pre-crisis rate immediately after two years. This scenario results in a large permanent loss of output over the medium term. The most severe scenario is shown in the **L-shaped** recovery path (4). In this case, there is a brief period of above trend growth in 2021 and 2022 but thereafter the economy returns to a lower potential growth rate than before the crisis and the gap between trend output pre-COVID and actual output widens over time. In this scenario, the virus does not abate and containment measures are required for a prolonged period. The downturn becomes entrenched leaving the economy mired in depressed economic conditions.

What are Hysteresis Effects?

One of the concerns with the COVID-19 pandemic is that it may have long lasting impacts on the economy. With the exception of the V-shaped scenario illustrated in Figure 1, in the other stylised paths the economic recovery from COVID-19 is impaired by the presence of hysteresis effects. These effects are strongest in the L-shaped scenario. In this section, we examine some potential channels whereby the crisis could have longer run effects on the economy.

Hysteresis (scarring) is the notion that temporary shocks can have very persistent or permanent effects on the economy. The term was initially coined by Blanchard and Summers (1986) with respect to widespread persistent unemployment witnessed across many western countries in the 1970s and 1980s and the forces that impede unemployed workers from finding new jobs. Cerena, Fatas and Saxena (2020) argue the idea of hysteresis is not unique to the labour market and that transitory or cyclical shocks may also have very persistent effects on other factors of production

such as physical capital or technology. These effects have negative implications for the level of output or growth rate of an economy.

In terms of the labour market, there are a number of mechanisms by which a cyclical downturn which results in job losses can lead to persistent unemployment. In the aftermath of the fiscal crisis and low growth episode of the 1980s, unemployment in Ireland remained persistently high until the late 1990s. In the 2008 crisis, the flexibility of the labour market and highly elastic labour supply through migration provided some mitigation against the build-up of severe hysteresis. The circumstances of the current crisis differ from those experienced in the past and it is useful to review the channels which could trigger hysteresis effects following COVID-19.

Job matches between employees and employers which are temporarily broken, due to the lockdown phase as firms shut down, could become more permanent once lockdown had eased. This would necessitate workers and firms to engage in costly job search and recruitment processes to form new matches as well as the potential loss of job specific human capital (see Fujita, Moscarini and Postel-Vinay (2020)). This belief in the importance of preserving the job match between employees and employers underlies the rationale for the Temporary Wage Subsidy Scheme. The aim of the scheme is to encourage the employer to rehire staff who were temporarily laid off during the pandemic. Byrne *et al*. (2020) provide more detail on the labour impact of COVID-19.

Being permanently laid off reduces future employment and wage prospects. Longer unemployment spells tend to lead to an actual or perceived (by the employer) depreciation of a worker's human capital. In addition, Lozej and Lydon (2018) found that those entering the labour market during a recession tend to be offered lower wages than current employees. Moreover, labour market participation can also be affected due to discouraged worker effects, with a non-temporary decline in the numbers participating in the labour market ultimately lowering the potential productive labour force (see Conefrey, Lawless and Lenihan (2014), Byrne and O'Brien (2017)).

If human capital accumulation slows, through the disruption of schooling or the process of learning-by-doing on the job, it can adversely impact the economy's supply potential. Even a short period of missed schooling can potentially have consequences for skills growth. With empirical estimates of the wage premium from an extra year of schooling of between 7-8 per cent, it is clear that even missing part of a year could be costly in terms of permanent wages (see Burgess and Sievertson (2020)).

COVID-19 has led to a widespread shutting down of many sectors in the economy. There are concerns that if the crisis is prolonged, this could result

in a large increase in insolvencies as well as a rise in non-performing loans (NPLs) as firms' revenue streams have disappeared while they still incur costs (see McGeever, McQuinn and Myers (2020) and the Central Bank's Financial Stability Review (2020)). This would have a negative effect on employment, growth and productivity. An increase in financial stress in the household sector could reduce consumption. High NPLs tend to be persistent and are consistent with deep recessions and weak recoveries. Two-thirds of the countries that experienced high NPLs following the 2008 financial crisis could not resolve those within seven years of the crisis. High NPLs impair bank balance sheets, depress credit growth and delay recovery (Aiyar *et al.*, (2015), Ari, Chen and Ratnovski, (2020)).

Higher firm closures, weaker balances sheets, depressed demand and generalised uncertainty will also depress firm investment and R&D activities over the period of the pandemic. Unless this is subsequently recovered, this could lead to a lower capital stock, reduced labour productivity and a lower level of output in the longer term. While COVID-19 is primarily a combination of real demand and supply shocks, a more persistent crisis could generate financial system shocks that could amplify the downturn (Ball (2014), Claessens, Kose and Terrones (2011), Jorda, Schularick and Taylor (2011)).

