#

A macroeconomic analysis of the impact of the EU Recovery and Resilience Facility

Stephen Millard[(1)]

Abstract

In this paper, I evaluate the macroeconomic effects of the EU Recovery and Resilience Facility (RRF) within the context of a macroeconometric model, specifically the National Institute of Economic and Social Research's global macroeconometric model, NiGEM. I examine the effects both on individual EU member states as well as the European Union as a whole, given the presence of potential spillovers between EU countries. I consider three key channels through which the RRF can impact the macroeconomy: the risk premium channel, the public investment channel, and the structural reforms channel. I find that the announcement of a recovery fund led to a sizeable reduction in spreads for many EU countries, increasing their fiscal headroom, though having only a negligible effect on GDP. I find that the increased public investment resulting from the RRF raises demand in the short run and supply in the long run with an implied multiplier of a little over two. Finally, although I cannot explicitly quantify the impacts of the planned structural reforms, I use NiGEM to consider the macroeconomic channels through which a subset of these reforms have effects on GDP and productivity in both the reforming Member States and the European Union as a whole.

Keywords: Recovery and Resilience Facility, Next Generation EU, Public investment, Structural reforms, Sovereign risk premia

***JEL* classification:** E2, E6, H54, H63, O52.

Preliminary version: 16 October 2023

(1) National Institute of Economic and Social Research, Durham University Business School, Portsmouth University and Centre for Macroeconomics; Email: s.millard@niesr.ac.uk.

The author would like to thank, without implication, colleagues at NIESR, Cinzia Alcidi, Francesco Corti, Daniel Nigohosyan and Chiara Pancotti, together with Martin Hallet, Muriel Jacubowicz, Phillip Pfeiffer, Jan In't Veld, Johannes Ziemendorff and their colleagues at the European Commission for useful comments.

1 Introduction

The Covid Pandemic, aside from causing large loss of life across the world, had devastating economic impacts. The lockdowns imposed in many countries led to substantial falls in output, consumption and investment, as well as a large rise in unemployment in those countries that did not have a 'short-time working' scheme in place (such as the Coronavirus Job Retention Scheme in the United Kingdom). In turn, this necessitated large fiscal interventions to support households through this exceptional period.

In response to this, on 18 May 2020 the French and German governments proposed a 500 billion euro 'Recovery Fund' to be distributed to those EU countries worst affected by Covid. This became an EU initiative entitled Next Generation EU (NGEU), which contained within it a 'Recovery and Resilience Facility' (RRF). The idea was that the European Commission would borrow funds in the financial markets and this borrowing would be paid back gradually using money from the EU budget. The purpose of this paper is to evaluate the macroeconomic effects of the RRF within the context of a macroeconometric model, specifically the National Institute of Economic and Social Research's global macroeconometric model, NiGEM. I look at the effects both on individual EU member states as well as the European Union as a whole, given the presence of potential spillovers between EU countries.

Following Bankowski *et al.* (2022), I consider three key channels through which the RRF can impact the macroeconomy. First, by reducing spreads and country risk premia, the facility can improve the sustainability of public finances in EU countries and also improve financing conditions for the household and corporate sectors, leading to increased investment. This channel will be particularly important in those countries which would otherwise struggle to borrow the funds, or else face much higher interest rates, to cover the large increase in spending that was brought about by the pandemic.

Second, the RRF was set up to enable governments to spend extra resources to help their economies recover from the pandemic. This increased public-sector spending will have a short-run demand effect, helping the economic recovery. But in addition, if used for productive public investment purposes, it will lead to increased output in the long run. It is these longer-run supply effects that are potentially much more important for continued productivity growth in the European Union.

Third, a key part of the RRF is its 'conditionality'. In order to apply for RRF funding, member states have to show that they are enacting, and have implemented, a number of structural reforms. These reforms include reforms to the legal and tax systems within the country, as well as reforms to product and labour markets, increasing competition and efficiency. Again, such reforms can potentially lead to long-run increases in the level of actual and potential GDP, above and beyond any short-run demand effects.

The rest of the paper is structured as follows. I first survey some of the recent literature attempting to evaluate the effects of the RRF before moving on to discuss the model, NiGEM. I then go on to discuss how I model and assess the impact of the RRF on the EU and individual Member States'

economies through each of the three channels discussed above and the results I obtain. A final section concludes.

2 Relevant Literature

Much work has been done on the macroeconomic effects of the Recovery and Resilience Facility (RRF) since it was first proposed in May 2020. An early attempt to assess its possible impact using the same macroeconometric model as in this paper – the National Institute of Economic and Social Research's global macroeconometric model, NiGEM, was Watt and Watzka (2020). In this paper, the authors concentrated on the potential effects of the increase in public investment financed by the RRF. They find that the RRF could result in large increases in public capital stocks throughout the European Union and that this would lead to higher output. In the case of some especially hard hit southern European countries, this higher output would offset a significant share of the output lost during the pandemic. Since this effect would be expected to be larger in poorer EU countries, the RRF could potentially lead to increased convergence between EU countries. Finally, they found that the RRF would lead to lower public debt ratios. Although my approach is very similar to that in Watt and Watzka, in this paper I can better quantify the effects of the RRF given the member states have all submitted their Recovery and Resilience plans and RRF payments have begun being made.

Bankowski *et al.* (2022) concentrate on the effects within the Euro Area, concluding that NGEU may increase euro-area GDP by up to 1.5% by 2026. They also find a much larger impact in the main beneficiary countries of southern Europe, but that NGEU should benefit all euro-area countries, both directly through increased GDP, and indirectly as a result of positive spillovers. They also make the point that the RRF has potentially large effects on public debt ratios, helping to mitigate the long-term risk of unsustainable public finances that resulted from the large fiscal interventions made during the Covid pandemic. This results from a sizeable reduction in spreads and country risk premia and the current and future increase in GDP growth, in turn resulting from RRF spending on public investment and structural reforms. This effect was most pronounced in high-debt countries, in particular, Spain (where they found a potential reduction in the debt to GDP ratio of 14 percentage points) and Italy (12 percentage points). This paper is probably the closest to mine, though I expand the analysis to all 27 member states in the European Union and not just the Euro Area.

Pfeiffer *et al.* (2022) examine the effects of public investment – financed by NGEU funds – on GDP and productivity growth across the European Union using a macroeconometric model. Within their model, public investment makes private capital and employment more productive, and, in addition, there are spillover effects to other EU countries. Specifically, the effects of the investment happening simultaneously in all 27 member states are larger than the sum of the individual effects of each of the 27 member states making the investment. Their approach is well-suited to evaluating the productivity-enhancing and spillover effects of RRF spending. They find that NGEU should increase aggregate euro-area GDP by about 1.5 percentage points by 2024. Importantly, about one third of this effect comes from spillovers resulting from trade between EU member states. The implication is that simply 'adding up' national effects would underestimate the total effects of NGEU. My approach to assessing the effects of public investment is very similar to that adopted in

this paper. However, as I explain below, there are some important differences between NiGEM and the model used by Pfeiffer *et al.* whose implications it will be important to explore.

