A NEW ERA FOR EUROPE

Volume II: Emerging challenges

Editors
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1. NEW TRENDS AND CHALLENGES POST-COVID AND POST-WAR: AN INTRODUCTION TO VOLUME II

István Pál Székely and Marco Ratto ([1])

INTRODUCTION

The outbreak of the global financial crisis in 2008 ended a long period of crisis-free development of the European Union. Since then, the Union has experienced several subsequent crises. The global financial crisis of 2008-2009 turned into a sovereign debt crisis in Europe that lasted until 2013. ([2]) This was followed by the COVID crisis in 2020-2021. Europe was just about to emerge from this crisis when Russia waged war on Ukraine in February 2022. The destructions of this brutal war, the sanctions on the aggressor, Russia, and the subsequent rapid decoupling from Russia led to an energy crisis in Europe. This series of crises tested the EU's economic, social, and political resilience, and its capacity to adjust and reinvent itself.

Realizing the importance of strengthening its capacities to identify new economic and social trends and policy challenges stemming from the COVID-19 pandemic, Commissioner for Economy Paolo Gentiloni convened a High-Level Group on Post-Covid Economic and Social Challenges. Volume I of this book presented their report (HLG, 2022).

Moreover, some members of the High-Level Group produced further analyses of some of the main issues they identified. Furthermore, throughout this period, there were several events focusing on this area, including the 2021 Annual Research Conference, jointly organized with the Joint Research Centre of the European Commission, and several seminars. This volume also contains contributions from these events, rounding out the set of issues we cover.

([1]) The views expressed here are solely those of the authors and do not necessarily reflect the official position of the European Commission.

([2]) In what follows, concerning Europe, we shall refer to the Global Financial Crisis of 2008-09 and the sovereign debt crisis of 2010-13 in Europe as the 2008-2013 double crisis in Europe.

Volume I aims to identify the key challenges policymakers and societies in the EU face at the European and national levels. It also offers possible public policy actions to help the Union emerge from the current crisis stronger. Volume II looks behind these challenges and zooms in on some key aspects to improve our understanding of the nature of the challenges and the factors that shape and sometimes constrain possible policy responses.

As mentioned in Volume I, the High-Level Group completed its report before Russia waged war on Ukraine. Similarly, most of the contributions in this volume were finished before the war. Nevertheless, as our chapter dates from a year into the war, in the second part of our discussion, we try to offer some preliminary thoughts on the current situation.

1.1. THE PERIOD LEADING UP TO THE CURRENT CRISIS

The COVID-19 crisis hit the EU economy hard just a few years after the 2008-2013 double crisis, which left deep and lasting economic and social scars in the EU, particularly in Southern Europe (van den Noord and Székely, 2011). The root cause of the macroeconomic imbalances that triggered the 2008-2013 double crisis, uneven progress with vital structural and institutional reforms in the EU, however, was not sufficiently addressed following this crisis. Thus, the EU-level institutional and policy innovations that emerged from the 2008-2013 double crisis transformed macroeconomic imbalances, or nominal divergence, into real divergence within the EU, among and within its Member States (Buti and Székely, 2021). The trend of divergence characterized not only the economic and fiscal but also social and institutional developments.

Moreover, the progress with the single market for services, particularly with the digital single market, and with the Capital Market Union (CMU) remained sluggish. This, in turn, hindered the expansion in the most critical areas, such as ICT or digital services, particularly innovation (R & D), putting the 'cutting edge' of the EU at a competitive disadvantage with the most innovative regions in the world (Aghion et al., 2021). By now, as Brousseau and Dalle (2023) in this volume also demonstrate, the latter also include a group of newly emerging global innovators, such as South Korea, Taiwan, Israel, and the most developed parts of China, such as Shanghai and Beijing.

