Report on the Impact Assessment

of the Recovery and Resilience Plan of Cyprus Preliminary Draft

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ABSTRACT

Under the Recovery and Resilience Plan (RRP), Cyprus is expected to draw significant funds totalling around 1.2 billion euro in the period 2021-2026. The economic impact assessment of the Cypriot RRP has provided estimates of the Plan's macroeconomic impact in the short, medium and long term. The analysis adopts several complementary methods and techniques – a Production Function approach, econometric models, and an Input-Output framework – to obtain multiple perspectives on the potential impacts.

Our Production Function (PF) approach evaluates the effects of RRP measures across all time horizons and accounts for reforms and it is therefore considered the primary method for this impact analysis. Results show that the RRP can increase the GDP of Cyprus by about 3% in the short-term and by around 7% in the medium-term), compared to the baseline development of the economy without the RRP. Reforms, among others, of public and local administration, the judicial, and the labour market would significantly affect productivity and GDP growth, in the medium-term and especially in the long-term. In the short- term, GDP growth is mainly induced directly by RRP investments and to a lesser extent by an increase in productivity and by additional employment stimulated by the Plan. In the medium-term, the effect of productivity becomes stronger due to the full implementation of reforms. In particular, the contribution of productivity to GDP and employment rises from 10.6% and 13.2% in the short-term and 23.5% and 29.3% in the medium-term. The Plan also increases employment by more than 2.5%, or by around 11,000 new jobs during the period 2021-2026, which can significantly reduce the unemployment rate in Cyprus.

The positive effects of the RRP are projected to be largely maintained in the long-term. GDP levels are expected to be 16.5% higher 20 years ahead (i.e. in 2041) compared to a scenario without RRP implementation. This is mainly due to the lasting contribution of productivity (reforms), if all reforms foreseen in the RRP are realized. Reforms account for around 60% and 75% of GDP and employment increase, respectively relative to the baseline scenario.

The results of the econometric analysis are broadly in line with the above findings and show that the maximum effect of the RRP on the growth rates of GDP and employment is realized in 2025-2026, which coincides with the end of the period of implementation of the RRP. Finally, the Input-Output analysis offer insights into the sectors of the economy that will be most significantly affected and assessed the broader welfare impacts of the Plan's green economy measures of the RRP due to environmental co-benefits.

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1. Impact Assessment Study of the Recovery and Resilience Plan of Cyprus: Executive Summary

Under the Recovery and Resilience Plan (RRP), Cyprus is expected to draw significant funds totalling around 1.2 billion euro over the period 2021-2026. This report analyses the economic impact assessment from the implementation of the RRP. In particular, it provides estimates of the short-medium- and long-term macroeconomic effects of the RRP. The analysis adopts several complementary methods and techniques - Production Function, econometric models, and an Input-Output framework – in order to assess the impact of all the measures included in the Plan.

The first method uses a Production Function - Growth Accounting framework to predict the evolution of the main macroeconomic variables (output and employment) from implementing the Recovery and Resilience Plan (RRP) of Cyprus. This approach evaluates the effects of RRP measures across all time horizons and accounts for reforms and it is therefore considered the primary method for this impact analysis. RRP measures lead to changes in the output growth of the economy that come through changes in the human capital and the capital inputs, adjustments in the labour input (conditional on the capital stocks and human capital), as well as through changes in the productivity growth.

The effects of the measures included in the RRP of Cyprus on output and employment are assessed for the short-term (2 years ahead), medium-term (5 years ahead) and long-term (20 years ahead) periods. The results (summarized in Table 1.1) show that the RRP can increase the level of the Cyprus GDP by about 3% two years ahead and by around 7% five years ahead compared to the baseline scenario (non-implementation of the Recovery Plan). In the short-term, GDP increase is caused by 69.5% directly from RRP investments, by 10.6% from an increase in productivity (reforms) and by 19.9% from additional employment. In the medium-term, RRP measures contribute to GDP increase by 56.6%, productivity by 23.5% and additional employment by 19.9%, relative to the baseline scenario.

Growth stimulated by the RRP is expected to be maintained in the long run: GDP levels are expected to be 16.5% higher 20 years ahead (i.e. in 2041) compared to a scenario without RRP implementation. Around 60% of this increase comes from productivity improvements relative to the baseline scenario if all reforms foreseen in the RRP are realized.

Focusing on the period of the implementation of the Plan, the 7% increase in GDP, relative to the baseline scenario, implies on average an additional 1.2 percentage points of GDP growth per year during 2021-2026. During the same period, the Plan increases employment by more than 2.5%, or by around 11,000 new jobs, which can significantly reduce Cyprus's unemployment rate.

Table 1.1: Economic impact of the RRP.

		Quantification of the impact % difference from policy neutral baseline					
		Short-term (2 years ahead)		Medium-term (5 years ahead)		Long-term (20 years ahead)	
		GDP	Employment	GDP	Employment	GDP	Employment
	Overall	**2.9%**	**1.1%**	**6.8%**	**2.6%**	**16.5%**	**6.2%**
Priority axis 1	Public health, civil protection and lessons learned from the pandemic	4.4%	5.6%	3.7%	3.3%		
Priority axis 2	Accelerated transition to a green economy	15.9%	19.8%	13.7%	14.1%		
Priority axis 3	Strengthening the resilience and competitiveness of the economy	34.8%	43.4%	26.5%	33.9%		
Priority axis 4	Towards a digital era	5.9%	7.4%	4.8%	9.0%		
Priority axis 5	Labour market, education and human capital	8.5%	10.6%	7.8%	10.4%		
	Total Contribution of the components	**69.5%**	**86.8%**	**56.6%**	**70.7%**	**20.0%**	**25.0%**
	Productivity Contribution (not quantified RRP measures)	10.6%	13.2%	23.5%	29.3%	59.8%	75.0%
	Labor Contribution	19.9%		19.9%		19.9%	
	Total Contribution to Overall Impact	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

The impact assessment of the RRP on key macroeconomic indicators of the Cyprus economy was also evaluated using alternative econometric time series models to capture the dynamic effects of the RRP. We use various VAR specifications and estimation methods, such as Structural VARs, FAVARs and frequentist and Bayesian VARs. Using these alternative VAR-type models we examine the difference between the two scenarios, the baseline/unconditional forecasts of key macro variables such as GDP and Employment growth (without the RRP) vis-à-vis the conditional forecasts of the aforementioned variables that include the RRP. We quantify the dynamic difference between the conditional forecasts from the baseline forecasts every year, identifying and quantifying the periods with the most significant impact. In addition, we estimate but also how long will the RRP impact last within the long-term of 20 years ahead, ceteris paribus.

More precisely, these dynamic models forecast the conditional path of key macroeconomic indicators, GDP and Employment growth, with the RRP which are compared with the baseline forecasts without the RRP. Figures 1.1a and 1.2a below, show these forecasts for these two scenarios for GDP and Employment growth, respectively. In addition, Figures 1.1b and 1.2b show the corresponding percentage difference between these two scenarios which quantifies the impact of the Cypriot RRP plan, for GDP and Employment, respectively. We find that the maximum effect of the RRP on the growth rates is realized in 2025-2026, which coincides with the end of the medium-term period of the RRP.

The econometric approach employs a number of model specifications and channels of the impact of the RRP and yields respective ranges of GDP and Employment of 3.4-5.6 and 1.8-2.8 percentage difference from the policy-neutral baseline (without the RRP) over the medium-term horizon, up to 2026. The econometric methods yield results, which are comparable to the main method of this report, the Production Function approach without reforms which finds the corresponding figures to be 4.8% and 1.8%, for GDP and Employment, over the medium-term. Moreover, we find that the impact of the RRP on GDP and Employment growth rate will last until 2030, as shown in the Figure

below, ceteris paribus. It is worth noting that these econometric models assume mean reversion and do not explicitly capture the impact of reforms compared to the Production Function method.

Figure 1.1a: GDP growth forecasts based on the RRP and baseline

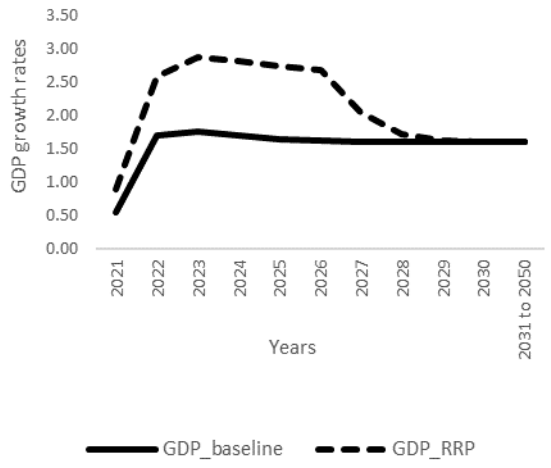


Figure 1.1b: Difference in the GDP growth forecasts between the RRP and baseline

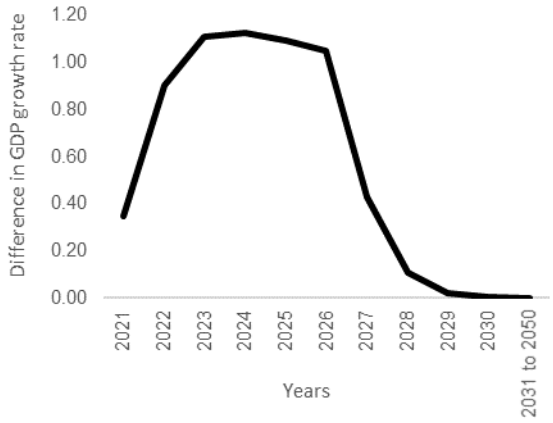


Figure 1.2a: Employment growth forecasts based on the RRP and baseline

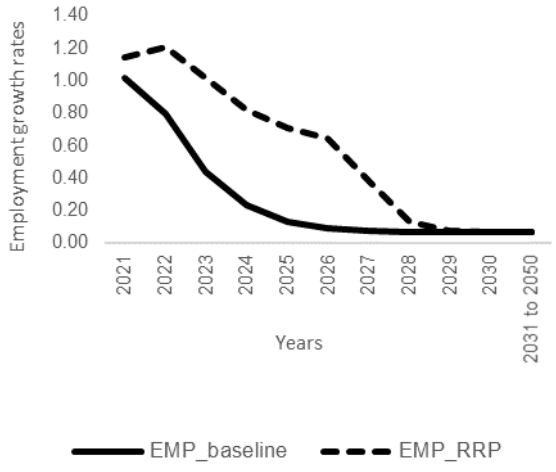
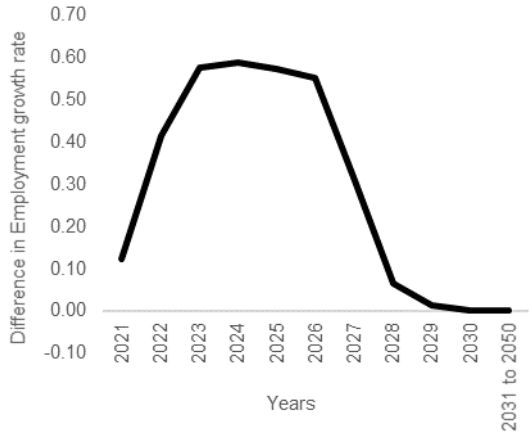


Figure 1.2b: Difference in the Employment growth forecasts between RRP and baseline



The third method analyses the results of the economic impact assessment of the reforms and investments under all priority axes of the RRP based on a Leontief demand-driven Input-Output (IO) model that has been developed and applied for Cyprus and covers all sectors of the economy. IO is a quantitative technique for studying the interdependence of production sectors in an economy over a stated period, which has been extensively applied for policy impact evaluation, technical change

analysis and forecasting. This assessment examines short-term and medium-term impacts, i.e. periods for which the input-output model can conduct simulations with reasonable reliability; assessments for the longer term would be less reliable and have not been considered.

According to the IO simulations, RRP investments increase GDP level by about 1.5% in the short term and 3.8% in the medium term. The GDP estimates under this method are close to the corresponding figures of the other two methods excluding reforms. In contrast, employment figures are higher and could be thought of as the upper bound. Despite the limitations of the IO approach for assessing policy impacts in the long term, it offers insights into the sectors of the economy that will be most significantly affected by the RRP such as for instance the green measures, among others. Chapter 4 presents results of these sectoral impacts.

2. Economic Impact Assessment of the Recovery and Resilience Plan of Cyprus

2.1 Introduction

This chapter evaluates the effects of the Recovery and Sustainability Plan on the Cyprus economy, in the context of a Production Function - Growth Accounting framework. To assess the impact of the RRP measures, it is necessary to map them with the appropriate variables of the model in order to identify the main channels through which they affect the economy. To this end, the RRP measures were matched with major investment categories in the economy that they are likely to affect.

The results show that the implementation of the RRP could potentially increase the level of GDP and employment by 6.8% and 2.6% respectively by 2026, compared to the baseline scenario, which is defined as the state of the economy without the implementation of the Plan. This implies an additional GDP growth of approximately 1.2 percentage points on average each year for the period 2021-2026. The 2.6% increase in employment, corresponds, ceteris paribus, to the creation of around 11,000 new jobs which can significantly reduce the unemployment rate in Cyprus.

After 2026, when the disbursement of resources ends, the economy gradually returns to the initial state of long-term equilibrium. However, the positive effects on GDP and employment remain for even 20 years later (16.5% increase in the level of GDP and 6.2% in employment by 2041, compared to the baseline scenario). This is mainly due to the positive lasting contribution of productivity improvements, if all reforms foreseen in the RRP are realized. The effect of Infrastructure and Other physical capital that also remains in the long – term since the depreciation rates of these two capital stocks is very low.

In summary, the following priority axes and components are analysed:

- Priority axis 1: Public health and civil protection - lessons learned from the pandemic (Components: 1.1. Resilient and effective health system and improved civil protection)
- Priority axis 2: Accelerated transition to a green economy (Components: 2.1 Climate neutrality, Energy efficiency and renewable energy penetration; 2.2 Sustainable transport; 2.3 Smart and Sustainable Water Management)
- Priority axis 3: Strengthening the resilience and competitiveness of the economy (Components: 3.1. New growth model and diversification of the economy; 3.2. Enhanced research and innovation; 3.3. Business support for competitiveness; 3.4. Public and Local Administration Reform, Judicial reform and Anti-corruption reform; 3.5. Safeguarding fiscal and financial stability)
- Priority axis 4: Towards a digital era (Components: 4.1. Upgrade infrastructure for connectivity; 4.2. Promote e-government)
- Priority axis 5: Labour market, education and human capital (Components: 5.1. Educational system modernization, upskilling and retraining; 5.2. Labour market).