Ireland is a highly open economy and is dependent on strong global economic activity. Given the worldwide nature of the COVID-19 shock, world output and income have fallen which in turn has led to a reduction in demand for Irish exports. Production processes have become much more globalised in recent years with many interlinked chains in the production of goods and services by firms and industries spread over a wide range of countries. However, there are concerns these global value chains may be re-evaluated as elements of the production processes were hindered during the pandemic. This could have implications for Ireland if multinational firms were to locate more activity in their home countries.

COVID-19 has affected the economy in a heterogenous manner with sectors that involved a large degree of personal contact with customers being the worst affected. While a vaccine may be developed, and there has been a large degree of adaptation and innovation by firms to reduce possible risks some industries such as tourism, hospitality and travel may see a persistent decline in their productive capacity. Moreover, demand for their services may not fully recover. Unless the underutilised resources in many sectors are successfully redeployed elsewhere, this could affect the productive capacity of the economy. Structural change – where one industry sees a secular decline – can have persistent negative consequences as there may be mismatches between the skills of staff in the sectors where jobs are being lost and the skills required for the jobs that

are available. Kambourov and Manovskii (2009) show that displaced workers future earnings losses are three times larger when they are unable to find a job in their original occupation.

Ireland entered the COVID-19 crisis with a high level of public debt. Since the start of the pandemic, the deficit has surged with a substantial decline in government revenue due to the lockdown while government expenditure has increased through enhanced automatic stabilisers, employment and firm supports and spending on the health service. While the current low interest rate environment reduces the cost of servicing the additional debt, lowering the debt ratio in future years may require a more restrictive fiscal stance than would have been the case in the absence of the pandemic. This could have a dampening impact on economic growth over the longer term.

Summing up, in a scenario where the economy is successfully reopened along the lines currently envisaged and there is no significant resurgence of the virus, it is likely that some of the most pernicious hysteresis effects could be avoided. In contrast, a severe adverse scenario where the crisis is prolonged could trigger some of these mechanisms and thereby result in a protracted period of low economic growth.

3. Scenarios for the Irish Economy

In this section we provide quantification for two possible recovery paths for the economy from the range of potential scenarios discussed above. The scenarios we examine are in line with those published in *Quarterly Bulletin 3* (2020). For the first three years (2020-2022), the scenarios match the projections in the *Quarterly Bulletin* and thereafter evolve in line with the underlying modelling assumptions.

In the *baseline* scenario, the strict lockdowns in place in April and May 2020 are assumed to be unwound on a phased basis over the coming months. The gradual reopening of the economy would allow for an initial rebound in economic activity over the near term. Some containment measures would remain in place meaning that activity would be constrained in some sectors for a longer period. The significant negative economic impact from the lockdown combined with a continuation of some containment measures mean that while output would recover, activity would be constrained by the effects of the severe recession in 2020 and the ongoing impact of the pandemic.

In the *severe* scenario, the strict lockdown period is assumed to have a more damaging impact on economic activity and is not successful in effectively containing the disease. Stringent, albeit gradually loosened, containment measures would remain in place based on an assumption that there would

be a resurgence of the virus at some point between now and the end of 2021. In this scenario there is a subdued economic recovery with a larger permanent loss of output as negative hysteresis effects are assumed to take hold.

For both scenarios, the main channels by which the COVID-19 pandemic is expected to impact the Irish economy are detailed below.

1. **Lower external demand from other countries affected by COVID-19.** As outlined above, preliminary data for Q1 indicate a sharp decline in output in all of Ireland's key trading partners. More timely PMI data point to a large drop in economic activity in April. The decline in activity is modelled by reducing spending by households and firms around the globe including in the Asia-Pacific economies, the euro area and advanced northern hemisphere economies. In both scenarios, the negative shocks peak in 2020 with a larger decline in external demand in the severe scenario. For the euro area, the decline in 2020 GDP is close to that in the "severe" scenario recently published by the ECB (ECB, 2020). Relative to the baseline case, the severe scenario assumes a weaker recovery in external demand as the necessity to maintain containment measures curtails the recovery in Ireland's key trading partners.

2. **Uncertainty and financial market effects:** For both scenarios, heightened uncertainty is modelled via an increase in investment risk premia in all countries in 2020 and equity prices are reduced. The risk premium on banks' lending rates is also assumed to rise due to the deteriorating economic outlook and the rise in unemployment.

3. **Reduced employment and economic activity due to sectors closing down:** A large-scale outbreak of the virus in Ireland and the containment measures already announced will result in a temporary reduction in labour supply. This will come about via absence through illness, for those infected by the virus, or indirectly, as a result of school closures which cause households with dependent children to temporarily stay at home. Calibrating the size of the potential labour supply effects is challenging given the few available estimates from the existing literature. It is also uncertain how practices such as homeworking may affect the scale of the reduction in labour supply and productivity. We have included the labour supply channel in our simulations based broadly on the work of Keogh-Brown, Wren-Lewis *et al.* (2009) and CBO (2006), and the observed trends in the data to date.