Bozou and Creel (2022) also use a DSGE model to examine the effects of NGEU. However, rather than modelling all 27 EU countries as in my paper, they simplify the model to just include two 'countries': the core and the periphery. They carefully distinguish between public consumption and public investment, between grant-financed spending and loan-financed spending, and between an EU-wide fiscal stimulus package and a national fiscal stimulus package. They find strong fiscal multipliers from the use of grants from NGEU to finance public investment spending with a one percentage point increase in public investment relative to GDP increasing GDP by eight per cent after 20 years. These multipliers are higher for grant-financed public investment relative to loan-financed public investment and for public investment relative to public consumption. They also find that a stimulus package financed by NGEU funding would add 0.8 and one percentage points of GDP to the core and the periphery of the euro area, respectively, in comparison with a similar increase of public investment funded domestically. Similarly to Pfeiffer *et al.* (2022), they find that the public investment leads to spillovers, with spending in the core raising GDP in the periphery and vice versa.

Turning to structural reforms, Varga *et al.* (2013) and Varga and in't Veld (2014) used stylised model simulations to examine the effects of various reforms on GDP and productivity growth across the European Union. Varga *et al*. (2013) modelled reforms in product markets, eg, reforms aimed at increasing competition in these markets, as a reduction in the mark-up of prices over marginal costs. They also examined the effects of lowering the costs of entering product markets as many reforms were aimed at reducing the barriers to entry experienced by potential new firms as well as tax reforms that shifted the burden of taxation from labour to consumption and fiscal incentives encouraging investment in research and development and human capital. Varga and in't Veld (2014) used a similar approach considering the same product market and fiscal reforms as well as examining the effects of unemployment benefit reforms and policies aimed at raising the labour force participation rate and improving matching between vacant jobs and unemployed workers. Rather than carrying out the 'benchmarking exercise' of Varga *et al.* and Varga and in't Veld, in this paper I focus on a set of countries with known reforms and analyse the channels through which these reforms might affect GDP and productivity growth.

3 The model

To examine quantitatively the impact of RRF-inspired structural reforms and RRF-financed increases in public investment on economic growth in the European Union in both the short and longer runs, I will make use of NIESR's global econometric model: NiGEM. NiGEM is the leading global macroeconomic model, used by both policymakers and the private sector across the globe for economic forecasting, scenario building and stress testing. NiGEM is used by many European central banks and international organisations such as the OECD. The model consists of individual country models for the major economies that are linked through trade in goods and services and integrated capital markets. The individual country models within NiGEM incorporate long-run relationships grounded in economic theory with flexible lag structures that are fitted to the data. Because NiGEM is fitted to the data, it can be reliably used to calculate the magnitudes of the effects of various economic shocks. Specifically, a model such as NiGEM can provide an efficient way of assessing the development of national economies, disaggregated by demand and supply components, in response to RRF spending. In addition, because NiGEM is a global model with trade and financial linkages across countries, it can be used to examine spillovers: that is, the effects of RRF spending and/or structural reforms in one EU country on the rest of the European Union.

NiGEM contains around 6,000 variables and over 10,000 model equations, as several variables have multiple equation options. It has global coverage with all OECD countries except Colombia, Israel and Luxembourg being modelled individually within it. There are also separate models of Argentina, Brazil, Bulgaria, Chile, China, Estonia, Hong Kong, India, Latvia, Lithuania, Malaysia, Romania, Russia, Slovenia, South Africa and Taiwan, while the rest of the world is modelled through regional blocks: Africa, Middle East, Latin America, Developing Europe, and East Asia. Within NiGEM some countries are represented with 'full' country models and some countries being represented with reduced form models. Within the European Union, NiGEM contains full country models for Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Romania, Spain and Sweden. It contains reduced country models for Bulgaria, Croatia, Estonia, Latvia, Lithuania, Slovakia and Slovenia. Cyprus, Luxembourg and Malta are not modelled separately within NiGEM.

Figures 1 and 2 present a broad schematic overview of country models, distinguishing between the full model and reduced model specifications. As detailed in the figures, the key difference between the two is that in a reduced country model there is no distinction between consumption and investment. That is, rather than split domestic demand into private consumption, private investment, stockbuilding, government consumption and government investment we only have the split between private and public-sector spending and no measure of either private or public-sector capital. In both cases, output is demand determined in the short run and supply determined in the long run. For full country models, long-run supply is determined by population growth, labour force participation, the equilibrium unemployment rate, labour-augmenting technological progress, and the capital stock. For reduced country models, long-run supply is simply determined by trends in the labour force and labour-augmenting technology. Importantly for the analysis contained in this paper, full country models contain a link between government investment and long-run potential output and so can be

used to analyse the long-run effects of RRF spending on investment projects. Unfortunately, this is not the case for reduced country models or for the three countries not modelled separately in NiGEM, though, given these countries only represent less than 4 per cent of EU GDP, this should not make much of a difference to the overall results for the European Union.