2.2 Methodology

2.2.1 Economic Model

It is assumed that the production process of the Cyprus economy follows a Cobb-Douglas production function of the form

$$Y_t = A_t L_t^{a_1} H_t^{a_2} \prod K_{it}^{b_i}, (1 < a_i, b_i > 0) \quad (1)$$

where *Y* is the quantity of output, *A* is the level of productivity or exogenous technical change, *L* is the labor input quantity, *H* is the average level of human capital, K_i are the quantities of capital inputs and the parameters α_i and b_i are the output elasticities. In order to calibrate our economy, we have to specify the output elasticities, level of productivity and the quantities of output and inputs. The quantity of output *Y*, measured as value added in constant 2010 prices, the labor input measured in man hours and the level of human capital measured as the population average of accumulated education and health expenditures in constant prices, are obtained from Eurostat. In addition, we have obtained and constructed investment quantities in constant 2010 prices of the following capital inputs: Information and Communication Technology (ICT), Research and Development (R&D), Infrastructure, and Other physical capital. To construct the capital stocks we use the perpetual inventory method assuming a constant deprecation rate δ_i for each capital stock.[1] Thus, the capital stock *i,* at time *t,* is given by

$$K_{it} = I_{it} + (1 - \delta_i) K_{it-1} \quad (2)$$

The output elasticities α_i and b_i used to calibrate the model are obtained from the literature (various sources, see Section 2.3, Table 2.3) and are summarized in Table 2.4. Assuming that firms maximizing profits, then the sum of labor and capital elasticities should be equal to the observed labor and capital income shares, that is

$$\begin{aligned} \sum a_i &= s_L, \\ \sum b_i &= s_K \end{aligned} \quad (3)$$

where s_L is the labor income share and s_K (=1 — s_L) is the capital income share. In order to obtained an estimate of the productivity change we calculate the productivity change residually, as the output growth minus the weighted average of all inputs growth, where the weights are the output elasticities,

$$\widehat{A_t} = \ln \frac{A_t}{A_{t-1}} = \ln \frac{Y_t}{Y_{t-1}} - a_1 \ln \frac{L_t}{L_{t-1}} - a_2 \ln \frac{H_t}{H_{t-1}} - \sum b_i \ln \frac{K_{it}}{K_{it-1}} \quad (4)$$

Expressing equation (1) in a growth form we have

$$\widehat{Y_t} = \widehat{A_t} + a_1 \widehat{L_t} + a_2 \widehat{H_t} + \sum b_i \widehat{K_{it}} \quad (5)$$

where a variable with $\widehat{\ }$ denotes growth rate.

[1] For details on the construction of depreciation rates see the data section and Table 2.1.

In order to obtain estimates of the output growth of the economy, first we assume that the economy is in a steady state and output growth of the economy will change due to changes of investment funded by the government which leads to changes in human capital and capital inputs (equation 2) and second that firms adjust the labor input by maximizing profits conditional on the capital stocks and human capital,

$$\max_{L} P_t A_t L_t^{a_1} H_t^{a_2} \prod K_{it}^{b_i} - w_{Lt} L_t$$

where P_t, ω_{Lt} are the prices of output and labor respectively. Then, the conditional labor demand is given by

$$L_t = a_1^{\frac{-1}{a_1-1}} A_t^{\frac{-1}{a_1-1}} \left(\frac{w_{Lt}}{P_t}\right)^{\frac{1}{a_1-1}} H_t^{\frac{-a_2}{a_1-1}} \prod K_{it}^{\frac{-b_i}{a_1-1}}$$

Assuming that the real wage remains constant over time ($\omega_{Lt+1} / P_{t+1} = c$) the labor growth at period $t+1$, is given by

$$\widehat{L_{t+1}} = \frac{1}{1-a_1}\left(\widehat{A_{t+1}} + a_2\widehat{H_{t+1}} + \sum b_i \widehat{K_{t+1}}\right) \quad (6)$$

and the output growth by

$$\widehat{Y_{t+1}} = \widehat{A_{t+1}} + a_1\widehat{L_{t+1}} + a_2\widehat{H_{t+1}} + \sum b_i \widehat{K_{t+1}} \quad (7)$$

Equations (6) and (7) are used to simulate the labor and output growth of the Cyprus economy for a two year period ahead, a five year period ahead and for 20 years ahead.

2.2.2 Data

To assess the impact of the RRP measures, it is necessary to map them with the appropriate variables of the model in order to identify the main channels through which a particular measure affects the economy. To this end, the RRP measures were examined on the basis of their description in the RRP of Cyprus and were subsequently matched with the major investment categories in the economy that they are likely to affect. These are[2]:

- Information and Communication Technology (ICT) equipment
- Research & Development (R&D) and Computer software & databases (CS&D)
- Infrastructure[3]

[2] We consider total investment. That is, we do not distinguish between private and public investment as long as it is funded by the government.

[3] For the construction of investment in Infrastructure the data are from the general government expenditure by function (COFOG). To calculate investment in Infrastructure we sum of following groups/divisions of government expenditure: Economic affairs (Fuel and energy + Mining, manufacturing and construction + Transport + Communication + Other industries), Environmental protection (Waste management + Waste water management + Pollution abatement + Protection of biodiversity and landscape), Housing and community amenities (Housing development + Water supply + Street lighting), Recreation, culture and religion (Recreational and sporting services + Broadcasting and publishing services + Religious and other community services), Health (Outpatient services + Hospital services + Public health services), Education (Pre-primary and primary education +Secondary education + Post-secondary non-tertiary education +Tertiary education + Education not definable by level).

- Other physical capital (OPC)[4]
- Human capital[5]

All data for Investment are from Eurostat and the Statistical Service of Cyprus, 2021. The relevant variable is: Gross fixed capital formation by industry and asset type.

Table 2.1 presents the breakdown of each of the economy's investments to its RRP sources of funding by priority axis (columns two to six). The last row of Table 2.1 shows the share of each investment in the total RRF budget. Infrastructure absorbs the greatest part of the RRF budget (around 30%), followed by Other physical capital and ICT (around 29% and 25% respectively). Around 6% of the budget goes to reforms and does not contribute to the economy's capital.

By the full implementation of the RRP, Human capital will be benefited from measures mostly related to labour market & education (priority axis 5) and health (priority axis 1): around 96% and 4% of the investments in Human capital will come from axis 5 and axis 1 respectively. Most of the investments in ICT will come from priority axis 3 (45%) and from priority axis 4 (around 30%). Investments in R&D come from measures strengthening the resilience and competitiveness of the economy (priority axis 3). Around 40% of investments in Infrastructure come from priority axis 2 and the remaining 60% from priority axes 3, 5 and 1 (in order of their contribution). Priority axis 2 provides also the highest contribution to investments in Other physical capital (around 76%) while the remaining 24% comes from priority axis 3.

There are cases, however, for which it was not possible to quantify all the measures included in the Plan due to the form of the model. This would limit the quantitative exercise of the cyERC study to a subset of measures. The affected measures concerned reforms related mainly to Public and Local Administration, Judicial and Anti-corruption reforms, Business support for competitiveness reforms, Labour market reforms, and Fiscal and Financial Stability reforms (around 6% of the total RRF budget – see column 7). Nevertheless, these measures have a potentially large effect on productivity (TFP) growth.

[4] Other physical capital includes the economy's remaining investments in physical capital. More precisely, Other physical capital includes: Total Construction assets (after the assets in Infrastructure are accounted for), Transport equipment assets, Other machinery and Cultivated biological resources.

[5] Investment in Human capital is defined as the sum of investments in Education and Health.

Table 2.1: Allocation of the RRF budget to Economy's Investment Expenditures.

	Investment					
	Human (%)	**ICT (%)**	**R&D (%)**	**Infrastructure (%)**	**OPC (%)**	**Reforms (%)**
Priority Axis 1. Public health, civil protection and lessons learned from the pandemic	4.07	5.76	-	14.58	-	0.38
Priority Axis 2. Accelerated transition to a green economy	-	12.09	-	38.29	76.36	1.93
Priority Axis 3. Strengthening the resilience and competitiveness of the economy	0.16	44.99	100	23.75	23.64	92.33
Priority Axis 4. Towards a digital era	-	29.35	-	-	-	-
Priority Axis 5. Labour market, education and human capital	95.77	7.81	-	23.39	-	5.36
% of Investment in total RRP Budget	4.98	24.70	5.87	29.89	28.52	6.05

Given the allocation of RRP funds, the capital stocks are then constructed as described by equation 2. The depreciation rate values for the physical capital inputs are taken from Stehrer et al. (2019)[6]. The aforementioned work uses the EUKLEMS dataset to calculate depreciation rates by asset type for a number of countries including Cyprus. Some of the depreciation rates were aggregated to match the specific capital stock series used in this study. The aggregation was performed using the weighted sum of depreciation rates of the assets included in the relevant aggregate investment category.[7] The depreciation rate for Human capital is constructed as the weighted sum of the depreciation rates of investments in Education and Health (taken from Carbone and Kverndokk, 2017)[8].[9] Table 2.2 lists the depreciation rates used.

Table 2.2: Depreciation rates.

Capital stock	δ
Information and Communication Technology (ICT)	0.265
Research & development (R&D) and Computer software & databases	0.246
Infrastructure	0.019
Other physical capital	0.083
Human capital	0.039

[6] Stehrer, R., A. Bykova, K. Jäger, O. Reiter and M. Schwarzhappel (2019): Industry level growth and productivity data with special focus on intangible assets, wiiw Statistical Report No. 8. Source of data: EU KLEMS database, 2019 release.

[7] $\delta_i = \sum_j v_j \delta_j$, where v_j is the share of asset type j in investment i.

[8] Jared C. Carbone & Snorre Kverndokk, 2017. "Individual Investments in Education and Health: Policy Responses and Interactions," Advances in Health Economics and Health Services Research, in: Kristian Bolin & Björn Lindgren & Michael Grossman & Dorte Gyrd-Hansen & Tor Iversen & Robert Kaestn (ed.), Human Capital and Health Behavior, volume 25, pages 33-83, Emerald Publishing Ltd

[9] The weights are the average shares of each investment to the total investment in Education and Health. The corresponding depreciation rates are 5% and 1% respectively.

For the construction of each capital stock we also need the initial capital stock. This is constructed as follows $K_{1995,} = \frac{I_{1995,}}{(\delta+g)}$, where *I* is Investment in 1995 (in constant prices), and *g* is the average growth rate of GDP before 1995.

2.3 Implementation of the model and calibration

The model predicts the evolution of the main macroeconomic variables. Government investments lead to changes in the production capacity of the economy through changes in its capital stocks, i.e. through changes in Human capital, ICT, R&D, Infrastructure and Other physical capital. In turn these changes affect labor demand (equation 6) and output supply (equation 7). In addition, reforms not quantified are assume to affect productivity growth (TFP Growth).

In order to assess this impact, we first need to set the parameters of the model. The output elasticities, a_i and b_i, are obtained from the literature. Table 2.3 offers an overview of the existing literature on the output elasticities.

Table 2.3: Overview of the most cited studies related to output elasticities of capital inputs.

Human Capital	**Method**	**Elasticity**
Barro (1991)	Growth regression , 98 countries (1960-1985)	0.0305
Barro (2001)	Growth regression , 100 countries (1965-1990)	0.0044
Kalaitzidakis et al. (2001)	Production function, 93 countries (1960-1990)	0.0440
Mamuneas et al. (2006)	Production function-TFP estimation, 51 countries (1971-1987)	0.1900
Ketteni et al. (2011)	Production function-TFP (labour productivity growth index) growth estimation, 15 OECD countries (1980-2004)	0.0340
Calderon et al. (2014)	Production function, 88 countries (1960-2000)	0.1000
Barro et al. (2013)	Growth regression, over 100 countries (1960-1995)	0.0044
Bloom et al. (2019)	Production function output growth, 116 countries (1970-2004)	0.0670
ICT Capital	**Method**	**Elasticity**
Siegel (1997)	TFP growth equation, US manufacturing industries, from 1972-1987	0.0572
O'Mahony and Vecchi (2005)	Production function, US (21 industries) and UK (24 industries) (1976-2000)	0.0550
Cziernich et al. (2011)	Production growth regression, 25 OECD countries (1996-2007)	0.0920

Table 2.3 cont.

ICT Capital	Method	Elasticity
Ketteni et al. (2011)	Production function-TFP (labour productivity growth index) growth estimation, 15 OECD countries (1980-2004)	0.0300
Spiezia (2012)	Production function, GMM estimation, 18 OECD countries (26 industries), (1980-2004)	0.0560
Ketteni et al. (2015)	Production function-TFP (labour productivity growth index) growth function, 15 OECD countries (1980-2004)	0.0280
Niebel (2018)	Cobb Douglas production function, 59 countries (1995-2010)	0.0490
R&D Capital	**Method**	**Elasticity**
Lichtenberg and Siegel (1991)	TFP growth function, US industries (1972-1987)	0.1320
Coe and Helpman (1995)	TFP equation, 22 OECD countries (1971-1990)	0.0890
Park (1995)	Production function (growth accounting equation estimation), 10 OECD countries (1970-1987)	0.11
Park (1995)	Production growth accounting equation, 10 OECD countries (1970-1987)	0.08
Nadiri and Mamuneas (1994)	Cost function estimation, 12 US industries (1956-1986)	0.0300
Mamuneas and Nadiri (1996)	Cost-Function of an industry, 15 US industries (1981-1998)	0.0800
Coe et al. (2009)	TFP equation, 24 OECD countries (1971-2004)	0.0960
O'Mahony and Vecchi (2009)	Production function estimation, 5 countries (US, UK, Japan France and Germany) company data (1988-1997)	0.0960
Bravo-Ortega and Marin (2011)	TFP equation, 65 countries (1965-2005)	0.1570
Guelec and van Potterlberghe de la Potterie (2004)	TFP equation, 16 OECD (1980-1998)	0.13
Guelec and van Potterlberghe de la Potterie (2004)	Cobb Douglas production, TFP-error correction model for 16 OECD countries (1980-1998)	0.07
Infrastructure Capital	**Method**	**Elasticity**
Nadiri and Mamuneas (1994)	Cost function estimation, 12 US industries(1956-1986)	0.1290
Demetriades and Mamuneas (2000)	Profit function estimation, 12 OECD countries (1971-1990)	0.1873
Roller and Waverman (2001)	Production function estimation, 21 OECD countries (1970-1990)	0.0340
Calderon et al. (2014)	Production function, 88 countries (1960-2000)	0.0800

The relationship of Human capital and economic growth is at the center of recent literature on economic growth. Although human capital includes education, health and aspects of social capital,

the vast majority of the literature proxies it through education (Barro, 2013). According to Table 2.3, Barro (1991, 2001, 2013)[10], Calderon et al. (2014)[11] and Bloom et al. (2019)[12]emphasize the significance of human capital for economic growth, while by estimating production functions Kalaitzidakis et al. (2001)[13], Mamuneas et al. (2006)[14] and Ketteni et al (2011)[15] find a positive impact of human capital on productivity growth.