We also assume a direct effect on employment from the closing down of sectors of the economy which occurred in March and April. The reduction in labour supply resulting from the closure of sectors, as well as through the channel above, causes a related fall in production and demand in the economy. In the baseline scenario, the recovery in employment continues beyond 2023 as output picks up. In contrast, employment is significantly weaker in the severe scenario due to subdued demand and the emergence of some hysteresis effects through the channels discussed in Section 3.

4. **Supply chain disruption:** There is already evidence of significant disruption to global supply chains as a result of the spread of the virus. Given the deep integration of Irish firms (both exporters and non-exporters) in Global Value Chains (GVCs), Irish output is particularly sensitive to disruption to imports of intermediate goods. In both scenarios, we proxy this shock to the supply of imported intermediate goods as a reduction in the effective capital stock using the respective shares of capital and imported intermediates in output.

Drawing on these assumptions, the model-based analysis in this *Article* is carried out in two steps. In the first stage, we estimate the impact of the scenarios on the international economy using the UK-based National Institute for Economic and Social Research's (NIESR) global model called NiGEM. In the second stage, on top of these international shocks, we add a layer of supply and demand shocks and simulate the final impact on the Irish economy using the Central Bank's COSMO model. This approach allows us to capture the impact of the combination of shocks to both the external environment (euro area, US and UK GDP, interest rates, exchange rates) and the Irish economy in an internally consistent manner.

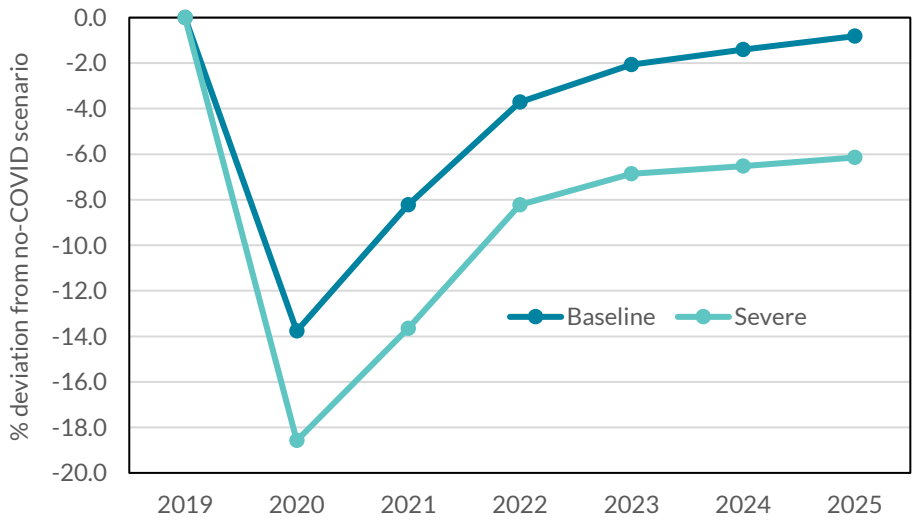
It is important to note that the possible path for the economy under the scenarios cannot be estimated with precision. The models we use capture only some of the channels through which the pandemic is likely to impact the economy. In addition, there is relatively little research on how particular epidemiological outcomes translate into macroeconomic effects. Since COVID-19 is a new virus, the level of uncertainty in this regard is exceptionally high. However, with these caveats in mind, some quantification is useful for illustrating the relative severity of the two scenarios.

Figure 2 shows the path of output under both scenarios out to 2025. The estimates for the first three years are consistent with the forecasts in the *Quarterly Bulletin*. The results are shown relative to a scenario in which the COVID-19 shocks listed above do not occur. In the baseline

scenario, there is a moderate recovery in line with a gradual and successful opening up of the economy. Consumer and business confidence improves giving rise to a strong recovery in consumption and investment in the initial period which is later supported by a pick-up in external demand. In line with the forecasts in the *Quarterly Bulletin*, the projected recovery in the baseline scenario would see output regain its 2019 level in around 2022.

Nevertheless, some containment measures are assumed to remain in place for a prolonged period and, as a result, a degree of caution prevails which curtails spending and investment. In the medium term, output continues on a steady recovery path but by 2025 still remains below the level that would have been achieved in the absence of the pandemic. Reflecting the path of output, the unemployment rate drops consistently from its 2020 peak and by 2025 would be around 1 percentage point above the no-COVID scenario.