Figure 1: NiGEM full country specification

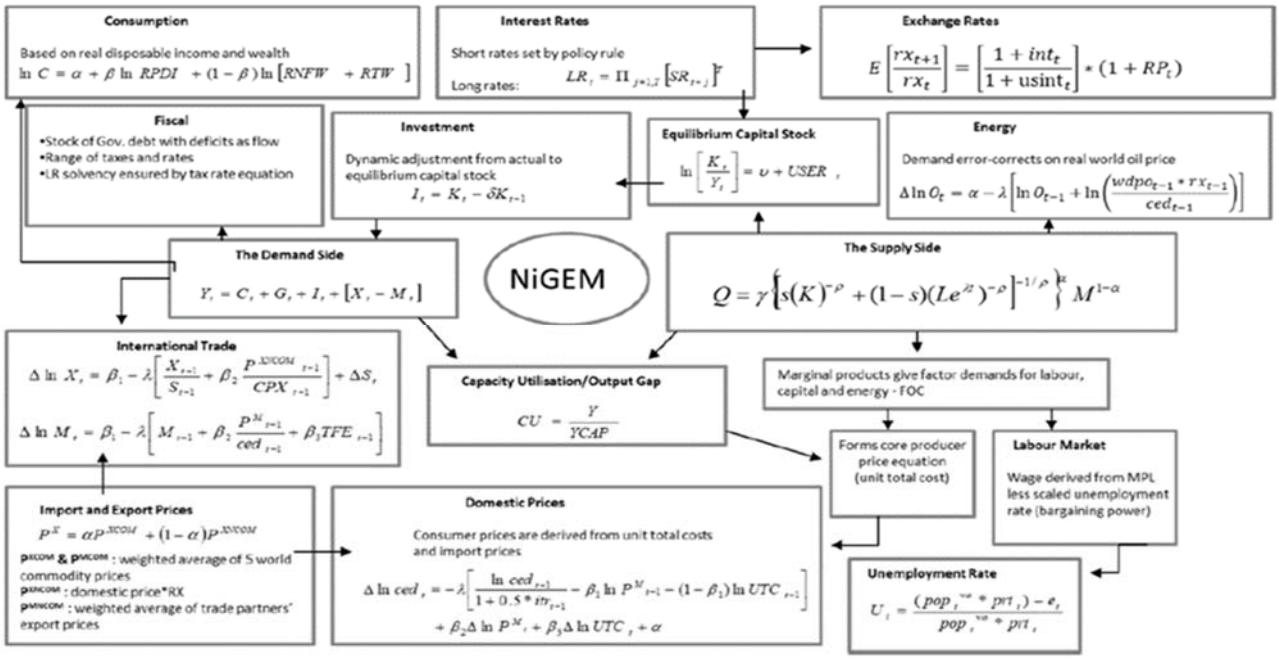
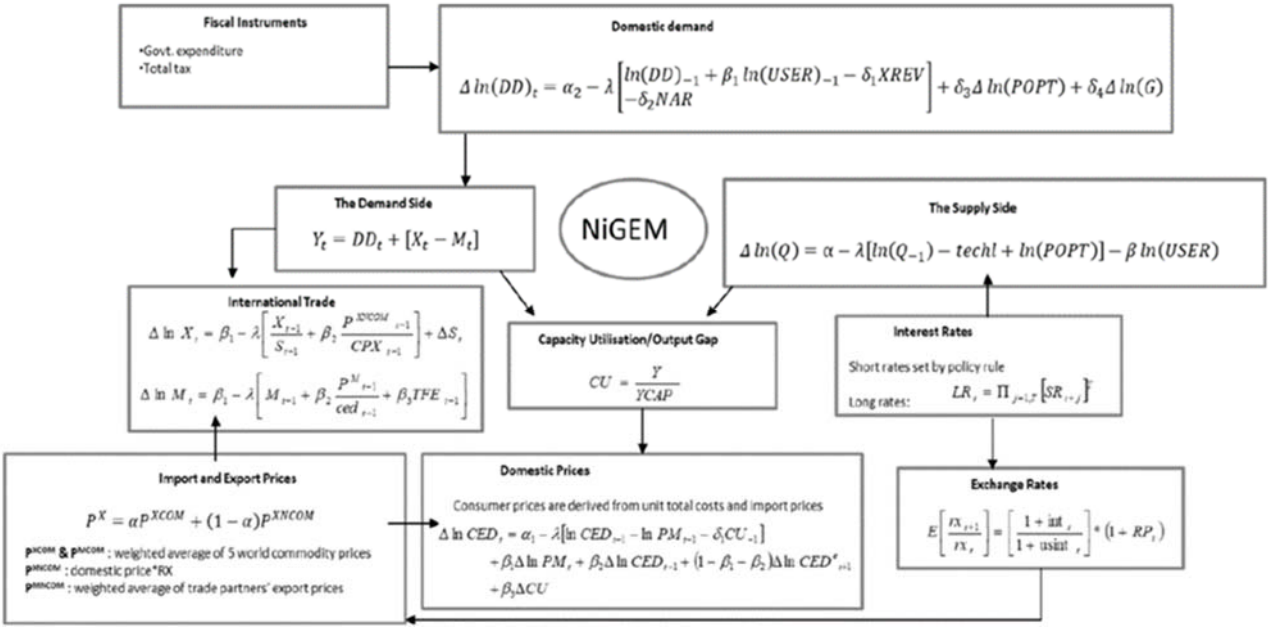


Figure 2: NiGEM reduced country sprecification



Full details of the equations underlying NiGEM can be found in Handzsche et al. (2018) but here we concentrate on the channels through which the RRF, by increasing public investment, may lead to higher EU GDP. We can first note that, for full country models within NiGEM, an increase in public investment, GI, will lead to an increase in GDP in the short run:

$$Y = C + DS + PSI + GC + GI + XVOL - MVOL \quad \textbf{(1)}$$

Where *Y* denotes GDP, *C* denotes household consumption, *DS* denotes stockbuilding, *PSI* denotes private-sector investment, *GC* denotes government consumption, *XVOL* denotes exports and *MVOL* denotes imports. The increase in GDP will depend on the size of the multiplier, which is itself determined by the general equilibrium responses of the other variables in equation **(1)**.

An increase in government investment will also lead to a higher public-sector capital stock, *KG*, in the future:

$$KG = (1 - \delta)KG_{-1} + GI \quad \textbf{(2)}$$

And this higher capital stock itself leads to higher trend output, *YCAP*, and so can increase in GDP in the long run:

$$YCAP = (KP + KG)^{1-\alpha-\theta}(TECHL * ETRND)^{\theta}(OIVOL * Y)^{\alpha} \quad \textbf{(3)}$$

Where *KP* denotes private-sector capital stock, *TECHL* denotes labour-augmenting technical progress, *ETRND* denotes trend employment and *OIVOL* is energy use as a share of GDP.

These are the two channels through which an increase in public investment affects output in NiGEM. As reduced country models do not include investment or capital, for those countries we instead shock total government expenditure. This adds directly to domestic demand and, hence, raises GDP in the short run but it has no effect on potential output or GDP in the long run.

4 The risk premium channel

Although reducing spreads was not *per se* one of the objectives of the RRF, it has been an important positive side effect and it is important that we explore the effects of this as part of any evaluation of the RRF. Specifically, the reduction in spreads has led to an improvement in the public finances in EU countries and, by improving financing conditions for the household and corporate sectors, it will likely lead to increased investment and GDP.

To examine the effects of the announcement of Next Generation EU and its core instrument, the RRF, on spreads, I propose to follow Bankowski et al. (2022) and use an 'event study' approach. Specifically, they measured the impact on spreads as 'the initial decline in sovereign bond spreads that was recorded within three weeks of the announcement, made on 18 May 2020, of the initial Franco-German proposal for a recovery fund' (given that this morphed into NGEU) and I do the

same in this paper. Of course, this approach assumes that the post Covid increase in spreads would have continued had it not been for NGEU and that all of the reduction in spreads over the three-week period resulted from the announcement of a Recovery Fund. The ECB had begun to implement its Pandemic Emergency Purchase programme (PEPP) in March 2020, announcing an increase in its size on 4 June 2020, and had, also in March, increased the amount their counterparties could borrow in the ECB's Targeted Long-Term Repo Operations (TLTROs) and, in April, had eased the conditions for borrowing in these operations. In addition, the European Union had already implemented its Support to mitigate Unemployment Risks in an Emergency (SURE) scheme in April 2020. These initiatives would certainly have acted to reduce bond yields in the Euro Area with probably some effect on bond spreads. In that light, my results should be taken as an upper bound of the effect of the 'Recovery Fund' announcement on bond spreads.