A key driving force for economic growth is ICT capital. Siegel (1997)[16], O'Mahony and Vecchi (2005)[17] find a positive contribution of ICT on productivity and output growth respectively. Moreover, Czernich et al. (2011)[18] and Spiezia (2012)[19] through production function estimates suggest a significant impact of ICT on economic growth. In addition, Ketteni et al (2011) and Ketteni et al. (2015)[20] finds a positive contribution of ICT on productivity growth, whereas Niebel (2018)[21] clarified that the positive impact stemming from ICT on economic growth can be an advantage not only for developing and emerging countries, but also for developed countries. Given that the ICT is only the first step towards economy's digitalization, improvement in the quality of technologies is essential (Evangelista et al., 2014)[22].

As far as the Research and Development (R&D) capital is concerned, as can be seen in Table 2.3, the studies conducted by Coe and Helpman (1995)[23] and Coe et al. (2009)[24] find a positive impact of R&D

[10] Barro, R.J. (1991). Economic Growth in a Cross Section of Countries, *The Quarterly Journal of Economics*, 106(2), 407-443.
Barro, R. (2001), Human Capital: Growth, History and Policy*, The American Economic Review*, 91(2), Papers and Proceedings of the Hundred Thirteenth Annual Meeting of the American Economic Association, 12-17
Barro, R. (2013). Education and Economic Growth, *Annals of Economics and Finance,* 14-2(A), 277-304.
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[17] O'Mahony, M. and M. Vecchi (2005). Quantifying the Impact of ICT Capital on Output Growth: A Heterogeneous Dynamic Panel Approach, *Economica*, 72(288), 615-633.
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[21] Niebel, T. (2018). ICT and economic growth-Comparing developing, emerging and developed countries. *World Development*, 104 (2018), 197-211
[22] Evangelistra, R., P. Guerrieri and V. Meliciani (2014). The economic impact of digital technologies in Europe, *Economics of Innovation and New Technology*, 23(8), 802-824.
[23] Coe .D.T. and E. Helpman, (1995). International R&D spillovers, *European Economic Review,* 39(1995), 859-887.
[24] Coe, D.T., E. Helpman, and A.W. Hoffmaister (2009). International R&D spillovers and institutions, *European Economic Review*, 53 (2009), 723-741.

on productivity growth. Moreover, Park (1995)[25] and Guellec and van Potterlsberghe de la Potterie (2004)[26] by distinguishing R&D investments into public and private, suggest the significance of both in affecting economic growth, whereas Bravo- Ortega and Marin (2011)[27] find that R&D expands productivity growth in a large sample of countries. At the US industry level Nadiri and Mamuneas (1994)[28] and Mamuneas and Nadiri (1996)[29] suggest the significance of public R&D investment in boosting output and productivity growth. Lichtenberg and Siegel (1991)[30] also find a positive impact of total R&D investment on productivity growth at the industry level. In addition, Mahony and Vecchi (2009)[31] show that industries intense to R&D and skills are characterized by higher productivity growth levels in comparison with non-R&D performed industries.

Infrastructure capital is an essential ingredient for productivity and growth, mainly during periods of economic slowdown. As it can be seen in Table 2.3, Nadiri and Mamuneas (1994) provide evidence that Infrastructure capital has cost-saving effects in the US manufacturing industry. Demetriades and Mamuneas (2000)[32] find a positive effect of public capital on output employment and physical capital investment in a set of OECD countries. In addition, Roller and Waverman (2001)[33] find a positive effect of infrastructure on economic development. Finally, Calderon et al (2014) by using a large cross-country dataset also find positive and statistically significant output elasticity of Infrastructure.

Since the RRP includes significant reforms that have not been quantified and since non-quantified reforms can further enhance productivity growth, the need has emerged to account for these in our estimations. The findings of the relevant literature show that reforms that improve the level of governance have the potential to support innovation and entrepreneurship and increase the overall productivity thus boosting economic growth. Nicolleti and Scarpetta (2003)[34] provide empirical evidence, suggesting important benefits from improved regulatory environment. They find that for some European countries (Portugal, Greece, Austria, France and Italy), reforms improving the business environment can increase TFP growth by 0.7 percentage points. Bourles et al. (2010,

[25] Park, W. G. (1995). International R&D spillovers and OECD economic growth, Economic Inquiry,33(4), 571-591.

[26] Guellec, D. and B. van Pottelsberghe de la Potterie (2004). From R&D to Productivity Growth: DO the Institutional Settings and the Source of Funds of R&D Matter? Oxford Bulleting of Economics and Statistics, 66(3), 353-378

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[31] O'Mahony, M. and M. Becchi (2009). R&D, Knowledge spillovers and company productivity performance, Research Policy, 38 (2009),35-44.

[32] Demetriades, P.O. and T.P. Mamuneas (2000). Intertemporal Output and Employment Effects of Public Infrastructure capital: Evidence from 12 OECD Economies, *The Economic Journal*, 110(465), 687-712.

[33] Roller, L.H., and L. Waverman (2001). Telecommunications Infrastructure and Economic Development: A Simultaneous Approach, *American Economic Review*, 19(4), 909-923.

[34] Nicoletti, G. and S. Scarpetta, (2003), Regulation, Productivity and Growth: OECD Evidence, Economic Policy, 18(36), 9-72.

2013)[35] show that competitive regulations and macroeconomic reforms positively affect GDP growth through improvements in TFP. Bourles et al. (2010) show that for some countries the effect of reforms on TFP growth varies among countries, ranging from 0-1 percentage points per year. Moreover, Doubla-Norris et al. (2013)[36] use a sample of industry-level data for more than 100 economies and find that policy reform indicators are positively correlated with TFP growth. Dabla-Norris et al. (2015)[37], also find a positive relationship between policy reforms and TFP growth. More precisely, they find that the adoption of Product Market Regulation can raise TFP growth annually by 0.1 percentage points.

The parameter values chosen for our model are based on the average estimates of elasticities provided in the literature for each capital input, as shown in Table 2.3. The chosen values are listed in Table 2.4 below.

Table 2.4: Model Parameters.

a_1	Output elasticity of Labor	0.532
a_2	Output elasticity of Human capital	0.060
b_1	Output elasticity of ICT capital	0.050
b_2	Output elasticity of R&D and Cs&D capital	0.109
b_3	Output elasticity of Infrastructure capital	0.100
b_4	Output elasticity of Other physical capital	0.149
s_L	Share of Labor income	0.592
s_K	Share of Capital income	0.408
$\hat{A}$	Total Factor Productivity (TFP) growth	0.02
γ	$\hat{A}(1+\gamma)$: Increments in TFP growth (2022-2026)	0, 0.01, 0.05, 0.10

In order to account for the effect of reforms (non-quantified measures) on growth and considering that reforms amount to 6% of the RRP budget, we assume that TFP grows by an extra 5% each year for the period 2022-2026 and remains constant thereafter (see last row of Table 2.4). In an exercise performed to check the robustness of the results, we calibrate the extra increase in TFP growth examining three more scenarios: no effect on TFP growth (0% extra increase), an extra 1% increase and an extra 10% increase each year.

Before moving to the impact assessment results, the model has been first calibrated to capture the current state of the Cyprus economy using data on an annual basis until 2019. Figures 2.1 and 2.2 present the actual and fitted growth rates –as predicted by the model (equations 6 and 7)- of output and labour for the period for which actual data are available, namely between 1995 and 2019. It is evident that the model fits the data well as the actual and fitted values move together (the period

[35] Bourlès, R., G., Cette, G, J. Lopez, J. Mairesse, J. and G. Nicoletti (2013). Do Product Market Regulations in Upstream Sectors Curb Productivity Growth? Panel data evidence for OECD countries. *The Review of Economic and Statistics*, 95(5), 1750-1768.
Bourlès, R., G., Cette, G, J. Lopez, J. Mairesse, J. and G. Nicoletti (2010), The Impact on Growth of Easing Regulatiions in Upstream Sectors, *CESifo Dice Report, Journal of International Comparisons*, 8(3).

[36] Dabla-Norris, E., Ho, G. and Kyober, A., (2013). Reforms and distance to frontier, IMF, December 2013.

[37] Dabla-Norris, E. Guo, S., Haksar, V., Kim, M., Kochhhar, K. Wiseman, K. and Zdzienicka, A. (2015), The New Normal: A Sector Level Perspective on Productivity Trends in Advanced Economies, Staff Discussion Notes No. 15/3.

between 2009 and 2014 corresponds to the financial crises, a shock that we do not account for in the model, hence the discrepancy for that period).

Figure 2.1: Output growth

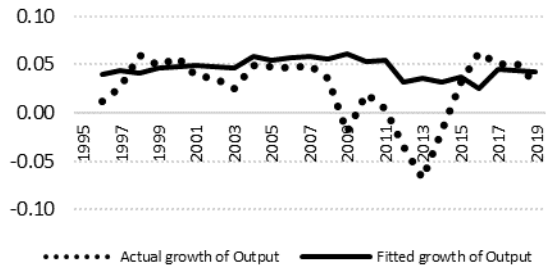
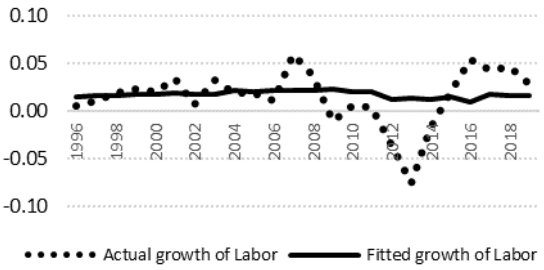


Figure 2.2: Labor growth



2.4 Impact Assessment Results

This section presents the results of the impact assessment model. It is important to note that, as is common in such simulation exercises, the analysis assumes that government investments return to their original levels, as they were before the implementation of the Plan. The results are expressed in log percentage changes compared to the baseline scenario (non-implementation of the Recovery Plan). By construction, percentage logarithmic differences in the levels are equal to the difference in logarithmic growth rates between the two scenarios. Table 2.5 presents the results for the short-term (2 years ahead), medium-term (5 years ahead) and long-term (20 years ahead) periods.

The results show that the Recovery and Sustainability Plan can increase the level of the Cyprus GDP by about 3% two years ahead and by around 7% five years ahead relatively to the baseline scenario. 69.5% and 56.6% comes from the effect of RRP measures for each period respectively. The corresponding contribution of productivity amounts to 10.6% and 23.5%. The increase in GDP is maintained in the long run: 16.5% increase 20 years ahead, compared to the baseline scenario. Around 60% of this comes from productivity improvements. The effect of Infrastructure and Other physical capital also remains in the long – term since the depreciation rates of these two capital stocks is very low (see Table 2.2). The plan also increases employment by 1.1% in the short-term, by 2.6% in the medium-term and by 6.2% in the long-term, relatively to the baseline scenario.[38]

As mentioned in the previous section, to account for the effect of reforms, we assume that TFP grows by an extra 5% each year for the period 2022-2026 and remains constant thereafter relative to the baseline model. We examine three additional values for the increment on TFP growth: 0%, 1% and 10% increments (first column of Table 2.6, the γ values). The case of γ = 0% corresponds to the scenario in which the reforms have no effect on productivity growth.[39] The results are summarized in Table 2.6 for the three periods: the short-term, medium-term and long-term periods. With respect to the period of the implementation of the plan (medium-term), we find that, by the end of 2026,

[38] In this report we do not consider the effect of RRP measures on investment funded by the private sector. Demetriades and Mamuneas (2000) have shown that the inducement effect of public on private capital is rather small in the short and intermediate run while the effect of public capital is higher in the long run. Since we do not model the response of privately funded investment to RRP measures, our results might underestimate the effect of RRP measures, especially in the long run.

[39] This is the equivalent of the non-implementation of the reforms.

the 1% extra increase in TFP growth results in an overall increase in GDP and employment by 5.2% and 1.95% respectively, whereas the 10% extra increase in TFP growth increases GDP and employment by around 9.1% and 3.4% respectively, relative to the baseline scenario. Our results lay in the middle of these two (γ = 5%).

Focusing on the period of the implementation of the plan, the 7% increase in GDP, implies an additional growth rate of GDP by approximately 1.2 percentage points on average each year during the period 2021-2026. During the same period, the plan increases employment by more than 2.5%, or by around 11,000 new jobs which can significantly reduce the unemployment rate in Cyprus (currently at 7.6%).[40]

With respect to each priority axis, the impact of the RRP compared to the baseline development of the economy without the RRP, for the period of the implementation of the plan, are summarized as follows:

Priority Axis 1. Public health, civil protection and lessons learned from the pandemic

The measures targeting a more resilient and effective health system as well as an improved civil protection system contribute by 3.7% to the additional increase of GDP and by around 3.3% to the additional increase in employment by the end of 2026. The channel of the impact of these measures is mainly the increase in Human, ICT, Infrastructure capital and Productivity.

Priority Axis 2. Accelerated transition to a green economy

By the end of 2026, the measures targeting a faster transition to a green economy contribute by around 14% to the additional increase of GDP and employment. The channel of impact of these measures is mainly the increase in ICT, Infrastructure, Other physical capital and Productivity.

Priority Axis 3. Strengthening the resilience and competitiveness of the economy

The largest of all priority axes, in terms of its share on total RRP budget, contributes by around 26.5% and 34% to the additional increase of GDP and employment respectively, by the end of 2026. The channel of impact of these measures is mainly the increase in Human, ICT, R&D, Infrastructure, Other physical capital and Productivity.

Priority Axis 4. Towards a digital era

The measures towards a digital era contribute by around 5% and 9% to the additional increase of GDP and employment respectively, by the end of 2026. The channel of impact of these measures is mainly the increase in the ICT capital of the economy.

Priority Axis 5. Labour market, education and human capital

By the end of 2026, the measures in this axis show a contribution of around 8% and 10.5% to the additional increase of GDP and employment respectively. The channel of impact of these measures is mainly the increase in Human, ICT, Infrastructure capital and Productivity.

[40] Labor force survey statistics, main results in Cyprus for the year 2020: Labor Force: 451,645 persons above the age of 15 years, Employment: 417,354 persons above the age of 15 years, Total unemployment: 34,291 persons unemployed above the age of 15 years old. Source: Labour Force Survey, 2020, Statistical Service of Cyprus (Last Update 02/03/2021).