Figure 2: Output in Baseline and Severe Scenarios, % Deviation from a no-COVID scenario

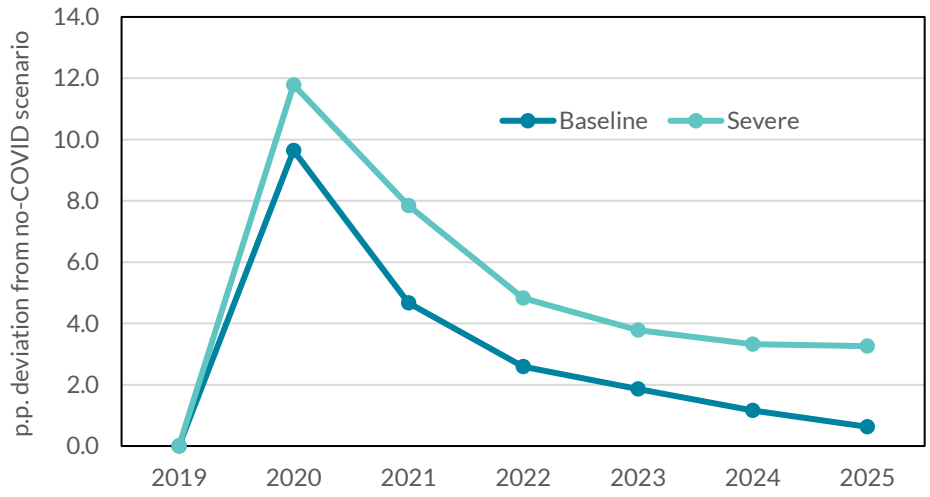


Source: Own calculations.

In the severe scenario, there would be some recovery in 2021 and 2022 but thereafter the pace of recovery weakens as the persistence of the virus triggers a series of negative shocks and hysteresis effects materialise. The prolonged contraction in global economic activity is transmitted directly to the Irish economy through lower demand for Irish goods and services. This reduces output in the traded sector and in turn lowers investment. These negative spillovers from the weaker external environment further reduces labour demand, compounding the negative impact on the economy from the drop in domestic

economic activity (Figure 3). With continuing high unemployment, consumer spending remains weak and subdued demand reduces investment. Overall, the level of output in the severe scenario remains substantially below the no-COVID scenario by 2025.

Figure 3: Unemployment Rate in Baseline and Severe Scenarios, p.p. Deviation from a no-COVID scenario



Source: Own calculations.

4. Impact of International and Domestic Policy Interventions

The policies implemented across countries to cushion the economic and financial impact of the pandemic have been swift and on an unprecedented scale. For example, NIESR (2020) estimate that the total economic policy measures taken to April amount to 2.5 per cent of GDP and have mitigated the fall in global GDP by close to a third.

In this section, we outline our approach to assessing the impact of the domestic and international monetary and fiscal policy measures on the Irish economy. As in the previous section, our analysis proceeds in two stages. In the first, we calibrate and simulate the impact on the global economy of the various international policy measures using NIESR's model NiGEM. In the second, we incorporate the international impact along with the domestic policy response in the Central Bank's model of the Irish economy, COSMO, and simulate their impact.

International Monetary Policy Response

Deteriorating financial conditions, rising uncertainty and a perceived increase in counterparty risk can impede the smooth functioning of financial markets and the banking system. This can inhibit access to credit

by both the private and public sector, thereby suppressing household consumption, corporate investment and government spending. In this context, the response of monetary authorities to the economic disruption generated by the pandemic has been aggressive and multi-faceted in an effort to mitigate a procyclical tightening of financial conditions. In addition, in the case of the ECB the policy supports have been designed to prevent medium-term inflation from deviating from its target of below, but close to, 2 per cent (Schnabel, 2020).

Table 1 outlines how central banks across the world have used a variety of policy instruments to provide monetary, financial and liquidity supports in their respective economies.[4] The monetary response has comprised both conventional and non-conventional measures, depending on whether the effective lower bound on policy rates was a binding constraint. Non-conventional measures have included the purchase of both government debt and corporate securities and have sought to mitigate the impact of market stress on the yields of these securities. Finally, central banks have deployed a range of liquidity tools with the aim of stabilising bank-intermediated credit conditions in the real economy. In the euro area, the announcement of measures such as new asset purchases in the Pandemic Emergency Purchase Programme (PEPP) and easing the conditions on the targeted long-term operations (TLTROs) have led to a narrowing of government bond spreads across member countries and to more accommodative bank lending conditions (Lane, 2020a).

To assess the impact of the international monetary policy measures on the Irish economy, we first simulate the effects of these measures using the NiGEM model. In terms of conventional measures, we implement in the model changes to policy rates that have been announced in those countries that are not constrained by the effective lower bound. As shown in Table 1, the cuts to policy rates have been particularly large in some countries, such as the United States and Canada, which in the model will not only have a domestic impact in those economies, but will also lead to significant international macroeconomic and financial spillovers.