Table A: Reduction in spreads over the three weeks after the Franco-German announcement of a 'Recovery Fund'

Country	Reduction in spread (basis points)
Greece	96.5
Cyprus	92
Romania	75.7
Italy	68.9
Bulgaria	65.7
Slovakia	62.4
Portugal	59.9
Slovenia	52.7
Spain	52.6
Latvia	31.55
Lithuania	30.7
Belgium	24.1
France	21.3
Ireland	21
Croatia	20
Malta	18.5
Finland	17.4
Austria	15.3
Sweden	12.4
Luxembourg	11.55
Denmark	11.2
Czech Republic	9.5
Netherlands	8.7
Poland	2.2
Hungary	1.7

The data was taken from Datastream. For Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden, I used daily data for the 10-year

benchmark bond yields. For Latvia and Luxembourg, the daily data was unavailable and so I had to use monthly data. Finally, the available data for Estonia only begins in June 2020, after the announcement of the Franco-German proposal for a recovery fund, and so I had to leave Estonia out of my calculations. Given the yields, I then calculated for each country for each data point the spread of the benchmark bond yield over the German 10-year benchmark bond yield.

Table A shows the change in this spread between 15 May 2020 (April for monthly data) and 5 June 2020 (June for monthly data) for EU countries excluding Estonia (for data availability reasons) and Germany. The reduction in spreads was sizeable for many EU countries. In particular, for Greece, Cyprus, Romania, Italy, Bulgaria, Slovakia, Portugal, Slovenia and Spain, the reduction in spreads was larger than half a percentage point.

Having estimated the effects of the announcement on country-specific spreads, I then estimated the effects of these movements in spreads on the long-run sustainability of individual member states' governments' fiscal position or, equivalently, the degree of 'fiscal space' available to these governments. The key driver of a government's long-run fiscal position will be its initial debt to GDP ratio, together with its steady-state interest, inflation and growth rates. From the government budget constraint:

$$B_t = (1 + i_{t-1})B_{t-1} + G_t - T_t \quad \textbf{(4)}$$

Where *B* denotes end-of-period nominal government debt, *i* denotes the average nominal interest rate on outstanding government debt, *G* denotes nominal government spending and *T* denotes nominal government receipts. We can calculate the primary budget surplus the government must run as a percentage of GDP to ensure that the debt to GDP ratio does not explode:

$$\frac{T-G}{Py} \geq \left(\frac{(1+i)-(1+\pi)(1+g)}{(1+\pi)(1+g)}\right)\frac{B}{Py} \quad \textbf{(5)}$$

Where *Py* denotes nominal GDP, π denotes the steady-state inflation rate (for the GDP deflator) and g denotes the steady-state growth rate of real GDP. For $1 + i > (1 + \pi)(1 + g)$, then the government must continuously run a surplus in the long run and the higher is the initial level of debt, the higher must be this surplus. A reduction in *i* leads to a fall in the size of the surplus relative to GDP that the government needs to run to ensure that debt does not explode in the long run. So, the reduction in spreads, by reducing *i*, will increase fiscal space. More specifically, for given inflation and growth rates, a reduction in the nominal interest rate of *x* percentage points leads to a fall in the minimum budget surplus of $\left(\frac{1}{(1+\pi)(1+g)}\right)\frac{B}{Py}x$. Table B gives the implied reduction in the required primary budget surplus for each EU country given their current (2022) debt to GDP ratio assuming that inflation is two per cent in the long run and the long-run growth rate is 1.5 per cent for each country. As can be seen Greece and Italy are major beneficiaries with an extra 1.60 and 0.97 percentage points of GDP in fiscal space, respectively. Cyprus, Portugal and Spain also gain more than a half a percentage point of GDP in fiscal space by this measure.

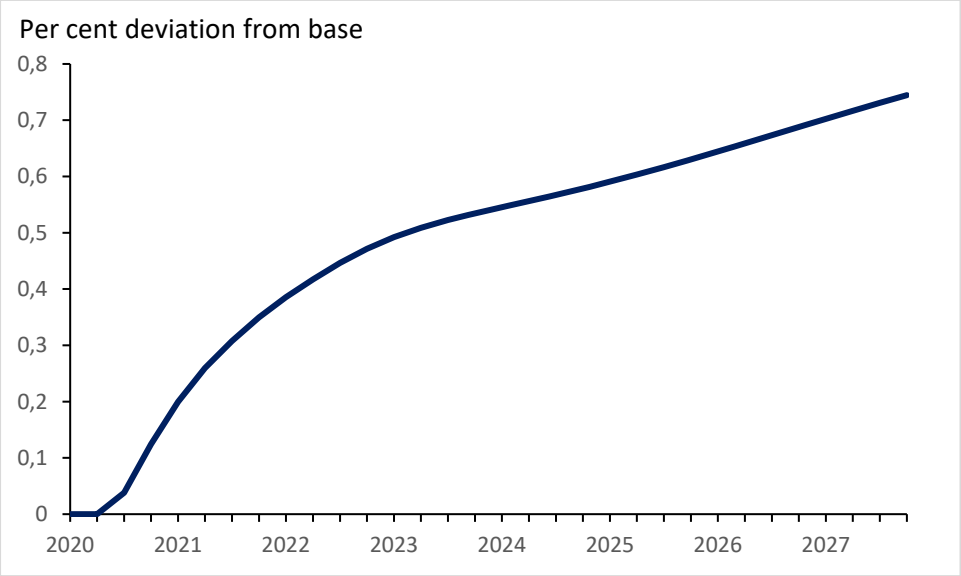
Table B: Reduction in required primary surplus resulting from the reduction in spreads over the three weeks after the Franco-German announcement of a 'Recovery Fund'

Country	Reduction in primary surplus (percentage points of GDP)
Greece	1.604137
Italy	0.965803
Cyprus	0.772821
Portugal	0.662481
Spain	0.578076
Slovenia	0.357673
Slovakia	0.350099
Romania	0.346173
Belgium	0.245935
France	0.231117
Bulgaria	0.145945
Croatia	0.13361
Latvia	0.125028
Finland	0.122444
Austria	0.11656
Lithuania	0.114542
Malta	0.095541
Ireland	0.090493
Netherlands	0.042294
Czech Republic	0.041488
Sweden	0.037716
Denmark	0.032328
Luxembourg	0.027584
Hungary	0.011809
Poland	0.010503

Finally, I use NiGEM to examine the effects of a fall in the spread of a particular EU country's bonds over German bunds on their economies. Within NiGEM, I interpret the fall in spreads as a fall in the 'government risk premium'. But reductions in risk premia only affect newly issued government debt and, so, will take time to pass through into the average interest rate on government debt. NiGEM allows for this by adjusting government debt interest payments to account for the average maturity of the government's debt. A fall in the government risk premium leads to a reduction in the cost of capital for the private sector and, so, an increase in private-sector investment. In NiGEM, the shock translates one-for-one into easier financial conditions for households and firms. Again, this is likely to be an overestimate of the actual effect given that private-sector risk premia reflect other factors, including the extra risk associated with the pandemic. In addition, the increased uncertainty related to the Covid pandemic and its aftermath would likely have made firms reduce their investment response to lower interest rates.