2.5 Conclusions of the Growth Accounting assessment

This chapter assesses the effects of the measures included in the RRP of Cyprus using a Production Function - Growth Accounting model. The model predicts the evolution of the main macroeconomic variables (output and employment) from the implementation of the RRP. RRP measures lead to changes in the output growth of the economy that come through changes in the human capital and the capital inputs, adjustments in the labor input (conditional on the capital stocks and human capital) as well as through changes in the productivity growth.

The results show that implementation of the RRP could potentially increase the level of GDP by around 7% and employment by around 2.5% by 2026, compared to the baseline scenario (non-implementation of the Recovery Plan). This implies an additional GDP growth of approximately 1.2 percentage points on average each year for the period 2021-2026. The employment increase by more than 2.5% corresponds, ceteris paribus, to the creation of around 11,000 new jobs which can potentially significantly reduce the unemployment rate in Cyprus.

Overall, the results for the short-term (2 years ahead), medium-term (5 years ahead) and long-term (20 years ahead) periods show that the level of the Cyprus GDP will be increase by about 3%, (69.5% of which is coming from the effect of RRP measures), 7% (56.6% of which is coming from the effect of RRP measures) and 16.5% respectively, compared to the baseline scenario. The effect of reforms, related mainly to Public and Local Administration reforms, Judicial and Anti-corruption reforms, Business support for competitiveness, Labour market reforms, and Fiscal and Financial Stability reforms, is assumed to affect productivity growth, which in turn generates an additional GDP growth of 10.6%, 23.5% and 59.8% in the short, medium and long-term, respectively, relative to the baseline scenario.

Table 2.5: Impact of the RRP.

	Component	Channels of impact	Quantification of the impact % difference from policy neutral baseline					
			Short-term (2 years ahead)		Medium-term (5 years ahead)		Long-term (20 years ahead)	
			GDP	Employment	GDP	Employment	GDP	Employment
	Overall		2.9%	1.1%	6.8%	2.6%	16.5%	6.2%
Priority axis 1	1.1 - Resilient and Effective Health System, Improved Civil Protection	Increase in Human, ICT and Infrastructure capital and Productivity	4.4%	5.6%	3.7%	3.3%		
Priority axis 2	2.1 - Climate neutrality, Energy efficiency and renewable energy penetration	Increase in ICT, Infrastructure, Other physical capital and Productivity	6.7%	8.3%	6.0%	7.0%		
	2.2 - Sustainable transport	Increase in ICT, Infrastructure, Other physical capital and Productivity	2.8%	3.5%	2.4%	2.7%		
	2.3 - Smart and Sustainable Water Management	Increase in ICT, Infrastructure capital and Productivity	6.4%	8.0%	5.3%	4.4%		
Priority axis 3	3.1 - New Growth Model and diversification of the economy	Increase in Human, ICT, R&D, Infrastructure, Other physical capital and Productivity	3.9%	4.9%	3.3%	8.3%		
	3.2 - Enhanced Research & Innovation	Increase in R&D capital	18.9%	23.6%	13.4%	15.3%		
	3.3 - Business support for competitiveness	Increase in ICT, Other physical capital and Productivity	1.5%	1.9%	1.3%	1.3%		
	3.4 - Public and Local Administration Reform, Judicial reform and Anti-corruption reform	Increase in ICT, R&D, Infrastructure, Other physical capital and Productivity	5.0%	6.3%	4.1%	6.7%		
	3.5 - Safeguarding Fiscal and Financial Stability	Increase in ICT capital and Productivity	5.5%	6.8%	4.4%	2.3%		
Priority axis 4	4.1 - Upgrade infrastructure for connectivity	Increase in ICT capital	1.4%	1.7%	1.1%	5.6%		
	4.2 - Promote e-government	Increase in ICT capital	4.5%	5.6%	3.7%	3.4%		
Priority axis 5	5.1 - Educational system modernization, upskilling and retraining	Increase in Human, ICT and Infrastructure capital	5.8%	7.2%	5.3%	6.4%		
	5.2 - Labour Market	Increase in Human, ICT, Infrastructure capital and Productivity	2.7%	3.4%	2.5%	3.9%		
		Total Contribution of the components	**69.5%**	**86.8%**	**56.6%**	**70.7%**	**20.0%**	**25.0%**
		Productivity Contribution	10.6%	13.2%	23.5%	29.3%	59.8%	75.0%
		Labor Contribution	19.9%		19.9%		19.9%	
		Total Contribution to Overall Impact	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 2.6: Effect of reforms on TFP growth.

	Quantification of the impact % difference from policy neutral baseline					
	Short-term (2 years ahead)		Medium-term (5 years ahead)		Long-term (20 years ahead)	
γ	GDP	Employment	GDP	Employment	GDP	Employment
0%	2.50%	0.94%	4.83%	1.81%	4.20%	1.57%
1%	2.57%	0.96%	5.20%	1.95%	6.49%	2.43%
5%	2.88%	1.08%	6.84%	2.56%	16.50%	6.20%
10%	3.27%	1.23%	9.12%	3.40%	31.36%	11.70%

3. Econometric Analysis of the Impact Assessment of the Recovery and Resilience Plan of Cyprus: Time series models

1. Introduction

The impact assessment of the RRP on key macroeconomic indicators of the Cyprus economy is also evaluated using alternative econometric time series models to capture the dynamic effects of the RRP. We use various VAR specifications and estimation methods, such as Structural VARs, and FAVARs and frequentist and Bayesian VARs. Using these alternative VAR-type models, we examine the difference between the two scenarios, the baseline/unconditional forecasts of key macro variable such as GDP and Employment growth (without the RRP) vis-à-vis the conditional forecasts of the aforementioned variables that would include the RRP. Hence, we quantify the dynamic difference between the conditional forecasts from the baseline forecasts every year, ceteris paribus. We identify and quantify not only the periods with the highest impact of the RRP during the various short-term and medium-term horizons (of 2 and 5 years ahead) but also how long will the impact of the RRP last within the long-term of 20 years ahead. Our results are robust for the aggregate impact on GDP growth and Employment growth and are consistent with the aforementioned studies.

Moreover, we find that the maximum effect of the RRP on the growth rates for GDP and Employment is realized in 2026, which coincides with the end of the medium-term period. It is worth noting that these econometric models assume mean reversion and do not explicitly capture the impact of reform, and hence the impact of the RRP on the GDP and Employment growth rate last until 2032, ceteris paribus.

2. Impact Assessment based on econometric time series models

This subsection evaluates the conditional forecasts based on time series models, which can capture the dynamic effects of key macroeconomic indicators of the RRP. The analysis based on time series models complements the other methods and results in that they study the dynamics of the conditional forecasts over time within the three different horizons of the RRP.

We consider Vector AutoRegressions (VARs) type models which are general, flexible models and provide a reliable empirical benchmark for alternative econometric representations. One such representation stems from Dynamic and Stochastic General Equilibrium (DSGE) models, a benchmark tool for policy analysis. While DSGE models are also taken to the data, both via calibration and estimation, they impose more structure on the data than a VAR model as they are more grounded in general equilibrium theory, as well as in micro-foundations. Given the historical time series data availability for Cyprus, we consider various specifications of VAR type models, which we use to assess the effects of structural shocks via impulse response analysis as well as for forecasting purposes.

The VAR methodology has been intensively used to identify and study the effects of structural shocks, e.g. Blanchard and Watson (1986)[41], Bernanke (1986)[42], Christiano et al. (1999)[43], Bernanke

[41] Blanchard, O., Watson, M.W. (1986). Are all business cycles alike? in: Gordon, R.J. (Ed.), The American Business Cycle: Continuity and Change. NBER. The University of Chicago Press, Chicago, IL.

[42] Bernanke, B.S. (1986). Alternative explanations of the money-income correlation. *Carnegie Rochester Conference Series on Public Policy*, 25, 49–99.

et al. (2005)[44], among others. The main reason for the success of VAR models for structural analysis is that the representation and tools of the VAR methodology are the same ones used to draw conclusions in the theoretical general equilibrium models. This, in turn, facilitates the comparison between the outcomes of the theoretical models and a set of stylized facts derived from the empirical analysis. Indeed, to match these structural shocks, we can link the innovations in a VAR model to these structural shocks imposing identification restrictions on the VAR coefficients. Several methods for identification have been used, such as alternative sets of recursive zero restrictions on the contemporaneous coefficients or triangularization, with Cholesky decomposition representing a special case (Sims, 1980[45]). The structural VAR (SVAR) is a more general approach (that nests the Cholesky decomposition) that uses either economic theory or outside estimates to constrain coefficients (Blanchard and Watson, 1986; Bernanke, 1986 and Bernanke et al., 2005). Similarly, Factor-Augmented VARs (FAVARs), e.g. Bernanke et al. (2005) based on dynamic factor models of Stock and Watson (2002)[46] and others incorporate the information a large number of time-series and it is much more likely to condition on relevant information for identifying shocks. Finally, Bayesian VARs (BVARs) have been estimated to address the challenge of a large number of variables and relatively small time series samples. By incorporating prior information into the estimation process, the estimates obtained using Bayesian methods are generally more precise than those obtained using the standard classical approach. In addition, Bayesian simulation methods such as Gibbs sampling provide an efficient way not only to obtain point estimates but also to characterize the uncertainty around those point estimates. Given the relatively short time-series sample for most of the historical data in Cyprus, we adopt different priors for tackling issues relating to small-sample limitations and how to, for example, incorporate prior beliefs about combination of coefficients that arise from the implications of DSGE models (see Del Negro and Schorfheide (2004)[47]). As an illustrative example, consider the scenario of being interested in a prior that incorporates the belief that the sum of the coefficients on lags of the dependent variable in each equation sum to one (i.e. each variable has a unit root). Widely used priors such as the Minnesota and the natural conjugate priors are straightforward to implement but, nonetheless, come with certain limitations that may be restrictive in many practical circumstances. In contrast, the independent normal Wishart prior allows for additional flexibility that is particularly relevant to addressing macroeconomic questions when faced with a very short sample period. Moreover, under certain scenarios, it might be useful to incorporate priors about the long-run behaviour of the variables included in the VAR. Although the aforementioned priors allow to impact the value of the constant terms in the VAR, there is no direct

way to affect the long run mean. Steady-state priors (see, for instance, Villani (2009)[48]) offer an easily implementable methodology for incorporating informative beliefs about the unconditional mean, frequently providing substantial gains in forecast accuracy.

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[43] Christiano, L.J., M. Eichenbaum and C. Evans. (1999), Monetary policy shocks: what have we learned and to what end? in Woodford M. and J. B. Taylor, eds., Handbook of Macroeconomics, North Holland, 65-148.

[44] Bernanke, B.S., Boivin, J., Eliasz, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *Quarterly Journal of Economics,* 120, 387–422.

[45] Sims, C.A. (1980). Macroeconomics and reality. *Econometrica*, 48, 1–48.

[46] Stock, J.H., Watson, M.W. (2002). Forecasting using principal components from a large number of predictors. *Journal of the American Statistical Association*, 97, 1167–1179.

[47] Del Negro M. and F. Schorfheide. (2009). Monetary policy analysis and potentially misspecified models. *American Economic Review*, 99, 4, 1415-1450.

[48] Villani N. (2009). Steady-state priors for Vector AutoRegressions. *Journal of the Applied Econometrics*, 24, 4, 630-650.

For the estimation of the models, we use quarterly data from 1995Q1-2019Q4. For some indicators, we also consider longer time series and monthly frequency when these are available. The choice of 1995 is based on data availability. The univariate properties of the series are evaluated, and in particular, their stationarity properties. To evaluate the impact of the RRP we consider aggregate macro indicators of GDP, Employment/Unemployment, Government Expenditure, Investment (private and government), Consumption, Inflation. Unit root tests (e.g. Augmented Dickey Fuller) confirm that the majority of these time-series exhibit a behaviour that is consistent with the presence of non-stationary data. To this end, these indicators become stationary after (log) first-differencing. In addition, we investigate the impact of the components of the RRP by considering the impact of various sub-aggregate indices such as ICT Investments, Health expenditures and various green economy indicators. The process of choosing the maximum lag length in multivariate models requires special attention because inference is dependent on correctness of the selected lag order. Therefore, we employ different criteria (Akaike Information Criterion and Bayesian Information Criterion), for choosing the optimal lag length. To maintain a parsimonious model that does not suffer from the curse of dimensionality, we set the maximum lag to three. For most of the examined specifications and set of variables, the chosen optimal lag-length is found to be one year. We confirm that all estimated VARs are stable and invertible.

Using alternative VAR-type specifications and estimation methods we pose the fundamental question often addressed also in applied macroeconomics and policy analysis: if a given variable follows alternative paths in the near to medium term, how will forecasts of other variables, say key macro variables, change? These alternative forecasts are called conditional, rather than unconditional, forecasts. Common applications of conditional forecasts include assessing the path of macroeconomic variables to alternative scenarios for different variables, e.g. related to the monetary policy and the fiscal policy stance. For conditional forecasts in VAR models, see, for instance, Waggoner and Zha (1999)[49], Banbura et al. (2015)[50] and Andersson et al. (2010)[51], among others.

The impact assessment of the RRP on key macroeconomic indicators of the Cyprus economy is evaluated based on the difference between the two scenarios, the baseline/unconditional forecasts of key macro variable such as GDP and Employment growth (without the RRP) vis-à-vis the conditional forecasts of the aforementioned variables that would include the RRP, using the methods of Waggoner and Zha (1999) using alternative VAR specifications and estimation methods. Using these VAR type models we estimate and forecast the dynamic behaviour of key macro variables. Hence, we quantify the dynamic difference between the conditional forecasts from the baseline forecasts every year, ceteris paribus. We identify and quantify not only the periods with the highest impact of the RRP during the various short-term and medium-term horizons (of 2 and 5 years ahead) but also how long will impact of the RRP last within the long-term of 20 years ahead.

We examine the aggregate impact of the RRP on various key macroeconomic indicators. From 2021-2026 the RRP grants will influence Government Expenditure, total Investment (public and private) Within the alternative VAR specifications we study how these RRP channels would affect GDP and Employment growth as well as other macro indicators such as Consumption growth, among others.

[49] Waggoner, D. F. and T. Zha. (1999). Conditional Forecasts in Dynamic Multivariate Models, *Review of Economics and Statistics*, 81, 639–651.

[50] Banbura, M., D. Giannone, and M. Lenza. (2015). Conditional forecasts and scenario analysis with vector autoregressions for large cross-sections. *International Journal of Forecasting*, 31, 739–756.