More broadly, Asia pulled ahead fast not only in terms of GDP but also regarding high-skill human capital and innovation, including in fintech (Brousseau and Dalle, 2023). The Asia challenge is perhaps the biggest for Europe in the world. Europe suffered the biggest loss in its share in global output, even vis-à-vis the US, also because of its demographic and immigration trends and limited capacity to attract global talent. The high-income countries in Asia overtook Southern European EU countries in per capita GDP and pulled way ahead of them regarding human capital accumulation, innovation, and creation of global value

chains (GVC). The Central and Eastern Europe Member States, after a short pause at the beginning of the previous crisis, continued their rapid convergence and were among the fastest converging countries regarding innovation, albeit from a rather low base regarding the latter (Landesmann and Székely, 2021).

Overall, the double-legacy of the 2008-2013 double crisis for the EU was a weakened global position, with major threats to its global leadership role on many fronts, particularly in the most dynamic sectors, and a strong trend of real divergence within the Union. Hence, it was imperative to avoid a further accentuation of these trends in the current crisis. In short, the EU had to find a way to turn challenges into opportunities when the COVID crisis broke out. The pressure to act in a fast and decisive fashion and address the underlying structural problems of the EU economy was even bigger when the energy crisis broke out in 2022.

1.2. THE CURRENT CRISIS

Episodes of major shocks are inherent to the process of development. They stress-test the economy and society. Shocks trigger a crisis when economies and/or societies are not sufficiently resilient to absorb them without producing major economic and social imbalances, mostly because of pre-existing structural or institutional problems. While the nature and type of shocks that trigger a crisis vary over time, the reasons why certain countries or regions are more crisis-prone show more stability and similarity across countries and regions. The main immediate reason is insufficient (capacity of) adjustments in the private and public sectors of the economy, and more broadly in society. The ultimate reason for failure is the inability of the political system to coordinate and mobilise society and, thus, promote the necessary adjustment. An important underlying factor that explains the failure of the political system is the lack of sufficiently strong trust of people in the government and state institutions, and among themselves.

Crises tend to have long-lasting impacts on the economy and society, positive or negative. They pose new challenges, as they tend to accelerate some of the previously existing developments in the economy and society and trigger new ones. Resilient countries and Unions tend to respond to a crisis by taking well-designed collective actions in a timely fashion. Their societies tend to react to a crisis by mobilizing support for reforms to enhance the growth potential and strengthen social cohesion. Their firms tend to use crisis periods to focus on changes in the way they work and on investments that can position them for the post-crisis environment.

In less resilient countries and Unions, crises tend to leave deep scars behind. The uneven capacity of families, firms, communities, and societies to adjust, and the insufficient level of trust, fuelled by a lack of fairness, lead to vastly suboptimal outcomes. The trend of divergence intensifies, leading to an uneven distribution

of the economic and social burden of the crisis. In short, crises tend to weaken less resilient countries and Unions and polarize their societies.

However, such an outcome is not inevitable. As Reichlin (2023) in this volume argues, challenges can be turned into opportunities for all if collective action is taken in a well-designed and timely fashion. A defining characteristic of successful countries or Unions is their ability to take such collective action during crises (or when it is possible, in time to avoid a crisis).

The European Union reacted to the COVID crisis with a series of major policy and institutional innovations demonstrating that it had learned the lessons of the 2008-2013 double crisis and the negative trends following the crisis that we discussed earlier. Moreover, it acted fast and decisively by getting off the ground its major new initiatives. The NGEU (RRF) provides major direct support to the Southern European Member States to help boost public investment and focus it on the strategic areas (green and digital). Moreover, by linking the release of funds to progress with implementing reforms that are central to boosting the growth potential of the country ('cash for reforms'), it also addresses the root cause of the divergence within the EU, uneven quality of institutions (within and among Member States). With progress with institutional reforms and with well-targeted and high-quality public investments, the chances for public investment to crowd-in private investment, so much needed for the success of the green and digital transformation, will also improve significantly.