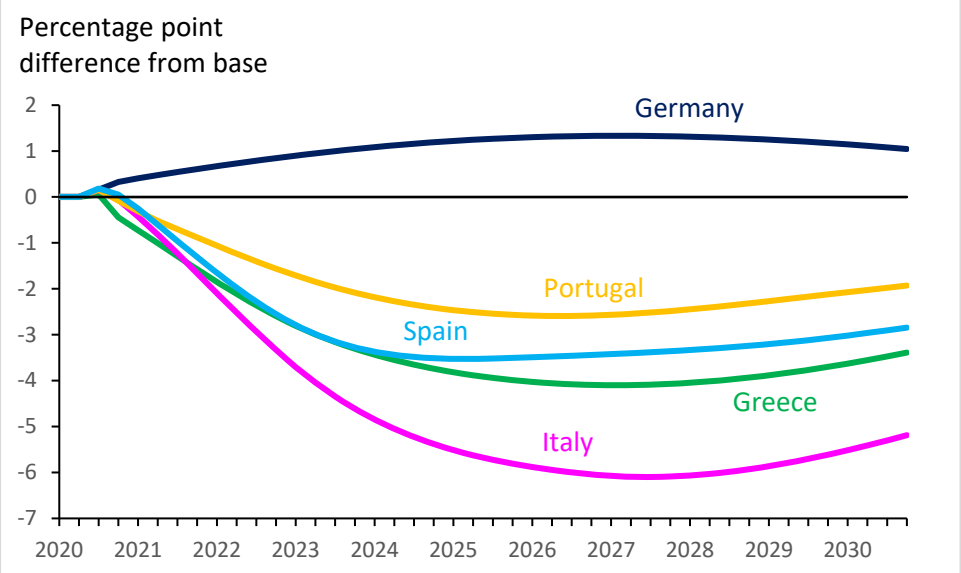
Bearing these caveats in mind, Figure 3 shows the effect on EU GDP over the lifetime of the RRF. As can be seen, the reduction in spreads by increasing consumption and, more importantly, private investment, leads to an increase in GDP. As the increase in investment leads to a rise in the capital stock, trend GDP rises, which is why GDP gets ever further away from its baseline. It should be stressed, however, that this result follows from the assumptions that the change in the government risk premium is permanent – which is unlikely to be the case given the temporary nature of the RRF – and that the change in the government risk premium passes one-for-one into changes in private-sector risk premia. As I said earlier, private-sector risk premia reflect other factors, including the extra risk associated with the pandemic. In addition, the increased uncertainty related to the Covid pandemic, and its aftermath, would likely have made firms reduce their investment response to lower interest rates.

Figure 3: The effect of lower risk premia on EU GDP



Source: NiGEM simulations

Figure 4: The effect of lower risk premia on debt to GDP ratios



Source: NiGEM simulations

The reduction in risk premia had only a small effect on the debt to GDP ratio of most EU countries. However, it is interesting to note that the reduction in spreads led to a significantly lower debt to GDP ratio in Spain, Italy, Greece, and Portugal, the four countries with the highest debt to GDP ratios in the European Union in 2022, as shown in Figure 4. Against that, the debt to GDP ratio in Germany rose. The reduction in spreads was equivalent to a rise in German interest rates relative to its EU trading partners and this led to a small fall in German GDP relative to the baseline and, so, a rise in the debt to GDP ratio.

5 Public spending channel

In order to assess the impact of RRF-financed public spending increases, I carry out stylised model simulations using NiGEM. More specifically, I follow the approach in Pfeiffer *et al.* (2022). We start with a baseline projection for the 27 EU economies and then apply RRF spending in each country as a 'shock' to public investment in that country financed by grants or loans, as appropriate, from the European Union.

The government budget constraint for each country is of the form:

$$B_t = \left(1 + i_{g,t-1}\right)B_{t-1} + G_t + I_{g,t} + Tran_t - Tax_t + EUCont_t - EUGrant_t + \omega i_{EU,t-1}B_{EU,t-1} \quad \textbf{(6)}$$

Where B denotes end-of-period domestic bonds (including RRF loans), i_g denotes the average rate of interest on domestic borrowing, G denotes government consumption spending, Ig denotes public investment, *Tran* denotes transfer payments, *Tax* denotes tax revenue, *EUCont* denotes contributions to the EU (specifically RRF) budget, *EUGrant* denotes RRF grants received from the European Union, B_{EU} denotes EU bonds issued to finance the RRF and i_{EU} is the interest rate on them. I assume that individual member states contribute towards these interest payments in proportion to their weight in EU GDP, ω. Equation **(6)** shows that an increase in public investment financed by RRF grants has no impact on the budget constraint for an individual member state except when EU contributions and/or interest payments rise as the Eu-wide borrowing is paid off.

RRF grants and loans will also affect the current account balance for each country:

$$\frac{NFA_t}{e_t} = \left(1 + i_{f,t-1}\right)\frac{NFA_{t-1}}{e_t} + X_t - M_t - EUCont_t + EUGrant_t \quad \textbf{(7)}$$

Where *NFA* denotes net foreign assets in foreign currency terms, e is the nominal exchange rate expressed as units of foreign currency per unit of domestic currency, X denotes nominal exports, and M denotes nominal imports.

For the European Union as a whole, debt will evolve according to:

$$B_{EU,t} = \left(1 + i_{EU,t-1}\right)B_{EU,t-1} + \sum_{i=1}^{27}\omega_i\left(GR_{i,t} - CO_{i,t}\right) \quad \textbf{(8)}$$

Following Pfeiffer *et al.* (2022), I assume that RRF grants are repaid over the period from 2027 to 2058 with individual member states contributing to this according to their current GDP shares whereas loans are repaid from 2031 to 2050. I assume a linear profile for the repayments and that they are financed by lump-sum taxes.

There will be some differences between the effects of an increase in government investment in this paper and Pfeiffer *et al.* (2022) on account of differences in the models used. In NiGEM, an increase in public investment has a short-run demand effect working through the multiplier and a longer-run supply effect. Specifically, an increase in government investment will lead to a higher public-sector capital stock, k_g, in the future:

$$k_{g,t} = (1-\delta)k_{g,t-1} + I_{g,t} \quad \textbf{(9)}$$

And this higher capital stock itself leads to higher trend output, y_{cap}, and so can increase in GDP in the long run:

$$y_{cap,t} = \left(k_{p,t-1} + k_{g,t-1}\right)^{1-\alpha-\theta}\left(A_t h_{trend,t}\right)^{\theta} En_t^{\alpha} \quad \textbf{(10)}$$

where k_p denotes end-of-period private-sector capital stock, A denotes labour-augmenting technical progress, h_{trend} denotes trend employment and En denotes energy usage. Note that, in NiGEM, private and public capital are perfectly substitutable and, importantly, the presence of public capital does not have a 'productivity-enhancing' effect on private capital.