[51] Andersson, M. K., S. Palmqvist, and D. F. Waggoner. (2010). Density Conditional Forecasts in Dynamic Multivariate Models, Sveriges Riksbank Working Paper Series 247, Sveriges Riksbank.

The results reported below refer to the conditional and unconditional/baseline forecasts and the corresponding percentage difference between these two forecasts for the aforementioned key macro indicators when considering the impact of grants on total Investment or Government Expenditure. These results are robust to using frequentist or Bayesian VARs.

First, we consider the impact of the RRP on total Investment which is consistent with the methodology of the previous chapter. The results reported below refer to a small scale stationary VAR which assumes mean reversion and treats the following variables as endogenous, total Investment, GDP, Employment, and Consumption growth rates (log differences). Similar qualitative results are found when considering additional variables as exogenous in the context of a VARX. Within the context of the aforementioned VAR, the impact of the RRP on GDP growth is presented in the following Figures. Figure 3.1a presents the conditional forecasts of GDP growth that include the effects of the National RRP and the unconditional/baseline forecasts of GDP growth without the RRP. The corresponding GDP growth rate difference between the two scenarios is shown in Figure 3.1b. This means that the GDP level projected in the short–term and medium-term would be 1.3% and 5.6% higher than in the no Plan scenario, respectively. The dynamic aspect of the VAR model shows that within the medium-term (up to 2026), the impact of the RRP on the GDP reaches its maximum growth rate from the baseline scenario. It is worth noting that the VAR based medium-term impact of the RRP result of 5,6 % higher GDP level over the first five years is broadly in line with the estimate of (4.8%) obtained from the Production Function methodology when the PF approach excludes the impact of reforms. Moreover, we find that the RRP has a long-lasting effect on GDP growth up to 2030 as shown by the Figures below, in the context of the VAR model which assumes mean reversion.

Figure 3.1a: GDP growth forecasts based on the RRP and baseline

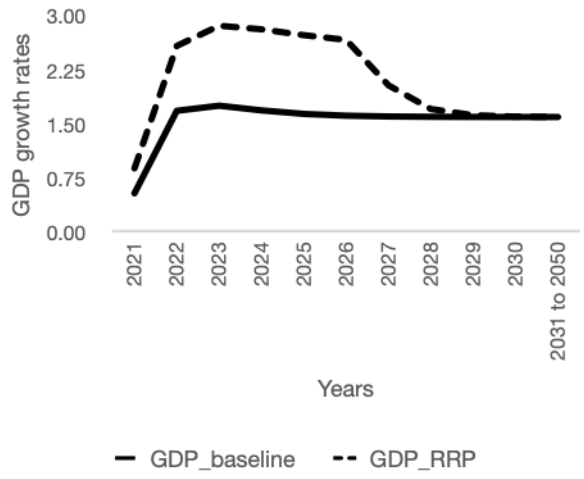
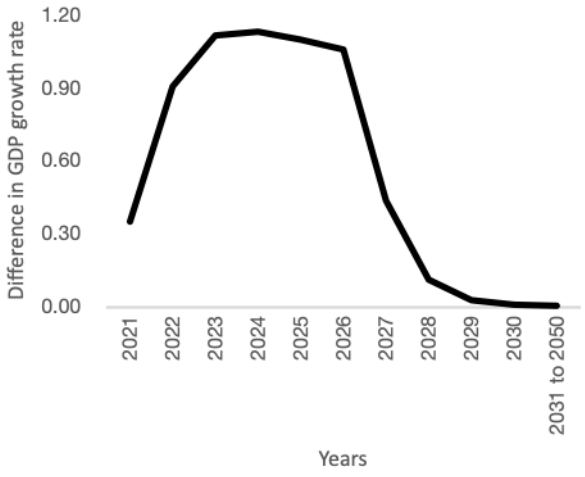


Figure 3.1b: Difference in the GDP growth forecasts between the RRP and baseline



Turning to the impact of the RRP on Employment, Figure 3.2a present the conditional forecasts of Employment growth that include the effects of the National RRP and the unconditional/baseline forecasts of Employment growth without the RRP. The corresponding Employment growth rate difference between the two scenarios is shown in Figure 3.2b. We find Employment growth rate

0.6% to 2.8% higher than the unconditional/baseline forecast in the short-term (of 2 years ahead) and medium-term (of 5 years ahead), respectively. The RRP also has a long-lasting declining effect on Employment growth up to 2029 as shown in Figure 3.2b below.

Figure 3.2a: Employment growth forecasts based on the RRP and baseline

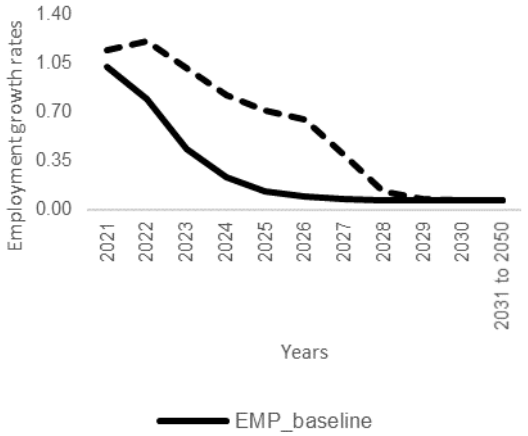
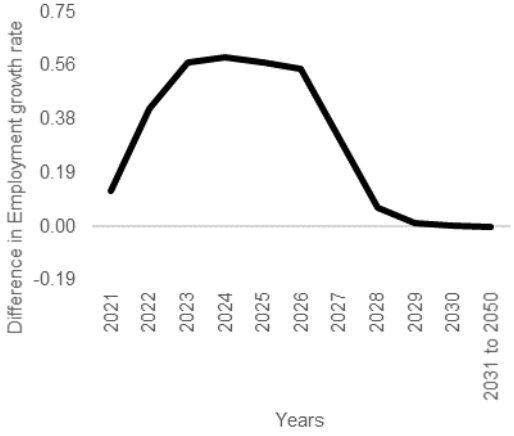


Figure 3.2b: Difference in the Employment growth forecasts between RRP and baseline



The impact of the RRP on Consumption growth is presented in Figure 3.3a that plots the conditional forecasts of Consumption growth that include the effects of the National RRP and the unconditional/baseline forecasts of Consumption growth without the RRP. The corresponding Consumption growth rate difference between the two scenarios is shown in Figure 3.3b. Within the medium-term the impact of the RRP on the Consumption growth reaches its maximum with a 0.8 Consumption growth rate in 2026 from the baseline scenario. The RRP has a long-lasting effect on Consumption growth up to 2029 as shown by the Figures below.

Figure 3.3a: Consumption growth forecasts based on the RRP and baseline

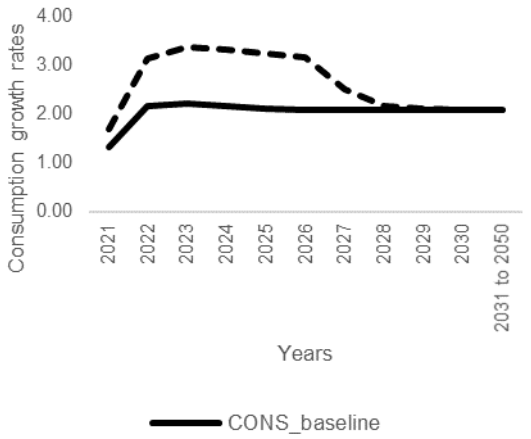
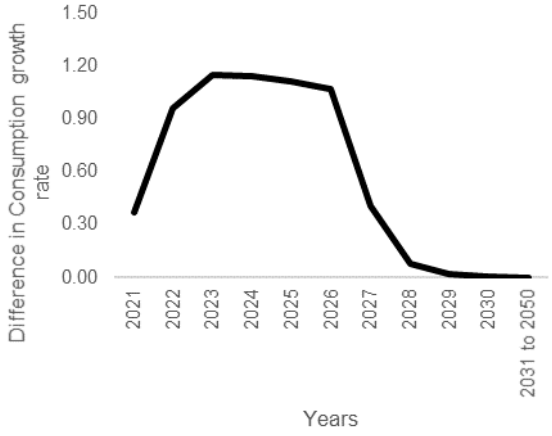


Figure 3.3b: Difference in the Consumption growth forecasts between RRP and baseline



Second, we examine the effects of the RRP through the government expenditure channel within the context of the stationary small scale aforementioned VAR to examine the robustness of our findings through the different macro channels of the RRP. It is worth mentioning at the outset that we find similar qualitative results to those discussed above in terms of the impact of the RRP on the key macro indicators, yet the quantitative estimates through this channel are relatively more conservative. Nevertheless, in terms of impact assessment, we consider this as a useful exercise for obtaining the corresponding range of estimates of the potential channels and impact of the RRP. Figures 3.4-3.7 below present these findings. Comparing the results from these two alternative VAR specifications we find that through the government expenditure channel the RRP produces a relatively more conservative impact on GDP and Employment levels being 3.4% and 1.8% higher than the no plan scenario, respectively, over the medium-term horizon until 2026.

Figure 3.4a: GDP growth forecasts based on the RRP and baseline

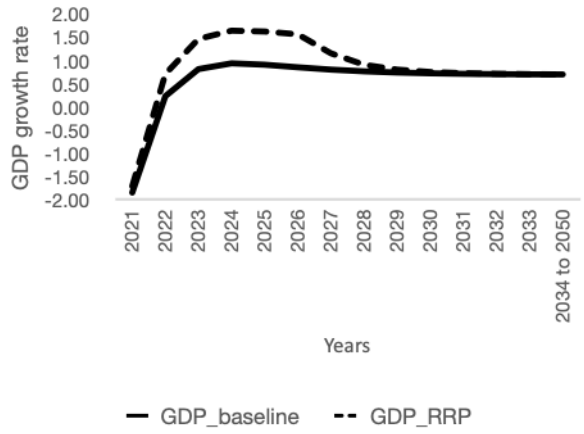


Figure 3.4b: Difference in the GDP growth forecasts between the RRP and baseline

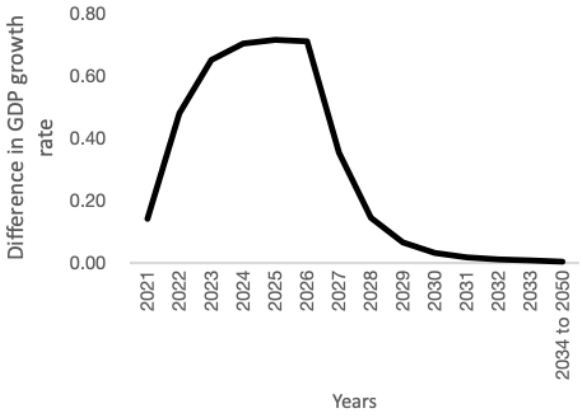


Figure 3.5a: Employment growth forecasts based on the RRP and baseline

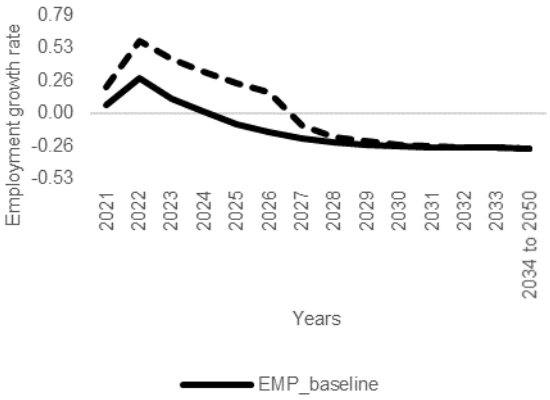


Figure 3.5b: Difference in the Employment growth forecasts between RRP and baseline

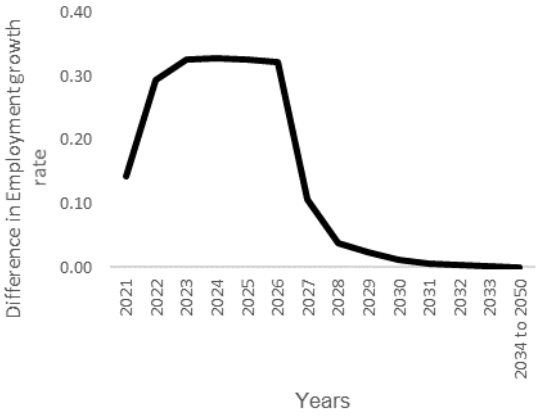


Figure 3.6a: Consumption growth forecasts based on the RRP and baseline

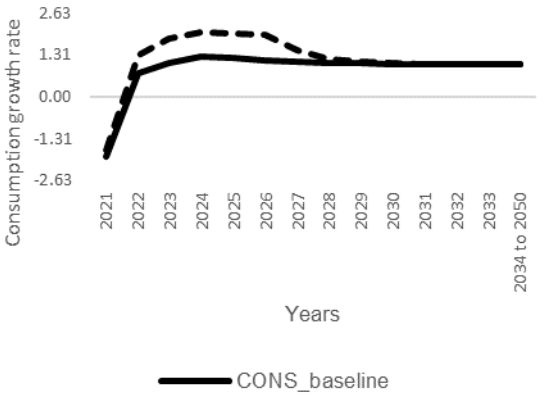
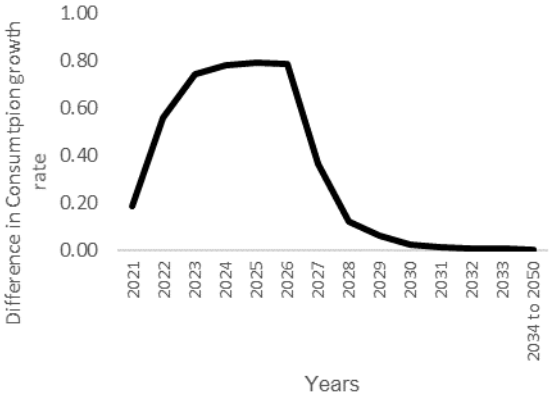


Figure 3.7b: Difference in the Consumption growth forecasts between RRP and baseline



Summarizing, the econometric approach yields respective ranges of GDP and employment of 3.4-5.6 and 1.8-2.8 percentage difference from the policy-neutral baseline over the medium-term horizon. These estimated ranges are based on alternative VAR model specifications and channels of the impact of the RRP. The econometric methods yield results, which are comparable to the main method of this report, the PF approach without reforms which finds the corresponding figures to be 4.8% and 1.8%, for GDP and Employment, over the medium-term. For ease of exposition and comparison of the results with the other methods of these report, we summarize the key finding of the econometric approach discussed above in Table A4.7 in the Appendix.