The second dimension of the monetary policy response we consider relates to asset purchases. As shown in Table 1, several central banks have announced asset purchases as part of their response to the pandemic. These purchases reduce the overall supply of government bonds in the market, thereby putting upward pressure on the prices and corresponding

[4] The analysis in this article excludes the impact of the various macroprudential measures that central banks and financial regulatory authorities have announced in response to the pandemic. For example, see DeNora et al (2020) for a discussion of the changes to the countercyclical capital buffer (CCyB) that have been introduced by the Central Bank of Ireland.

downward pressure on the yields of the bonds (Schnabel, 2020). In NiGEM, the impact of asset purchases on the economy can be simulated by calibrating the expected impact of the purchases on the term premium component of long-term sovereign yields and then solving the model with these term premium shocks imposed. To calibrate the impact on yields in each country, we use estimates from the empirical literature on the effects of previous purchase programmes, detailed below. [5]

In terms of the euro area, the ECB has announced that it will purchase €120bn of government bonds through the Asset Purchase Programme (APP) and €1350bn of both government and corporate bonds through the newly established PEPP, specifically to counter the effects of the virus (Lane, 2020a; Lane, 2020b). Based on recent data on ECB purchases through these programmes, we assume that approximately 80 percent of asset purchases through the PEPP will comprise government bonds.[6] We use estimates from Rostagno *et al.* (2019) and Chadha and Hantzsche (2018) of the effects of previous ECB asset purchase programmes to inform the calibration of the impact of the newly announced purchases on euro-area yields in NiGEM.[7] Based on these estimates, (GDP) weighted-average euro-area yields could fall by over 50 basis points (bps) over the horizon of the APP and PEPP programmes. It should be noted that the assumed fall in yields is relative to the yields that would have prevailed in the absence of these purchase programmes.

Our estimates for the impact of asset purchase announcements on US long-term yields are based on Gagnon *et al.* (2011) and Krishnamurthy and Vissing-Jorgenson (2011). Broadly, these studies find that $600 billion of large scale asset purchases lower ten-year Treasury yields by 15-25 bps. We scale these results based on the assumption that the Federal Reserve continues to purchase securities at its current rate of $US80bn per month until the end of the year.

In terms of the UK, we use the estimates from Meaning and Warren (2015) who find that the first GBP 375 billion of purchases of UK government bonds by the Bank of England lowered long-term yields by 25 bps.[8] For Japan, we take the estimates from Lam (2011) and Ueda (2012) who show that the announcement of a 5 trillion yen quantitative easing program lowered long-term government bond yields by approximately 8 basis points. We proportionately scale these estimates for the UK and Japan

[5] For the purposes of this exercise we abstract from potential issues underlying the structural relationship between central bank asset purchases and government bond yields such as non-linearities and state-dependence.
[6] See https://www.ecb.europa.eu/mopo/implement/pepp/html/index.en.html .
[7] Broadly similar estimates are contained in Eser *et al.* (2019).
[8] Note that the most recent expansion of the asset purchase programme announced by the Bank of England on 18 June is not included in our analysis.

based on the respective central bank's planned purchases outlined in Table 1.

Table 1: Policy Responses to COVID-19 by selected Central Banks

Central Bank	Conventional Policy	Asset Purchases	Other (selected) Interventions
ECB	Deposit facility rate maintained at -0.5%.	€120bn through APP and €1350bn through PEPP (including corporate securities).	Forward Guidance; Collateral easing measures; TLTRO III and PELTRO programmes; Foreign currency swap lines.
Federal Reserve	Federal funds target range lowered 150bps to 0-0.25%.	Announcement US$500bn Treasury purchases (currently US$80bn per month).	Forward guidance; Purchases of MBS; US$750bn Primary and Secondary Market Corporate Credit Facility.
Peoples Bank of China	One-year prime rate reduced from 4.15% to 3.85%.		Reserve requirement ratio (RRR) reduced by 50-150bps; One-year Medium-term Lending Facility rate lowered to 2.95%.
Bank of Japan	Overnight call rate maintained at -0.1%.	Purchases conditional on achieving 0% target for sovereign ten-year yield (currently 80trn yen p.a.).	12trn yen annual purchases of Exchange Traded Funds; 180bn yen per month purchases of Japanese REITs.
Bank of England	Bank rate lowered from 0.75% to 0.1%.	Set GBP 745bn target for total purchases of government and corporate bonds.	Expansion of Treasury account; liquidity support to firms through Covid Corporate Financing Facility.
Reserve Bank of India	Policy repo rate lowered by 115bps to 4%.		RRR reduced by 100bps to 3%; Reverse repo rate reduced by 130bps to 3.35%.
Bank of Canada	Overnight lending rate cut by 150bps to 0.25%.	Minimum C$5bn per week of government bonds, conditional on economic outlook.	Purchases of C$10bn corporate bonds and C$50bn regional government bonds.
Central Bank of Brasil	Policy rate lowered by 125bps to 3%.		RRR reduced by 600bps; US$20bn in liquidity support for households and firms.
Bank of Russia	Policy rate lowered by 50bps to 5.5%.		500bn roubles bank liquidity supports through repo auctions.
Bank of Korea	Base rate lowered by 75bps to 0.5%.		Bank Intermediated Lending Support Facility limit raised to 35trn won.
Reserve Bank of Australia	Target for cash rate lowered by 50bps to 0.25%.	Purchases conditional on achieving 0.25% target for three-year sovereign yield.	Forward guidance for cash rate; AU$90bn Term Funding Facility for banks at 0.25%.