In their model, by contrast, Pfeiffer *et al.* (2022) also allowed for this externality where public investment makes private capital more productive and, so, the aggregate production function exhibits increasing returns to scale. Specifically, their aggregate production function took the form:

$$y_t = \left(k_{p,t-1}\right)^{\alpha}(A_t h_t)^{1-\alpha} k_{g,t-1}^{\theta} \quad \textbf{(11)}$$

In addition, they slowed down the effects of increases in public investment by adding in 'time-to-build' and 'time-to-spend' delays. By 'time-to-build', they were thinking in terms of the delay between the government authorising an investment project and that project being completed. By 'time-to-spend' they were thinking in terms of the delay between the government authorising the investment project and the project showing up in actual government investment. Since neither of these features is present in NiGEM, the effects of RRF spending come through much more quickly in this paper than in that of Pfeiffer *et al*. (2022).

In both models there is a rich structure of trade that links individual economies together, which leads the effects of public investment in one EU country to spill over to other EU countries. As a result, the effects of public investment happening simultaneously in all 27 member states will be larger than the sum of the individual effects of each of the 27 member states making the investment. To estimate the size of these spillovers, I follow Pfeiffer *et al.* (2022) and apply the investment shocks both 'country-by-country' (ie, obtaining 27 different simulations) and in all countries

simultaneously. The difference between the effects on each country within this simulation and the effects in the individual country simulation can tell us the extent of positive 'spillovers' to other EU countries resulting from RRF spending.

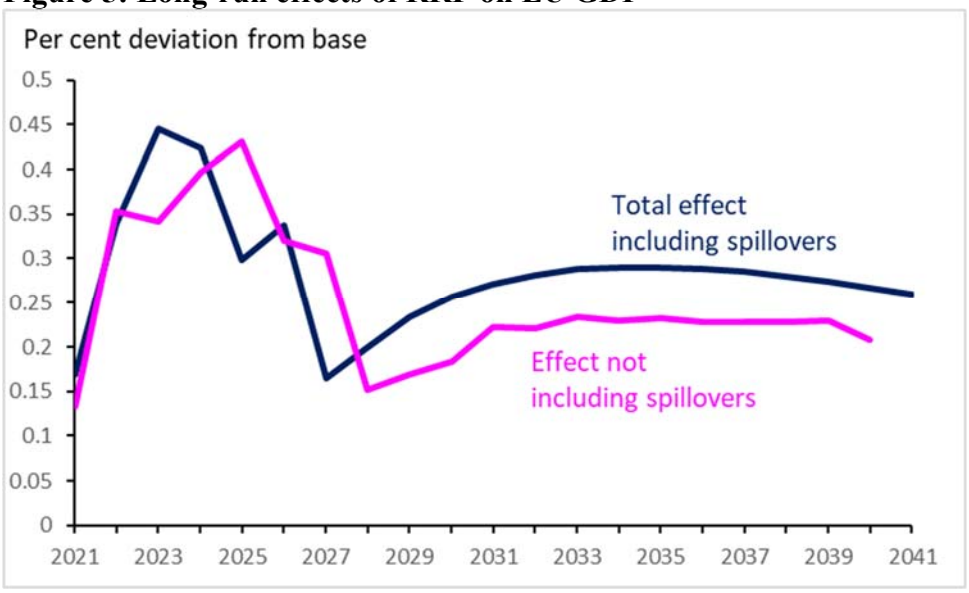
There are some difficulties associated, in particular, with calibrating the size of the public investment increases. I first note the lack of any correlation between RRF disbursements and public investment spending: RRF is a performance-based approach and disbursements are linked to milestones and targets fulfilment and not to actual spending. Furthermore, most Member States have front-loaded reforms and back-loaded investments. For the timing of investments, I followed the same assumption as Pfeiffer *et al.* (2022) whereas for the timing of payments from the European Union to the Member States, I assumed that this reflected their current (as of August 2023) Recovery Plans. As a result, for some countries, I am assuming that the investment precedes receipt of grants and loans, whereas for others, the investment takes place after they receive their grants and/or loans.

Another issue is the distinction between public investment that is financed by RRF 'Grants' versus 'Loans'. Unlike grants, public investment financed by RRF Loans contribute directly to public-sector debt in the borrowing country and carry an additional interest rate cost. The interest rate charged on RRF loans – which represent the cost of joint EU borrowing – will be lower than the borrowing country would have to pay to borrow those funds in the normal way. This represents an additional benefit to financing public investment through the RRF. Indeed, it is noticeable that those countries that have requested loans – Greece, Italy, Cyprus, Poland, Portugal, Romanis and Slovenia – are all countries whose domestic interest rates are high relative to EU borrowing rates. That said, this additional benefit is relative to a counterfactual in which the country was going to borrow those funds anyway. For public investment that would not otherwise have happened unless financed by the RRF, the interest payments – though relatively low – still remain a 'cost'. Following Pfeiffer *et al.* (2022), I assume that 50 per cent of loans represent new public investment while the remaining 50 per cent represent money that would have been spent anyway, with the benefit of the RRF coming from the reduction in interest rates. For grants I assume that they are entirely spent on new public investment.[1]

Finally, I follow Pfeiffer *et al.* (2022) and assume that Member States cover the interest payments on EU borrowing in proportion to their 2021 share of total EU GDP, and that grants are paid back between 2027 and 2058 and loans from 2031 to 2050, again in line with Member States' 2021 GDP shares.

[1] In a future version of this paper, I intend to run some robustness analysis where I assume a lower fraction of grants and loans are spent on new investment projects and make a distinction between the core EU countries – who are more likely to spend the funds on existing planned public investment projects – and the Southern and Eastern EU countries. who are more likely to spend the funds on new public investment projects.