4. Economic Impact Assessment for the Short and Medium Term with an Input-Output Model

4.1. Introduction

This chapter analyses the results of the economic impact assessment of the reforms and investments under all priority axes of the Recovery and Resilience Plan (RRP) of Cyprus based on an economic input-output (IO) model that has been developed and applied for Cyprus and covers all sectors of the economy. IO is a quantitative technique for studying the interdependence of production sectors in an economy over a stated time period, which has been extensively applied for policy impact evaluation, technical change analysis and forecasting.

Similarly to what was mentioned in the previous chapters, the following priority axes and components were analysed:

- Priority axis 1: Public health and civil protection - lessons learned from the pandemic (Components: 1.1. Resilient and effective health system and improved civil protection)
- Priority axis 2: Accelerated transition to a green economy (Components: 2.1 Climate neutrality, Energy efficiency and renewable energy penetration; 2.2 Sustainable transport; 2.3 Smart and Sustainable Water Management)
- Priority axis 3: Strengthening the resilience and competitiveness of the economy (Components: 3.1. New growth model and diversification of the economy; 3.2. Enhanced research and innovation; 3.3. Business support for competitiveness; 3.4. Public and Local Administration Reform, Judicial reform and Anti-corruption reform; 3.5. Safeguarding fiscal and financial stability)
- Priority axis 4: Towards a digital era (Components: 4.1. Upgrade infrastructure for connectivity; 4.2. Promote e-government)
- Priority axis 5: Labour market, education and human capital (Components: 5.1. Educational system modernization, upskilling and retraining; 5.2. Labour market).

This assessment examines short-term (2021-2023) and medium-term (2021-2026) impacts, i.e. periods for which the input-output model can conduct simulations with reasonable reliability; assessments for the longer term would be less reliable and have not been considered.

4.2. Methodology

Individual investments and reforms were examined on the basis of their description in the RRP and were subsequently aggregated in categories of similar measures. For priority axes 1, 3, 4 and 5, individual measures were grouped in line with a classification made by the government of Cyprus, which we kept and updated with the information of the final submitted RRP. The categories of measures are as follows:

- Consulting/Studies/Staff Cost
- Digital, Energy Efficiency,
- Financial instruments,

- Legislation,
- Technical/Construction,
- Training,
- Other schemes (e.g. incentives, grants etc).

Given the above classification, we then matched each investment/reform with the directly affected industries/sectors of economic activity (the latter is based on the NACE Rev. 2 industry classification). In cases where direct matching was not possible, further assumptions were made in order for an investment/reform to be matched with one or more industries.

The measures of Priority Axis 2 (Accelerated Transition to a Green Economy) were examined in more detail on the basis of their description in the RRP and were subsequently grouped in the following categories:

- *Component 2.1 (climate neutrality, energy efficiency and renewable energy penetration):*
  - Energy efficiency measures in buildings of the residential and services sectors, including local authorities
  - Measures to promote the use of renewable energy sources
  - Modernisation of energy infrastructure through the installation of smart electricity meters
  - Horizontal measures to reduce CO_2 emissions in industries, businesses and organisations
  - Forest fire protection.

- *Component 2.2 (sustainable transport):*
  - Promotion of public and non-motorised transport modes in line with Sustainable Urban Mobility Plans of Limassol and Larnaca
  - Electrification of the vehicle fleet through a) grants for installing solar-powered electricity chargers, b) grants for purchasing electric cars, c) procurement of electric vehicles in the public sector, and d) installation of charging stations in public areas.

- *Component 2.3 (smart and sustainable water management):*
  - Construction works for improved water supply & treatment
  - Construction works for improved water collection & flood protection
  - Smart water management
  - Marine protection from oil pollution.

An economic input-output model was developed and applied for Cyprus to assess the short- and medium-term effect of each group of measures on economic activity and employment from a demand perspective, which means that investment in a specific sector creates demand for the products of the other sectors of the economy through its backward linkages. The model specification was presented by Taliotis et al. (2020)[52], and was initially applied to assess green stimulus measures as shown by Zachariadis et al. (2021).[53] For the purpose of this study, the input-output model which covers all (sub)sectors was updated with most recent available official data.[54]

[52] Taliotis C., Giannakis E., Karmellos M., Fylaktos N. and Zachariadis T., Estimating the economy-wide impacts of energy policies in Cyprus. *Energy Strategy Reviews* 29 (2020) 100495.

[53] Zachariadis T., Giannakis E., Taliotis C., Karmellos M., Fylaktos N., Howells M., Blyth W. and Hallegatte S., 2021. "Building Back Better" in Practice: A Science-Policy Framework for a Green Economic Recovery After COVID-19. Policy Research Working Paper no. WPS 9528; Washington, D.C.: World Bank Group.

[54] The Statistical Service of Cyprus provided the latest available data for the year 2017.

In summary, the effect of a measure on gross value added (GVA) and employment in the country depends on factors such as:

- To what extent new investments in a sector affect demand for intermediate goods/services in other sectors
- What part of intermediate inputs of a sector takes place in the country or depends on imports
- How labour-intensive are the local sectors affected by the new measures
- In case a measure reduces demand for some goods or services in other economic sectors, which production activities are displaced, how they are spread in different sectors, and how labour-intensive these displaced activities are.[55]

Detailed tables with the assumptions about the above effects on each sector are available upon request.

4.3. Aggregate IO Assessment Results

Table A4.1 of the Appendix presents the economic and employment multipliers by economic industry/sector that resulted from the input-output model.[56] Most of these are in line with corresponding IO simulations for other European economies. In particular, we find similar multiplier effects of investments in the construction sector (Ilhan and Yaman, 2011; Hung et al., 2019), ICT sector (Rohman, 2013; Keček et al., 2016) and consultation services (Mandras and Salotti, 2020), as reported for certain European countries.[57] Moreover, with regard to the impact of green measures of priority axis 2, similar multiplier effects for the same type of interventions are reported for other EU countries such as Greece[58] and Spain[59], while the size of the estimated multipliers is in accordance with findings from widely-cited international studies.[60]

[55] This aspect has not been addressed in the model simulations shown here, because such effects are likely to happen in the medium and longer term, whereas the current results refer to short-term impacts only. They will be taken into account to the extent possible in the next stages of the impact assessment.

[56] These are Type 1 multipliers; for more details see Giannakis, E., & Mamuneas, T. P. (2018). Sectoral linkages and economic crisis: An input-output analysis of the Cypriot economy. Cyprus Economic Policy Review, 12(1), 28-40.

[57] Hung, C. C., Hsu, S. C., Pratt, S., Chen, P. C., Lee, C. J., & Chan, A. P. (2019). Quantifying the linkages and leakages of construction activities in an open economy using multiregional input–output analysis. Journal of Management in Engineering, 35(1), 04018054.

Ilhan, B., & Yaman, H. (2011). A comparative input-output analysis of the construction sector in Turkey and EU countries. Engineering, Construction and Architectural Management, 18(3), 248-265.

Keček, D., Žajdela Hrustek, N., & Dušak, V. (2016). Analysis of multiplier effects of ICT sectors–a Croatian case. Croatian Operational Research Review, 7(1), 129-145

Mandras, G., & Salotti, S. (2020). An Input–Output Analysis of Sectoral Specialization and Trade Integration of the Western Balkans Economies. Economies, 8(4), 93.

Rohman, I. K. (2013). The globalization and stagnation of the ICT sectors in European countries: An input-output analysis. Telecommunications Policy, 37(4-5), 387-399.

[58] Markaki, M., Belegri-Roboli, A., Michaelides, P., Mirasgedis, S., & Lalas, D. P. (2013). The impact of clean energy investments on the Greek economy: An input–output analysis (2010–2020). *Energy Policy*, 57, 263-275.

[59] Medina, A., Cámara, Á., & Monrobel, J. R. (2016). Measuring the socioeconomic and environmental effects of energy efficiency investments for a more sustainable Spanish economy. *Sustainability*, 8(10), 1039.

[60] Garrett-Peltier, H. (2017). Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, 61, 439-447.

Having obtained the multipliers from the input-output model simulations, it was then possible to assess the impacts of each priority axis and their related measures on GVA and employment for the short and medium term. The share of the taxes less subsidies was added to the GVA estimates to calculate GDP projections. These estimates are shown in Tables 4.1 and 4.2. Note that the impacts are adjusted for imports, which means that the tables show the local economic impact of each measure, in line with the GVA definition.

Table 4.1 presents all priority axes (aggregated across all their individual components) and thus enables a comparison between them in terms of costs and effects. Columns three to six present the main results of interest in percentage terms, i.e. the short- and medium-term effect of each priority axis on GDP and employment. It is evident that the IO simulations indicate an impact of the RRP investments of about 1.5% on GDP and employment in the short term, and a cumulative impact of 3.8% in the medium term, i.e. up to 2026.

Table 4.1: Assessment of the short- and medium-term economic impact of RRP measures across all Priority Axes.

Priority Axes	Cost from RRP (mio €)	Short-term (2 years ahead) growth rates		Medium-term (5 years ahead) growth rates	
		GDP	Employment	GDP	Employment
Priority axis 1: Public health and civil protection - lessons learned from the pandemic	74.1	0.05%	0.04%	0.13%	0.10%
Priority axis 2: Accelerated transition to a green economy	448.3	0.51%	0.57%	1.28%	1.42%
Priority axis 3: Strengthening the resilience and competitiveness of the economy	449.4	0.54%	0.44%	1.36%	1.11%
Priority axis 4: Towards a digital era	89.5	0.11%	0.11%	0.27%	0.28%
Priority axis 5: Labour market, education and human capital	172.9	0.30%	0.30%	0.75%	0.76%
Total	**1,234.1**	**1.52%**	**1.47%**	**3.79%**	**3.67%**

Table A4.2 in the Appendix provides additional information by presenting the short- and medium-term effect of each priority axis on GDP and employment in (a) absolute terms, and (b) in the form of average multipliers (i.e. the corresponding impact per million euro invested in a priority axis). In total, all measures of the RRP, which amount to slightly over 1.2 billion euro of public funds, are assessed to increase GDP by over 282 million euro in the short term (2021-2023) and by 705 million Euros in the medium term (2021-2026). When it comes to the impact divided by the amount of funding, i.e. the average economic multipliers, the results show that GDP increases by 0.57 million Euros for each million Euros invested. The 282 million Euros increase from the RRP measures in the short-term suggests a 1.52% growth in GDP, while the 705 million Euros correspond to 3.79% growth in GDP by the time of completion of the whole RRP in 2026.[61] Further, the sum of all measures creates about 6500 jobs in the short-term (2021-2023) and more than 16,000 jobs in the medium-term (2021-2026), or about 13.1 new jobs per million Euro invested (Table A4.2). This can contribute

[61] GDP is for the year 2017. Source: National Accounts data, 2020, Statistical Service of Cyprus (Last update 02/03/2021).

to a significant reduction in the unemployment rate, which is currently 7.6%.[62] These results are close but not identical to those conducted with other methods and presented in the previous chapters because the IO model follows a different methodology from those presented earlier and only captures the demand-driven effects of RRP measures, as will be explained below.

The main results of the assessment of the economic impact across all priority axes can be summarised as follows:

- According to the average multipliers per axis, priority axis 5 shows the best performance in terms of its effect on GDP. With a value added multiplier of 0.81, national GDP increases by 0.81 million Euros for each million Euros invested in measures of this axis. Furthermore, it has the greatest relative impact on job creation, creating around 19 new jobs per million Euro invested. In absolute terms, investments in priority axes 3 and 2 (the axes with the largest budget request) generate around two thirds of the total number of jobs created.

- It has to be noted that the input-output model we employ does not distinguish between different types of labour (e.g. skilled vs. unskilled), consequently the employment effect mentioned above has to be interpreted with caution. Jobs contributing to sustainable economic growth will mostly be those for highly skilled workers, and not all sectors employ the same mix of skilled labour. Several studies have highlighted that the transition to digital services, clean energy and circular economy will mostly involve medium and highly skilled new jobs in Europe, thus inducing economic growth.[63]

- Moreover, one has to keep in mind that multiplier estimates derived from the Leontief demand-driven IO model tend to overestimate the real impact on the economy caused by an exogenous increase in final demand, mainly in terms of labour generation due to the fact that economy does not exhibit the levels of excess capacity assumed by the model, especially in the short-run[64].

  In view of the aforementioned considerations, it is important to observe the distribution of jobs across economic activities as simulated by the model. To this end, Table A4.3 of the Appendix presents the distribution of investments (column three) as well as estimates of the short- and medium-term GDP and employment impact across economic sectors.

  The investments in the Construction sector are the highest, followed by investments in Education, Professional, scientific and technical activities, Financial and insurance activities and Information and communication, sectors. With some exceptions, most of these sectors show middle - to - high output, value added and employment multipliers (columns three to five of Table A4.1). Since results depend on both the size of the investments as well as on the value of the multipliers in each economic activity, as expected the investments in sectors like the ones above also show the greatest impacts on the economy.

  The direct, indirect and the total impact of investments on jobs created are shown in column 5 for the short-term and in column 7 for the medium term of Table A4.3. The investments related

[62] This refers to total unemployment: 34291 persons unemployed above the age of 15 years old. Source: Labour Force Survey, 2020, Statistical Service of Cyprus (Last Update 02/03/2021).

[63] See the review in Section 5 of the report of the UN Sustainable Development Solutions Network: "Transformations for the Joint Implementation of Agenda 2030 for Sustainable Development and the European Green Deal", February 2021.

[64] Ten Raa, T. and Rueda-Cantuche, J.M., (2007). Stochastic Analysis of Input-Output Multipliers on the basis of Use and Make Matrices. Review of Income and Wealth, 53, 3, pp.1-17

to the Construction sector generate the greatest number of jobs. The investments related to the Education sector, Financial and insurance activities, Accommodation and food service activities, Professional, scientific and technical activities, and Information and communication, follow in terms of job creation in the economy. The impact of the green measures of policy axis 2, which wa simulated in more detail as described above, is indicated separately in Table A4.3; green measures account for 39% of the total job creation potential according to IO results.

However, the GDP growth induced by these jobs varies substantially. Observing Table A4.4 of the Appendix, it is evident that Construction is amongst the lowest-paying sectors, with an average compensation of around 15 thousand Euros. On the other hand, investments related to e.g., the Information and Communications sector create only around 60 jobs within the sector, but the value added by these jobs is much higher; with an average compensation of 43 thousand Euros, Information and Communications is amongst the highest-paying sectors in the economy.[65]

In what follows, section 4.4 presents the short- and medium-term effects of Priority axes 1, 3, 4 and 5 whereas the economic impact of the green economic recovery measures of priority axis 2 is presented separately in section 4.5.