Source: Central Banks, various regions.

Both the Reserve Bank of Australia (RBA) and Bank of Canada have announced that they will begin a programme of asset purchases. We assume that the RBA conducts purchases to meet the 25 bps target reduction in the three-year government bonds yields so that longer term yields fall by a similar amount. In the case of Canada, we assume the initial rate of purchases continues until the end of this year. As Canada has not previously conducted an asset purchase program, there are no empirical estimates with which to calibrate the likely impact of the purchases on Canadian government bond yields. We therefore calibrate the impact to be proportionately similar to that of the Federal Reserve purchases on US Treasury yields.

In addition to purchases of sovereign bonds, some central banks have also announced that they will purchase corporate securities, including commercial paper. Estimates of the impact of these purchases on corporate spreads are relatively scarce. However, for the euro area we can use the estimates reported in DeSantis *et al.* (2018), who find that the €150bn of corporate bond purchases under the ECB's Corporate Security Purchase Program (CSPP) since 2016 has lowered corporate bond spreads by approximately 20 basis points. If we assume that the 20 per cent, or €270bn, of the PEPP not used to purchase government bonds is used to purchase corporate securities, corporate spreads in the euro area could fall by over 35 basis points as a result of these purchases. In NiGEM, we implement this fall in debt costs as a similar reduction in the risk premium component of the user cost of capital.

Finally, Table 1 also outlines other important innovations by central banks in response to the pandemic including cuts to reserve requirement ratios and liquidity facilities. In most cases, it is not possible to incorporate the impact of these interventions as either that element of the transmission mechanism is not present in the model or it is not possible to calibrate the instrument with any certainty due to the absence of empirical evidence on its impact. Accordingly, we focus only on modelling the impact of the third key element of the ECB's monetary response: the TLTROs and pandemic emergency longer-term refinancing operations (PELTROs) programmes.[9] These programmes are designed to funnel monetary easing through the banking system to firms and households. Although the actual rate paid by banks in some of these operations will be conditional on their lending behaviour, we assume that the average effect will be to reduce banks'

[9] PELTROs allow banks with loans not eligible for TLTROs, such as mortgages, or banks that have exhausted TLTRO limits to access cheaper sources of funding from the ECB. See Holton *et al.* (2020), Lane (2020a) and Lane (2020b) for an overview of the TLTRO-III and PELTRO programmes.

funding costs by 50 basis points.[10] In NiGEM, we implement this as a corresponding reduction in short-term funding rates, which will be passed through to the real economy in the form of lower lending rates.

International Fiscal Policy Response

Regarding the international fiscal policy responses, we model the impact of these in NiGEM based on shocks to government consumption, transfers and changes in taxation. The size of the specific fiscal shocks in each country are based on those included in NIESR's latest global projections (NIESR, 2020), which in turn are informed by the estimates from the IMF's Policy Responses Tracker.[11,12] The impact of these discretionary policy shocks are in addition to the impact of automatic fiscal stabilisers, which reflect the cyclical behaviour of government revenue and expenditure.

As mentioned, the response of fiscal authorities has been unprecedented in both size and scope. A particular focus of the measures has been the use of transfers and wage subsidies to preserve the link between firms and workers. In broad terms, the fiscal policy response has included a combination of income supports, tax rebates, business grants and increases in government consumption.

In most countries, the most sizeable outlays have been in terms of furlough schemes. In the case of the UK, the government established the Coronavirus Job Retention Scheme in which companies that have been severely affected by the pandemic can furlough employees and avail of a grant covering 80 percent of their monthly wage costs, up to GBP 2,500 per employee. The total expected cost of this package is between GBP 10 billion and GBP 30 billion (NIESR, 2020). We calibrate the fiscal cost of these job retention schemes across countries as an increase in public transfer payments.

A second key element of the international fiscal response has been in the form of tax rebates and VAT deferrals. For example, the German government has announced a three percentage points reduction to VAT until the end of 2020, with an expected cost to the German exchequer of €20 billion. Similarly, in France the government have postponed social security and tax payment for companies and accelerated the refund of tax

[10] Funding cost relief from TLTROs applies also to banks that do not bid in the operations, as they benefit from the general reduction in demand for liquidity in financial markets, which reduces the cost of market financing for all banks.
[11] See https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19
[12] As the detailed composition of the €750 billion recovery fund proposed by the European Commission in May 2020 is currently unclear, the potential impact of the policy package on EU countries including Ireland is excluded from our analysis.

credits. We treat these tax measures in NiGEM as a reduction in corporate tax rates.