Figure 5: Long-run effects of RRF on EU GDP



Source: NiGEM simulations

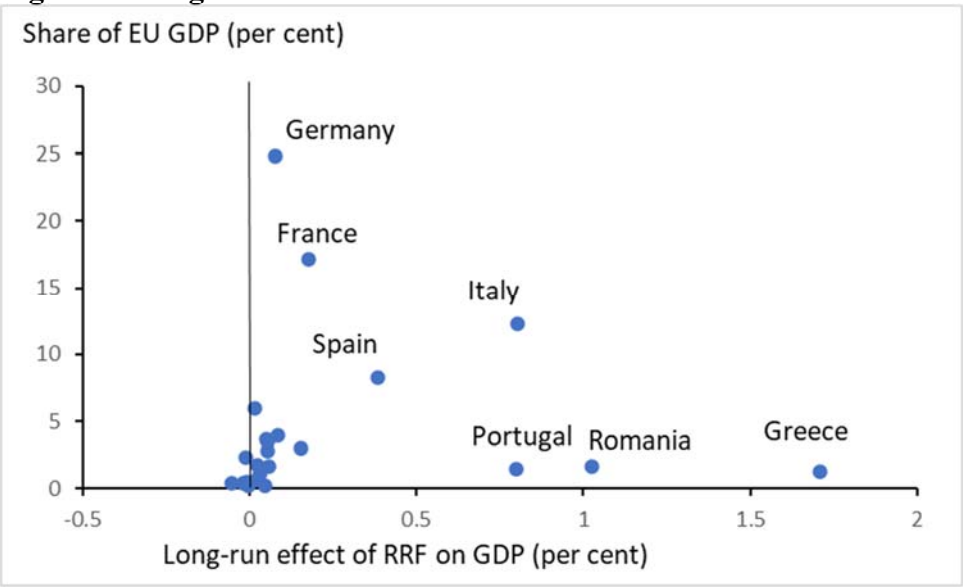
Figure 5 shows the results of simulating the effects of the RRF using NiGEM. As can be seen, the public investment resulting from the RRF raises demand in the short run, with EU GDP in 2023 0.45 per cent higher than it would have been absent the RRF. The lack of smoothness in the GDP response results from the lack of smoothness in RRF disbursements as 'crowding out' resulting from the increased government spending in each country will be smaller or larger depending on whether this increase in spending is financed initially by domestic borrowing or by an RRF transfer. These 'timing effects' also explain why there can be negative 'spillover effects' in the short run. Where grants are made to MSs using funds raised in the financial markets by the European Union, other MSs will need to cover part of the interest payment on this funding. For those MSs yet to receive RRF payments, these interest payments act as a 'negative spillover', which could potentially outweigh the positive spillovers coming through trade effects, at least in the short run.

In the long run, where these 'timing effects' no longer matter, the public investment spending leads to a rise in supply, and so potential output and GDP. Specifically, our results suggest that the RRF raises long-run EU GDP by a little over 0.25 per cent. The difference between our results and those of Pfeiffer *et al.* (2022) can be explained by the lack of spillover effects from public capital to private capital in the production functions underlying NiGEM. As I discussed earlier, in NiGEM, public and private capital are perfectly substitutable – whereas in the QUEST model used by Pfeiffer *et al.* the elasticity of substitution is unity – and the aggregate production function has constant returns to scale. Indeed, my long-run results are more or less in line with the 'low productivity' case considered in Pfeiffer *et al.*

Figure 6 shows the long-run effects of the RRF on individual EU Member States (specifically, the difference between the GDP projection in 2040 accounting for the RRF and a baseline projection with no RRF). The effects on most Member States are small, clustering in the zero to 0.15 per cent region. For a number of countries, this results from the way they are modelled within NiGEM. Specifically, for Bulgaria, Croatia, Estonia, Latvia, Lithuania, Slovakia and Slovenia, which are

'reduced country' models, all government spending is treated as 'consumption' and so does not add to the economy's capital stock, which is the main way that government investment raises GDP in the long run. But even for those countries where this channel is present, the effect is small, given the assumption of constant returns to scale in production and a unit elasticity of substitution between public and private capital. For the small number of countries where the RRF has a particularly noticeable long-run effect, either because the RRF payments represent a significant fraction of their GDP, or the elasticity of output with respect to capital is particularly large, or both, this effect is larger for the relatively poorer southern European countries, which were also particularly badly affected by the Covid pandemic.

Figure 6: Long-run effects of the RRF on individual MSs



Source: NiGEM simulations

We can summarise the effects of the RRF spending via their multiplier, which we calculate as the ratio of the absolute cumulative change in real GDP predicted by our model to occur by 2041 as a result of the RRF (against the baseline) to the total RRF payments (both grants and loans). Table C shows these multipliers both at the Member State level and the EU level. It is important to note that the ratio associated with the entire European Union will not correspond to the average of the national ratios as a result of the spillover effects described above. The table suggests that the EU-level quantifiable impact of the RRF on GDP is more than twice the disbursed RRF funds.

When examining the multipliers for individual countries, the situation varies. We first recall that, for a number of EU countries – specifically Bulgaria, Croatia, Estonia, Latvia, Lithuania, Slovakia and Slovenia – we cannot capture all of the benefits of RRF spending given the way these countries are modelled within NiGEM. In addition, Cyprus, Luxembourg and Malta are not modelled at all within NiGEM. As a result, we do not report the multipliers for these countries. For the remaining countries (ie, those for which we have 'full country' models within NiGEM), we find that the multiplier is greater than one in all countries except Denmark, where it is close to one. This indicates that the benefits of the RRF outweigh the costs in all countries except Denmark, and quite considerably in some, e.g., Ireland, Germany and Portugal.

Table C: RRF multipliers

Country	Cumulative change in real GDP (2015EU millions unless otherwise stated)	Real payments (2015 EU millions unless otherwise stated)	Multiplier
Austria	6112	2844	**2.15**
Belgium	8864	3272	**2.71**
Czechia (2015 CZK millions)	139171	138630	**1.00**
Denmark (2010 DKr millions)	7721	8254	**0.94**
Finland	1662	1507	**1.10**
France (2014 EU millions)	75683	31773	**2.38**
Germany	73077	21915	**3.33**
Greece	59511	26826	**2.22**
Hungary (2015 HUF millions)	1372068	1243536	**1.10**
Ireland (2020 EU millions)	8379	790	**10.60**
Italy	389135	166984	**2.33**
Netherlands	4289	3448	**1.24**
Poland (2010 Zloty millions)	109540	90311	**1.21**
Portugal (2016 EU millions)	46309	14604	**3.17**
Romania (2015 Leu millions)	171463	78525	**2.18**
Spain	132427	63840	**2.07**
Sweden (2022 SKr millions)	61705	23907	**2.58**
European Union	394595.10	912489	**2.31**
European Union Discounted	391750.47	884763	**2.26**

Source: NiGEM simulations

6 Structural reforms channel

Perhaps the most important long-run channel through which the RRF will affect European economies will be the structural reforms that the MSs put in place as part of their Recovery and Resilience Plans. These structural reforms have been put in place specifically to address six pillars: the green transition; digital transformation; smart, sustainable and inclusive growth; social and territorial cohesion; health and economic, social and institutional resilience; and education and skills. Unfortunately, though, we cannot explicitly quantify the impacts of these reforms, either in the short run or the long run. Instead, we use NiGEM to consider the macroeconomic channels through which a subset of these reforms have effects on GDP and productivity in both the reforming MSs and the European Union as a whole. Specifically, we consider reforms to the labour market, education, investment incentives and the legal system. We should note at this point that this stylised approach cannot be taken as an assessment of the quantitative effects of the RRF reforms we consider; rather it simply gives us an idea of the channels through which these reforms can work.

We first consider labour market reforms. The Spanish Government has instituted several labour market reforms, including simplifying contracts, restricting the use of temporary and short-term contracts, generalising open-ended contracts (making it harder to 'fire' workers), and setting up training/apprenticeship contracts to encourage greater labour supply. They also established a permanent 'short time working scheme' to adjust to cyclical and structural shocks, including a system that provides internal flexibility to companies and stability to workers. Such reforms act to make employment more stable, but possibly at the expense of a higher average unemployment rate, given that firms would then have a disincentive to hire since it would be harder to then lay off workers in a downturn. Indeed, Millard and Mortensen (1997) show that increased costs of laying off workers – which would be implied by the Spanish reforms – lead to a higher unemployment rate. The Croatian Government also instituted new active labour market policies to boost employment and self-employment with a particular focus on the activation of the long-term unemployed. Such a policy is likely to bring down the natural rate of unemployment by increasing job creation as well as increasing labour market participation.