4.4. Economic Impact of Priority axes 1, 3, 4 and 5 of the RRP

The short- and medium-term GDP and employment growth rates due to RRP measures by component are presented in Table 4.2, while Table A4.5 in the Appendix presents the short- and medium-term effect of RRP measures by component on GDP and employment (a) in absolute terms and (b) in the form of average multipliers (i.e. the corresponding impact per million Euros invested in a component).

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[65] Data are from Eurostat and the Statistical Service of Cyprus, 2019.

Table 4.2: Short- and medium-term economic impact of RRP measures by component.

Components	Cost from RRP (mio €)	Short-term (2 years ahead) growth rates		Medium-term (5 years ahead) growth rates	
		GDP	Employment	GDP	Employment
1.1 Resilient and Effective Health System, Improved Civil Protection	74.1	0.05%	0.04%	0.13%	0.10%
2.1 Climate neutrality	269.3	0.39%	0.42%	0.97%	1.05%
2.2 Sustainable Transport	91.3	0.08%	0.10%	0.20%	0.26%
2.3 - Smart and Sustainable Water Management	87.6	0.04%	0.04%	0.11%	0.10%
3.1 New Growth Model and diversification of the economy	166.4	0.24%	0.25%	0.60%	0.63%
3.2 Enhanced Research & Innovation	64.0	0.06%	0.03%	0.16%	0.07%
3.3 Business support for competitiveness	78.4	0.09%	0.05%	0.23%	0.13%
3.4 Public and Local Administration Reform, Judicial reform and Anti-corruption reform	96.0	0.09%	0.08%	0.22%	0.19%
3.5 Safeguarding Fiscal and Financial Stability	44.5	0.06%	0.03%	0.15%	0.09%
4.1 Upgrade infrastructure for connectivity	53.0	0.09%	0.10%	0.22%	0.26%
4.2 Promote e-government	36.5	0.02%	0.01%	0.04%	0.02%
5.1 Educational system modernization, upskilling and retraining	94.0	0.17%	0.18%	0.42%	0.45%
5.2 Labour Market	78.9	0.13%	0.12%	0.33%	0.31%
Total	**1,234.1**	**1.52%**	**1.47%**	**3.79%**	**3.67%**

According to our simulations, health-related measures (Priority Axis 1) increase GDP in the short-term by 10 million Euros (0.05%) and in the medium-term by 24 million Euros (0.13%), while in the medium-term they create around 1450 jobs in the affected sectors (i.e., 0.10% increase of employment). Investments that induce relatively more economic activity in sectors like the Construction sector generate the larger GDP and employment effects in relation to other measures of this priority axis. This is the result of both large investment budget and the high economic multipliers in Construction. Priority Axis 3 is the largest of all priority axes and is assessed to increase GDP in the medium term by 253 million Euros and create around 5000 jobs in the affected sectors. Digitalization measures of Priority Axis 4 are assessed to increase GDP in the medium term by 49 million Euros and create around 1220 jobs in the affected sectors. Finally, measures of Priority Axis 5 increase GDP by around 140 million Euros in the medium term and create around 3340 jobs.

4.5. Economic Impact of Green Investments - Priority axis 2 of the RRP

This section presents the results on the short- and medium-term economic impact of the green economic recovery measures that have been included in priority axis 2 of the RRP of Cyprus. The first two components (2.1 and 2.2) are the major ones that will yield environmental benefits in the field of clean energy and climate change mitigation, and required more detailed energy and emissions

modelling, which was conducted in the frame of this study. Therefore, apart from simulations with the input-output model, this section provides additional calculations of the economic benefits of measures of components 2.1 and 2.2 due to reduced fuel import costs and improved environmental performance, and discusses the results in view of recent findings from other studies in the international literature.

As shown in Tables 4.2 and A4.2, green measures promoting climate action and sustainable mobility are assessed to increase GDP by 239 million Euros (1.28%) and create 6330 jobs (1.42%) in the affected sectors. Overall, they turn out to have in the medium term a GDP multiplier of 0.53, i.e. increase national GDP by 0.53 million Euros for each million Euros invested in these measures, and create about 13.9 new jobs per million Euro invested.

For each category of measures, the costs foreseen in the RRP were taken into account, along with assumptions about the level of private funds to be mobilized thanks to these measures. Among the sub-components, the component 2.1 'climate neutrality' has the highest average GDP and employment multipliers, that is, 0.67 and 17.2, respectively (Table A4.5). More specifically, the most growth-enhancing interventions are those related to energy efficiency and sustainable mobility as they induce relatively more economic activity in local branches like construction and manufacture of metal products. Conversely, measures related to electrification of transport have relatively low growth and job impacts as a large part of these expenditures is spent on imported goods (electric vehicles) with limited national value added.

Even if these effects of green stimulus seem to be relatively low, it is important to keep in mind three additional considerations:

- A previous analysis that was carried out by the authors with similar data[66] revealed that most green recovery measures stimulate economic growth more strongly than an untargeted economy-wide stimulus package. More broadly, international studies demonstrate that green recovery policies are superior for economic output and employment. Recent simulations for several European countries show that a Green Recovery Plan has a consistently larger economic and employment effect in comparison to a 'Return-to-Normal' stimulus plan.[67] This finding is in line with those of the European Commission's Impact Assessment on stepping up Europe's 2030 climate ambition that was published in September 2020.[68]

- Green interventions are an important ingredient of recovery packages not only because of their economic impacts but also due to their effectiveness in enabling the low-carbon transition envisaged by EU policy, in line with the objective of the Paris agreement for global climate stabilisation.

- Green measures yield additional economic benefits that are not captured by the input-output model used in this analysis. These are outlined and quantified in the next section.

[66] Zachariadis et al. (2021) – see footnote 3.
[67] Pollitt, H., 2020. Assessment of Green Recovery Plans After COVID-19. Cambridge Econometrics, Cambridge, October.
[68] European Commission, Impact Assessment Accompanying the Communication on Stepping up Europe's 2030 climate ambition – Investing in a climate-neutral future for the benefit of our people. Document SWD(2020) 176 final, Brussels, September 2020.

4.6. Broader effect of green measures on social welfare

Policies and measures that promote energy efficiency, clean energy and sustainable mobility have additional benefits:

- They increase the productivity of the economy – an aspect that is addressed in other sections of this report.
- They increase energy security of Cyprus by reducing the dependence on imported fuels that are used in motor vehicles and power generation.
- They curb fuel import costs of the country, improving eventually its trade balance.
- They reduce air pollution and thereby improve the quality of life, especially in urban areas.

The last two effects have been quantified for the categories of measures of components 2.1 and 2.2. To calculate the change in fuel import costs, savings in final energy demand by each group of measures were calculated on the basis of runs of the OSeMOSYS model used for energy planning in Cyprus[69], multiplied by the import cost of automotive fuels (i.e. their retail prices net of taxes) and fuels used by the Electricity Authority of Cyprus.

To compute the environmental benefit, we employed air emissions data and calculations that have been used in national energy planning studies of Cyprus to assess the reduction in emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur dioxide (SO_2) and particulate matter (PM). We then monetized these decreases in emissions by employing estimates of the marginal damage costs per tonne of each one of these substances, based on nationally adapted externality estimates.[70]

Table A4.6 presents these calculations, which show that the green recovery measures of components 2.1 and 2.2 of the RRP are expected to yield benefits of the order of 38 million Euros due to reduced fuel imports and improved environmental quality by the end of the Recovery Plan (2026). Note that the fuel savings and avoided environmental damages will be accumulated throughout the entire lifetime of these investments beyond the period of the Plan, so that they will lead to long-term benefits to the Cypriot economy and society.

Other green measures of policy axis 2 of the RRP are associated with better water management, marine pollution reduction, and improvement of infrastructure for nature protection. These have additional environmental benefits, due to avoided external damages from water scarcity and water pollution, and improved absorption of carbon dioxide from the atmosphere due to forest protection.

4.7. Conclusions of the IO modelling assessment

This chapter described the approach and results for assessing the short- and medium-term economic impact of the RRP measures of Cyprus with an IO method. In total, all measures, which amount to 1.2 billion Euros of public funds, are expected to increase GDP in the short term by 282 million Euros or 1.52% compared to the baseline, and by 705 million Euros or 3.79% in the medium-term, which

[69] See e.g. the impact assessment (Chapter 5) of the 2020 National Energy and Climate Plan of Cyprus that was conducted by the authors.

[70] Sotiriou, C., Michopoulos, A., Zachariadis, T., 2019. On the cost-effectiveness of national economy-wide greenhouse gas emissions abatement measures. *Energy Policy,* 128, 519–529.

corresponds to increasing GDP by 0.57 million Euros for each million Euros invested. Furthermore, together all measures create more than 16000 jobs, or about 13.1 new jobs per million Euro invested. This can contribute to significantly reducing the unemployment rate in Cyprus, which is currently 7.6%.

Results show that investments in the Construction sector will create the greatest number of jobs, both within the sector as well in other sectors of the economy. Investments in sectors like Education, Professional, scientific and technical activities, Information and communication, Financial and insurance activities as well as Accommodation and food service activities, follow in terms of job creation in the economy. The value added created by these jobs however varies substantially. For example, Construction is amongst the lowest-paying sectors, whereas e.g. the Information and Communications sector, although it is simulated to experience a much smaller increase in employment, is amongst the highest-paying sectors in the economy.

As far as the specific priority axes are concerned, investments in priority axes 3 and 2 (the axes with the largest budget demands) generate around two thirds of the total number of jobs created. Judging by the relative impact of the measures, priority axis 5 shows the largest growth-enhancing impact, with a GDP multiplier of 0.81. Further, it creates about 19 new jobs per million Euro invested.

As regards especially the green measures of priority axis 2, they are simulated to mobilise additional private funds of the order of 448 million Euros, increase GDP by 239 million Euros, create over 6200 new jobs in the affected sectors, and yield additional long-lasting benefits of the order of 38 million Euros per year due to reduced fuel imports and improved environmental quality. According to the Coalition of Finance Ministers for Climate Action – a group of fifty-two Finance Ministers (including the Finance Minister of Cyprus) engaged in efforts to address climate change through economic and financial policies – the right investments at this stage will need to be labour-intensive in the short run and have high multipliers and environmental co-benefits.[71] The approach presented here attempts to capture these effects in order to provide a wide-ranging assessment of recovery interventions, e.g., the importance of investments in energy efficiency and sustainable mobility. At the same time, it is likely that measures related to the transformation of businesses to adopt circular economy practices (which are part of component 3.1 of the RRP) can induce demand for highly skilled labour, perhaps even more than energy efficiency and construction-related measures. Such considerations have to be kept in mind when prioritizing recovery investments and reforms.

[71] Stern N., Bhattacharya A. and Rydge J. (2020) Better Recovery, Better World: Resetting climate action in the aftermath of the COVID-19 pandemic. The Coalition of Finance Ministers for Climate Action, July 2020.

APPENDIX

Table A4.1: Multipliers by Industry/Sector.

Sector-Industry/name	Share of local intermediate inputs to total	Output Multipliers	GVA Multipliers	Employment multipliers
CPA_A01 - Products of agriculture, hunting and related services	0.65	1.66	0.55	22.03
CPA_A02 - Products of forestry, logging and related services	0.67	1.15	0.90	15.66
CPA_A03 - Fish and other fishing products; aquaculture products; support services to fishing	0.68	1.54	0.70	12.51
CPA_B - Mining and quarrying	0.34	1.46	0.24	6.93
CPA_C10-12 - Food, beverages and tobacco products	0.50	1.69	0.36	12.74
CPA_C13-15 - Textiles, wearing apparel, leather and related products	0.05	1.06	0.05	2.49
CPA_C16 - Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	0.55	1.65	0.44	20.10
CPA_C17 - Paper and paper products	0.24	1.29	0.17	5.50
CPA_C18 - Printing and recording services	0.94	1.79	0.61	19.93
CPA_C19 - Coke and refined petroleum products	0.00	1.00	0.00	0.01
CPA_C20 - Chemicals and chemical products	0.08	1.10	0.08	2.00
CPA_C21 - Basic pharmaceutical products and pharmaceutical preparations	0.26	1.27	0.28	4.59
CPA_C22 - Rubber and plastic products	0.24	1.27	0.16	4.98
CPA_C23 - Other non-metallic mineral products	0.63	1.71	0.44	8.93
CPA_C24 - Basic metals	0.18	1.22	0.14	2.88
CPA_C25 - Fabricated metal products, except machinery and equipment	0.62	1.63	0.43	11.87
CPA_C26 - Computer, electronic and optical products	0.03	1.04	0.04	0.32
CPA_C27 - Electrical equipment	0.09	1.12	0.08	2.49
CPA_C28 - Machinery and equipment n.e.c.	0.10	1.13	0.11	2.59
CPA_C29 - Motor vehicles, trailers and semi-trailers	0.01	1.01	0.01	0.35
CPA_C30 - Other transport equipment	0.01	1.01	0.01	0.09
CPA_C31_32 - Furniture and other manufactured goods	0.17	1.21	0.19	6.71
CPA_C33 - Repair and installation services of machinery and equipment	0.91	1.63	0.69	16.96
CPA_D - Electricity, gas, steam and air conditioning	1.00	1.68	0.49	7.16
CPA_E36 - Natural water; water treatment and supply services	1.00	2.31	0.72	8.73
CPA_E37-39 - Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services	0.99	1.71	0.85	14.97
CPA_F - Constructions and construction works	1.00	2.33	0.69	21.79
CPA_G45 - Wholesale and retail trade and repair services of motor vehicles and motorcycles	1.00	1.72	0.67	28.26
CPA_G46 - Wholesale trade services, except of motor vehicles and motorcycles	0.95	1.53	0.82	20.88
CPA_G47 - Retail trade services, except of motor vehicles and motorcycles	1.00	1.60	0.86	28.77
CPA_H49 - Land transport services and transport services via pipelines	0.85	1.59	0.63	16.70
CPA_H50 - Water transport services	0.99	2.21	0.70	7.08
CPA_H51 - Air transport services	0.16	1.21	0.01	2.20
CPA_H52 - Warehousing and support services for transportation	0.65	2.07	0.41	7.43
CPA_H53 - Postal and courier services	0.88	1.62	0.74	23.56
CPA_I - Accommodation and food services	0.92	1.74	0.75	24.17
CPA_J58 - Publishing services	0.83	2.08	0.50	5.83
CPA_J59_60 - Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services	0.54	1.50	0.56	13.58
CPA_J61 - Telecommunications services	0.73	1.66	0.69	8.01
CPA_J62_63 - Computer programming, consultancy and related services;Information services	0.54	1.77	0.34	3.94
CPA_K64 - Financial services, except insurance and pension funding	0.71	1.75	0.64	8.10
CPA_K65 - Insurance, reinsurance and pension funding services, except compulsory social security	0.63	1.78	0.49	9.32
CPA_K66 - Services auxiliary to financial services and insurance services	0.62	1.92	0.39	6.04
CPA_L68A - Imputed rents of owner-occupied dwellings	1.00	1.56	0.90	4.75
CPA_L68B - Real estate services excluding imputed rents	1.00	1.30	0.94	2.74
CPA_M69_70 - Legal and accounting services; services of head offices; management consultancy services	0.81	1.42	0.84	13.03
CPA_M71 - Architectural and engineering services; technical testing and analysis services	0.68	1.40	0.76	25.73
CPA_M72 - Scientific research and development services	0.27	1.16	0.62	2.26
CPA_M73 - Advertising and market research services	0.36	1.49	0.25	6.96
CPA_M74_75 - Other professional, scientific and technical services and veterinary services	0.94	1.97	0.63	20.86
CPA_N77 - Rental and leasing services	0.39	1.34	0.55	8.06
CPA_N78 - Employment services	0.97	1.56	0.83	25.50
CPA_N79 - Travel agency, tour operator and other reservation services and related services	1.00	1.52	0.87	22.77
CPA_N80-82 - Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	0.89	1.55	0.77	41.03
CPA_O - Public administration and defence services; compulsory social security services	0.84	1.24	0.92	21.68
CPA_P - Education services	1.00	1.27	0.93	26.57
CPA_Q86 - Human health services	1.00	1.53	0.81	19.77
CPA_Q87_88 - Residential care services; social work services without accommodation	1.00	1.57	0.83	38.11
CPA_R90-92 - Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services	0.47	1.37	0.62	11.05
CPA_R93 - Sporting services and amusement and recreation services	0.96	1.72	0.78	20.04
CPA_S94 - Services furnished by membership organisations	1.00	1.62	0.85	31.32
CPA_S95 - Repair services of computers and personal and household goods	0.56	1.45	0.53	9.09
CPA_S96 - Other personal services	0.98	1.38	0.89	28.10