Given the nature of the pandemic, an important component of the policy packages that have been introduced by governments relates to health expenditure. This expenditure is designed to strengthen the healthcare system in terms of infrastructure, equipment and personnel. Italy, for example, introduced fiscal measures worth €7 billion to support hospitals, while Spain introduced measures worth close to €5 billion to protect health services. In NiGEM, we calibrate this health-related expenditure as an increase in government consumption.

In many countries, governments have introduced fiscal supports in the form of conditional guarantees for loans to firms and the broader banking system.[13] For example, the US announced a package worth US$510 billion as part of the Cororavirus Aid, Relief and Economy Security Act that would provide loans and guarantees to firms to prevent bankruptcy. However, calibrating the impact of policies such as loan guarantees across countries is exceptionally difficult given differences in the particular details of each guarantee, the extent of the fiscal liability, and uncertainty regarding how much support will likely be drawn down and how exactly it will affect businesses given the incentives they face. Accordingly, we exclude the impact of contingent business loans and loan guarantees from the international component of our analysis.

An important caveat to our analysis of the impact of domestic and international fiscal shocks is that there are many uncertainties as to the effectiveness of fiscal interventions depending on what particular measure is used (a rise in transfers, direct government spending or tax cuts), where the economy is in the cycle and the marginal propensity to consume of individuals who may benefit from the expansion.

Impact of Domestic and International Policy Measures in COSMO

The second stage of our analysis incorporates the results from NiGEM on the impact of the international policy measures as shocks to external variables in the Central Bank's semi-structural model of the Irish economy, COSMO. Along with the international measures, we calibrate the fiscal and monetary policy variables in the model to capture the impact of the domestic policy response.

In addition to the international channels through which the policy actions of different central banks will indirectly affect the Irish economy, the programmes announced by the ECB in response to the pandemic will have a

[13] See https://www.bruegel.org/publications/datasets/covid-national-dataset/

direct effect on the Irish banking system and market for Irish sovereign debt. To calibrate the impact of the PEPP and APP asset purchases on Irish government bond yields, we again use the estimates of the impact of previous ECB asset purchase programmes from Rostagno *et al.* (2019) and Chadha and Hantzsche (2018). Based on these estimates, we assume that the asset purchase programmes will lower long-term Irish government bond yields by close 50 basis points.

COSMO also has a detailed banking sector so that changes to ECB actions that affect banks' funding costs can be directly incorporated in the model.[14] Similar to the calibration in NiGEM, we assume that the average effect of the TLTRO-III and PELTRO programmes will be to reduce non-deposit funding costs by approximately 50 basis points.[15] In COSMO, this reduction in the weighted- average cost of capital will be passed through to households and firms in the form of lower lending rates.

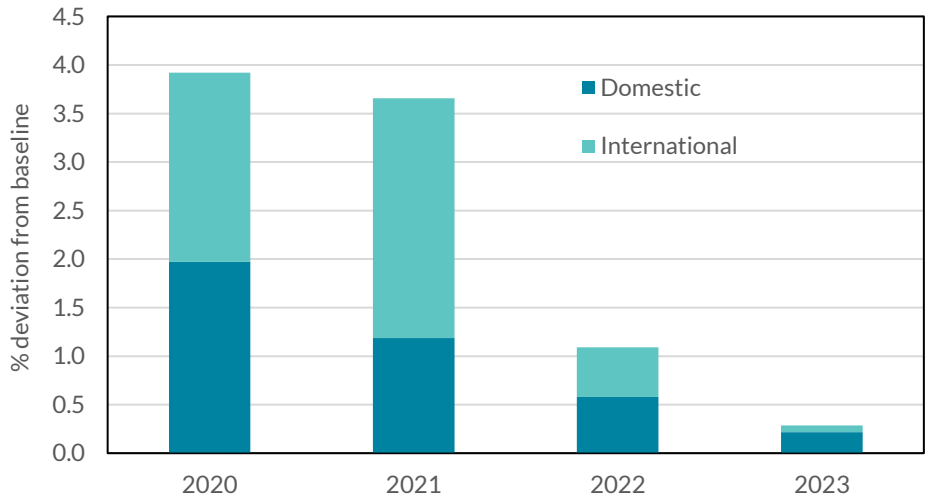
The fiscal shocks for Ireland are implemented based on the measures announced by the government for households and businesses. The majority of the supports to households are modelled as an increase in transfers arising from the Pandemic Unemployment Payment (PUP) and the Temporary COVID-19 Wage Subsidy Scheme (TWSS), with a smaller rise in government consumption to account for the additional spending in the health area. In terms of the supports to business announced on 2 May, these are modelled as follows. The impact of the €2 billion ISIF Pandemic Stabilisation and Recovery Fund is proxied by an increase in investment in the private sector. The effect of the €2 billion Credit Guarantee Scheme is modelled as a 50 basis point reduction in the risk premium component of the corporate lending rate.[16]