Within NiGEM, we can examine the effects of reforms aimed at increasing labour force participation. We find that a rise in participation leads to greater GDP over time as the increased labour force is gradually assimilated into employment. The size of this effect depends on the elasticity of potential output with respect to the size of the labour force but is somewhere between roughly 0.5 and 1.0 per cent of GDP per percentage point increase in the participation rate.

Education reforms have been introduced in a number of MSs, including Bulgaria and Croatia. In addition, the Spanish reforms mentioned earlier include the introduction of new training/apprenticeship contracts, which should lead to upskilling within the existing labour force. In all three cases, these reforms will raise labour productivity in the long run, in turn raising potential output and GDP. The size of this effect will again depend on the elasticity of potential output with respect to labour productivity but is somewhere between roughly 0.5 and 1.0 per cent of GDP for a one per cent increase in labour augmenting technical progress. But it will take time – possibly more

than a decade – for the education reforms to lead to a significantly better educated and more productive workforce. Our results using NiGEM also suggest that employment falls, and the unemployment rate increases, in the short run, as less labour is needed to produce the same amount of GDP. But as the rise in labour productivity continues, firms start hiring more labour until the unemployment rate has returned to its 'natural rate', which is unaffected by the reforms. The extent to which this might happen in reality would depend on how fast relatively higher productivity jobs are created relative to the speed with which the educational reforms lead to a more productive workforce.

Various MS governments, including Bulgaria and Germany, have adopted reforms that should make investment more attractive. More specifically, Germany has introduced a joint programme at national and regional levels to tackle investment bottlenecks, while the Bulgarian parliament passed the Industrial Parks Act, which created a legal framework to attract industrial investment and develop industrial ecosystems. To the extent these policies are successful, we would expect them to lead to higher business investment, increasing demand in the short run and supply (i.e., potential output and GDP) in the long run. Within NiGEM, the effects are of a similar magnitude to the increases in public investment that we have already discussed; that is, we would expect each additional euro of investment resulting from the reforms to result roughly in an additional two euros of GDP (i.e., a multiplier of around two).

Our final example involves reforms to the justice systems. In Italy, for example, reforms have been mainly focused on reducing the length of civil and criminal proceedings by identifying a wide range of actions to reduce the number of incoming cases in courts, by simplifying existing procedures, by reducing the backlogs and by increasing the productivity of courts. Similarly, the Croatian government is seeking to establish a legal, organisational, and technological framework that shall contribute to reducing backlogs and shortening court proceedings and focusing on the transparent and efficient administration of the justice system. In both cases, we might expect such reforms to reduce various risk premia in financial transactions. At the national level, this would act to lower the government bond spread, with knock-on effects on domestic borrowing rates as discussed above; at a sub-national level, increased certainty would act to lower the investment premium (i.e., the spread of private sector borrowing for investment over the risk-free rate). Both effects would lead to an increase in private investment and, so, domestic demand in the short run and potential output and GDP in the long run. Again, we would expect each additional euro of investment resulting from the reforms to result roughly in an additional two euros of GDP (i.e., a multiplier of around two).

7 Conclusions

In this paper, I have attempted to evaluate the macroeconomic effects of the RRF within the context of a macroeconometric model, specifically the National Institute of Economic and Social Research's global macroeconometric model, NiGEM. I have examined the effects both on individual EU member states as well as the European Union as a whole, given the presence of potential spillovers between EU countries. Following Bankowski *et al.* (2022), I considered three key channels through which the RRF can impact the macroeconomy: the risk premium channel, the public investment channel, and the structural reforms channel. I found that the original Franco-German announcement of a recovery fund on 18 May 2020 led to a sizeable reduction in spreads for many EU countries. In turn, this led to large gains in 'fiscal space' for, in particular, Cyprus, Greece, Italy, Portugal and Spain, while only having a small effect on the debt to GDP ratio of most EU countries and a negligible effect on GDP. In terms of public investment, I found that this raised demand in the short run, with EU GDP in 2023 0.45 per cent higher than it would have been absent the RRF, and supply in the long run with long-run EU GDP a little over 0.25 per cent higher than it would have been absent the RRF. In terms of the implied multiplier, I found that the EU-level quantifiable impact of the RRF on GDP should be a little more than twice the disbursed RRF funds.

Finally, although the most important long-run channel through which the RRF will affect European economies will be the structural reforms that the MSs put in place as part of their Recovery and Resilience Plans, I was not able explicitly to quantify the impacts of these reforms, either in the short run or the long run. But I used NiGEM to consider the macroeconomic channels through which a subset of these reforms have effects on GDP and productivity in both the reforming Member States and the European Union as a whole. In future work, I hope by carefully calibrating the impact of some reforms on the premia they might be expected to affect to obtain some, at the very least, rough results on the expected magnitude of these reforms on GDP in the Member States applying them.

References

Bankowski, K, Bouabdallah, O,Domingues Semeano, J, Dorrucci, E, Freier, M, Jacquinot, P, Modery, W, Rodríguez-Vives, M, Valenta, V and Zorell, N (2022), 'The economic impact of Next Generation EU: A euro area perspective', European Central Bank *Occasional Papers* No. 291.

Bozou, C and Creel, J (2022), 'Comparing different features of a fiscal stimulus in the euro area', Sciences Po, *mimeo*.

Hantzsche, A, Lopresto, M, and Young, G (2018), 'Using NiGEM in uncertain times: Introduction and overview of NiGEM', *National Institute Economic Review*, Vol. 244, pages R1-R14.

Millard, S P and Mortensen, D T (1997), 'The unemployment and welfare effects of labour market policy: A comparison of the USA and the UK', in Snower, D J and de la Dehesa, G (eds.), *Unemployment policy: Government options for the labour market*, Cambridge, United Kingdom: Cambridge University Press.

Pfeiffer, P, Varga, J and in't Veld, J (2022), 'Quantifying spillovers of coordinated investment stimulus in the EU', *Macroeconomic Dynamics*, published online.

Varga, J, Roeger, W and in't Veld, J (2013), 'Growth effects of structural reforms in Southern Europe: The case of Greece, Italy, Spain and Portugal', European Commission *Economic Papers* No. 511.

Varga, J and in't Veld, J (2014), 'The potential growth impact of structural reforms in the EU: A benchmarking exercise', European Commission *Economic Papers* No. 541.

Watt, S and Watzka, S (2020), 'The macroeconomic effects of the EU recovery and resilience facility: A preliminary assessment', Institut für Makroökonomie und Konjunkturforschung *Policy Brief* No. 98. #
#