Table A4.2: Assessment of the short- and medium-term economic impact of RRP measures across all Priority Axes in absolute terms (mio €) and in the form of average multipliers.

Priority Axes	Cost from RRP (mio €)	Short-term (2 years ahead)		Medium-term (5 years ahead)			
		Impact on GDP (mio €)	Impact on jobs (FTE)	Impact on GDP (mio €)	Impact on jobs (FTE)	Impact on GDP (mio € per mio € invested)	Impact on jobs (FTE per mio € invested)
Priority axis 1: Public health and civil protection - lessons learned from the pandemic	74.1	9.8	179	24.4	448	0.33	6.0
Priority axis 2: Accelerated transition to a green economy	448.3	95.4	2491	238.6	6226	0.53	13.9
Priority axis 3: Strengthening the resilience and competitiveness of the economy	449.4	101.4	1950	253.5	4874	0.56	10.8
Priority axis 4: Towards a digital era	89.5	19.7	489	49.4	1222	0.55	13.7
Priority axis 5: Labour market, education and human capital	172.9	55.8	1337	139.5	3343	0.81	19.3
Total	**1,234.1**	**282.1**	**6445**	**705.4**	**16113**	**0.57**	**13.1**

Note: the average multipliers (i.e. the corresponding impact per million Euros invested in a priority axis) are derived from estimated sectoral analysis multipliers based on the corresponding investments and reforms that belong to each sector.

Table A4.3: Short- and medium-term economic impact of measures by economic sector.

	Sector name		Short-term impact (2021-2023)		Medium-term impact (2021-2023)	
		Cost from RRP (mio €)	Impact on GDP (mio €)	Impact on jobs (FTE)	Impact on GDP (mio €)	Impact on jobs (FTE)
A	Agriculture, forestry and fishing	0.1	0.01	0.36	0.03	0.91
B	Mining and quarrying	0.01	0.0004	0.01	0.001	0.02
C	Manufacturing	1.6	0.04	1.04	0.11	2.6
E	Water supply; sewerage, waste management and remediation activities	0.03	0.01	0.2	0.03	0.5
F	Construction	300.9	82.9	2612.6	207.2	6531.4
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	0.2	0.088	1.96	0.22	4.9
H	Transportation and storage	10.5	2.8	58.4	7.1	146
I	Accommodation and food service activities	17.2	6	167.2	14.9	418
J	Information and communication	207.6	22.3	55.1	55.8	138.7
K	Financial and insurance activities	72.4	16.6	182.1	41.5	455.2
L	Real estate activities	2.3	1.1	2.8	2.8	7
M	Professional, scientific and technical activities	105.8	24.7	136.2	61.7	341.4
N	Administrative and support service activities	4.5	1.5	32.1	3.7	80.3
O	Public administration and defence; compulsory social security	0.01	0.004	0.09	0.01	0.23
P	Education	54.6	25.4	634.6	63.6	1586.6
Q	Human health and social work activities	8	3.3	69.1	8.1	172.8
R	Arts, entertainment and recreation	0.01	0.004	0.082	0.009	0.205
S	Other service activities	0.03	0.004	0.057	0.01	0.141
	Priority Axis 2. Accelerated transition to a green economy	448.3	95.4	2,491	238.6	6,226
	Total	**1,234.10**	**282.1**	**6,445**	**705.4**	**16,113**

Table A4.4: Average compensation by economic sector.

Section	Sector name	Average compensation (thousand €)
A	Agriculture, forestry and fishing	10.3
B	Mining and quarrying	23.8
C	Manufacturing	23.9
E	Water supply; sewerage, waste management and remediation activities	23.9
F	Construction	14.8
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	16.6
H	Transportation and storage	26.3
I	Accommodation and food service activities	19.6
J	Information and communication	43.2
K	Financial and insurance activities	48.3
L	Real estate activities	15.5
M	Professional, scientific and technical activities	22.7
N	Administrative and support service activities	19.8
O	Public administration and defence; compulsory social security	43.9
P	Education	31.4
Q	Human health and social work activities	24.8
R	Arts, entertainment and recreation	16.6
S	Other service activities	10.0
	Total Economy	23.8

Source: Eurostat and Statistical Service of Cyprus, 2019.

Table A4.5: Assessment of the short- and medium-term effect of RRP measures by component on GDP and employment in absolute terms and in the form of average multipliers.

Components	Cost from RRP (mio €)	Short-term (2 years ahead)		Medium-term (5 years ahead)			
		Impact on GDP (mio €)	Impact on jobs (FTE)	Impact on GDP (mio €)	Impact on jobs (FTE)	Impact on GDP (mio € per mio € invested)	Impact on jobs (FTE per mio € invested)
1.1 Resilient and Effective Health System, Improved Civil Protection	74.1	9.8	179	24.4	448	0.33	6.0
2.1 Climate neutrality	269.3	72.4	1,850	181.0	4,624	0.67	17.2
2.2 Sustainable Transport	91.3	14.7	456	36.8	1,141	0.40	12.5
2.3 - Smart and Sustainable Water Management	87.6	8.3	184	20.8	461	0.24	5.3
3.1 New Growth Model and diversification of the economy	166.4	44.7	1,113	111.7	2,782	0.67	16.7
3.2 Enhanced Research & Innovation	64.0	11.8	123	29.6	307	0.46	4.8
3.3 Business support for competitiveness	78.4	17.2	222	42.9	554	0.55	7.1
3.4 Public and Local Administration Reform, Judicial reform and Anti-corruption reform	96.0	16.4	341	41.0	854	0.43	8.9
3.5 Safeguarding Fiscal and Financial Stability	44.5	11.3	151	28.3	377	0.64	8.5
4.1 Upgrade infrastructure for connectivity	53.0	16.7	458	41.8	1,145	0.79	21.6
4.2 Promote e-government	36.5	3.0	31	7.5	77	0.21	2.1
5.1 Educational system modernization, upskilling and retraining	94.0	31.1	789	77.7	1,974	0.83	21.0
5.2 Labour Market	78.9	24.7	548	61.8	1,370	0.78	17.4
Total	1,234.1	282.1	6,445	705.4	16,113	0.57	13.1

Table A4.6: Assessment of the medium-term economic benefits of measures included in components 2.1 and 2.2 of the RRP due to reduced fuel imports and improved environmental performance.

			Annual energy and emission savings		Annual energy and emissions impact					Annual cost savings due to energy savings (mio €)	Annual cost savings due to reduced environmental damages (mio €)	Total annual cost savings (mio €)
Project Category	**Measures of draft RRP addressed**	**Component**	**Energy savings (tonnes oil equivalent per mio € invested)**	**Carbon emission savings (tonnes CO2 equivalent per mio € invested)**	**Energy savings (tonnes oil equivalent / y)**	**Carbon emission savings (tonnes CO2 equivalent / y)**	**NOx emission savings (tonnes/y)**	**SO2 emission savings (tonnes/y)**	**PM emission savings (tonnes/y)**			
Energy Efficiency - Buildings in Residential & Commercial Sector	15, 16, 17 (50% of budget as the rest accounts for PVs) + measure 25 (interconnector) + measures 19+22 (grants to public sector)	2.1 - Climate neutrality etc.	23.3	201.6	4431.8	38295.6	78.233	238.527	3.447	1.773	6.803	8.576
Renewable Energy - Photovoltaics & Wind Turbines	50% of the energy efficiency measures + measures 20 (investment 6) + 24 (investment 10)	2.1 - Climate neutrality etc.	23.33	201.6	8067.2	69709.3	142.406	434.189	6.274	3.227	12.383	15.610
Smart Electricity Meters	21 (investment 7)	2.1 - Climate neutrality etc.	13.5	116.3	470.9	4069.2	8.313	25.345	0.366	0.188	0.723	0.911
Reduction of CO2 emissions in industries, businesses and organisations	18 (investment 4)	2.1 - Climate neutrality etc.	25.0	150.0	883.3	5300.0	10.827	33.011	0.477	0.353	0.942	1.295
Sustainable Urban Mobility Plans - Promotion of Public & Non-Motorised Transport	29 (investment 1)	2.2 - Sustainable Transport	141.0	395.0	4441.5	12442.5	33.180	20.738	4.148	3.781	1.732	5.514
Electric Vehicles - Grants for Chargers with PV	36 (investment 7)	2.2 - Sustainable Transport	20.0	50.0	68.7	171.7	0.458	0.286	0.057	0.058	0.024	0.082
Electric Vehicles - Promotion of purchase of electric cars	31 (investment 3)	2.2 - Sustainable Transport	20.0	50.0	4631.1	11577.7	30.874	19.296	3.859	3.943	1.612	5.555
Electric Vehicles - Installation of charging stations	Measure 34 & 35 (investments 5 & 6)	2.2 - Sustainable Transport	20.0	50.0	149.1	372.8	0.994	0.621	0.124	0.127	0.052	0.179
Total					**23144**	**141939**	**305.3**	**772.0**	**18.8**	**13.5**	**24.3**	**37.7**

Table A4.7: Summary results of the three alternative methods for the RRP impact assessment on the aggregate cumulative GDP and Employment growth as a percentage difference from the policy-neutral baseline over the three different horizons

	Quantification of the impact % difference from policy-neutral baseline					
	Short-term (2 years ahead)		Medium-term (5 years ahead)		Long-term (20 years ahead)	
	GDP	Employment	GDP	Employment	GDP	Employment
Production Function - Growth Accounting framework	**2.9%**	**1.1%**	**6.8%**	**2.6%**	**16.5%**	**6.2%**
Econometric Analysis based on VAR models	**0.6-1.3%**	**0.4-0.6%**	**3.4%- 5.6%**	**1.8-2.8%**		
Input-Output (IO) framework	**1.52%**	**1.47%**	**3.79%**	**3.67%**		

5. Summary

Under the Recovery and Resilience Plan (RRP), Cyprus is expected to draw significant funds totalling around 1.2 billion Euros in the period 2021-2026. This report presents a comprehensive analysis of the economic impact assessment from the implementation of the RRP in Cyprus. More precisely, it provides estimates of the short- medium- and long-term economic effects of the RRP. It focuses on the impact of the RRP measures on key macroeconomic indicators such as GDP and Employment and on major sectors of the Cyprus economy. The analysis is based on several complementary methods and techniques - a Production Function approach, econometric methods based on alternative VAR specifications, and an Input-Output framework. These methods help to obtain multiple perspectives and insights on the potential economic impacts. On average all these methods yield broadly similar findings for the aggregate impact on GDP and employment growth[72].

Our PF approach evaluates the effects of RRP measures across all time horizons and accounts for reforms and it is therefore considered the primary method for this impact analysis. Results show that the RRP can increase the GDP of Cyprus by about 3% in the short-term two-year period and by around 7% in the medium-term five-year period, compared to the baseline development of the economy without the RRP. Reforms, among others, of public and local administration, the judicial, and the labour market would significantly affect productivity and GDP growth, in the medium-term and especially in the long-term. In the short- term, GDP growth is mainly induced directly by RRP investments and to a lesser extent by an increase in productivity and by additional employment stimulated by the Plan. In the medium-term, the effect of productivity becomes stronger due to the full implementation of reforms. In particular, the contribution of productivity to GDP and employment rises from 10.6% and 13.2% in the short-term and 23.5% and 29.3% in the medium-term. The Plan also increases employment by more than 2.5%, or by around 11,000 new jobs during the period 2021-2026, which can significantly reduce the unemployment rate in Cyprus.

The positive effects of the RRP are projected to be largely maintained in the long-term. GDP levels are expected to be 16.5% higher 20 years ahead (i.e. in 2041) compared to a scenario without RRP implementation. This is mainly due to the lasting contribution of productivity (reforms), if all reforms foreseen in the RRP are realized. Reforms account for around 60% and 75% of GDP and employment increase, respectively relative to the baseline scenario.

The results of the econometric analysis are in line with the above findings and show that the maximum effect of the RRP on the growth rates of GDP and employment is realized in 2025-2026, which coincides with the end of the period of implementation of the RRP. Finally, the input-output analysis offered insights into the sectors of the economy that will be most significantly affected and assessed the broader welfare impacts of the Plan's green economy measures of the RRP due to environmental co-benefits.

[72] Table A4.7 summarizes the aggregate results obtained from the alternative methods for the RRP impact assessment on the aggregate GDP and Employment growth as a percentage difference from the policy neutral baseline over the three different horizons.