Based on this range of assumptions, we estimate the economic impact of the fiscal and monetary policy measures that have been introduced around the globe. The results are shown in Figure 4 and indicate that the international monetary and fiscal policy interventions, as well as the fiscal measures announced by the Irish government, have a meaningful impact in reducing the severity of the COVID-19 crisis. Our estimates suggest that

[14] See McInerney (2020) for details on the banking sector in COSMO.
[15] The impact of these programmes will be influenced by the level of take up by financial institutions in Ireland which has been low to date.
[16] Assessing the impact of both the Pandemic Stabilisation and Recovery Fund and the Credit Guarantee Scheme is difficult ex-ante due to the demand-driven nature of the supports. We assume that there is full take-up of the Recovery Fund which translates into higher investment than in the baseline. We calibrate the impact of the Credit Guarantee Scheme on risk premiums based on NIESR (2020).

including these measures would reduce the scale of the decline in output in 2020 by just under 4 percentage points (Figure 4).[17]

Figure 4: Impact of Domestic and International Policy Measures on Irish Output, % deviation from Baseline



Source: Own calculations.

The positive effect on Irish output comes through the following channels. The fiscal expansion in Ireland's trading partners supports demand in those economies both directly, through higher government consumption and transfer payments, and indirectly through the impact of fiscal multipliers on the aggregate economy. Higher levels of economic activity in those countries also spills over into higher demand for Irish exports, thereby supporting the output recovery in Ireland. Similarly, the domestic fiscal measures boost Irish growth both directly and indirectly, by stimulating investment and consumption. They also increase Irish demand for imports from our trading partners, which supports the recovery in those countries.

It is important to note, however, that while the domestic and international fiscal supports help to mitigate the loss of output, they result in a rise in government debt. As discussed in Section 2, excessive levels of public debt overhang can act as a drag on economic growth. The impact of the COVID-19 crisis on the public finances in Ireland is discussed in detail in the latest *Quarterly Bulletin* and by IFAC (Central Bank, 2020 and IFAC, 2020).

On the monetary side, policy rate cuts are likely to lower borrowing costs for firms and households and thus incentivise consumption and

[17] Note that our analysis only considers the impact of the *announced* fiscal and monetary measures. It therefore abstracts from additional stimulus that may be introduced in future and which may be conditional on the effectiveness of these measures.

investment.[18] In addition, lower interest rates are associated with higher asset prices, which can further support these components of demand. Lower sovereign yields due to asset purchases enhance the government's fiscal position and reduce firms' user cost of capital.[19] Finally, the ECB's targeted operations lower banks' funding costs and therefore support bank lending to the economy.

The policy interventions continue to have a positive effect beyond 2020, although their impact begins to taper out. While the policy supports help to mitigate the losses in some areas, they are not sufficient to outweigh the negative impact of the crisis given the range of channels through which the pandemic is impairing growth in the economy. The policy measures we have modelled are in line with those announced to date by central banks and governments. If additional measures were announced, or if the existing measures are kept in place for a longer period, then their impact on the economy would be larger than shown here.

5. Conclusions

As well as its high and rising human costs, the coronavirus pandemic has triggered a severe economic shock that is being felt in Ireland and around the globe. At present, there is still major uncertainty over the economic outlook. The timing and pace of the recovery will depend on the evolution of the virus and on how households and businesses respond once the containment measures are lifted, as well as on policy actions in Ireland and around the world.

In this *Article*, we illustrate a range of potential paths for the economy over the medium term and discuss the economic mechanisms that will influence the shape of the recovery. Based on a set of key assumptions, we then attempt to quantify two of these possible scenarios out to 2025. The baseline scenario would see a strong but incomplete rebound in activity in 2021 and 2022, followed by more gradual pace of recovery thereafter. In the severe scenario, output in Ireland would remain significantly below the level that could have been achieved in the absence of the pandemic. The unemployment rate would fall initially but remain persistently higher than its level prior to the pandemic outbreak until the middle of the decade. This recovery path is consistent with the emergence of hysteresis effects which result in the economy becoming entrenched in a protracted period of low growth.

[18] Due to the difficulty of disentangling the impact of euro area monetary policy on Ireland vis-à-vis other member countries, we allocate all of the impact of the ECB's policy measures to the international policy component in Figure 4.
[19] Long-term government bond rates act as the reference risk-free rate in most loan and capital asset pricing models.

Our analysis shows that international and domestic policy interventions (expansionary fiscal policy and accommodative monetary policy) are likely to play an important role in reducing the loss of output and employment from the COVID-19 crisis. As an open economy highly interconnected with the global system, Ireland benefits from the positive effects of monetary and fiscal policy measures implemented abroad. Our preliminary assessment of the combined effects of domestic and international policy supports indicates that the interventions will help to meaningfully reduce the scale of the output loss in Ireland from the pandemic.

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