Moreover, as the analysis in Harasztosi et al. (2023) in this volume shows, government support to the corporate sector during the current crisis proved overall rather efficient in reaching the companies that most needed the support and shielding investment essential to undertake the twin transition.

On the social side, the SURE was there just months into the crisis to help Member States avoid repeating the bitter experience of increasing economic and social inequalities during the 2008-2013 double crisis.

The major shocks that this war caused came very soon after the COVID shocks, much sooner than the COVID shocks after the repeated shocks in the 2008-2013 double crisis. While economics can offer relatively decent theoretical frameworks (models) and empirical findings to analyse the behaviour of economies in a steady state, it is much less helpful when it comes to understanding crisis periods.

However, when an economy (and society) is hit by a series of subsequent large and lasting shocks in a relatively short period of time, humbleness is perhaps the best attitude economists and policymakers can take. Our knowledge about how economies and societies behave in such periods is extremely limited. Moreover, an (or perhaps the most) important message of the report of the High-Level Group is that it is no longer possible to work only with the standard models of economics which implicitly assume away the interaction of the economy with society and environment (HLG, 2022).

1.3. CRISES AND THE TWIN TRANSITION

Crises tend to accentuate and accelerate previously existing trends. The COVID crisis forced governments, companies, and families to undergo a digital transformation sometimes overnight. E-government, teleworking and teleteaching, no-contact food ordering and delivery, or using FaceTime to talk to grandparents or grandchildren became an inevitable reality for most families.

The energy crisis triggered by the war on Ukraine, on the other hand, accelerates the green transition, possibly with an inevitable detour to a more fossil fuel-intensive early phase of this transition. Carraro (2022) in Volume I provides an extensive analysis of the main issues and policy challenges involved in the green transition in the EU, particularly regarding stranded assets and the size and nature of the investment needed to undertake this transformation. The energy crisis in Europe that the war on Ukraine and the subsequent sanctions triggered made this analysis even more relevant, as those investments will have to be made faster and the issue of stranded assets will have to be carefully considered when choosing solutions in the short run.

To put recent developments into a broader context, Mairate (2023) in this volume offers a broad overview of the economics of green transition that can help policymakers to address the new challenges in this regard. Like in the COVID crisis, the EU reacted to the energy crisis with renewed policy and institutional innovation, the RepowerEU initiative. This can help use the NextGenerationEU, particularly the RRF to adjust to the new situation and mitigate any possible trade-off between short and long-term considerations (the need for an immediate change in the energy mix and reorientation of energy import away from Russia vs. fast transition to green energy).

The Report of the High-Level Group emphasized the increasing importance of geopolitics and geo-economics (Carraro et al., 2022, Schwarzer, 2022) pointing to the need to rethink and perhaps redefine the relationships of the EU with China and Russia. The issue of strategic autonomy, the necessary decoupling from these countries while maintaining a Union that is open to global value chains and global trade, and managing an orderly green and digital transition is at the centre of these contributions. The brutal war on Ukraine triggered not only a rapid reorientation of the energy import of the Union but also an immediate and wide-ranging decoupling from Russia, regarding trade, FDI, migration and travel, and knowledge transfer. As the analysis in Schwarzer (2022) in Volume I seems to suggest, a deeper and wider decoupling from Russia was probably inherent in the developments prior to the war. Yet again, this trend has accelerated tremendously, making the analyses on this aspect and the recommendations offered in the Report of the High-Level Group even more relevant.

More broadly, the cumulative effect of the COVID and energy crisis is that some of the options the European Union and its Member States might have had prior to these events or perhaps even after the COVID crisis, have been brutally eliminated by the new realities brought about by the war on Ukraine. The report of the High-Level Group (Carraro et al., 2022, Sapir, 2022 in Volume I) discusses three

main scenarios, 'Business as Usual', 'European New Era', and 'Fragmentation and Conflict'. The discussion in the report already casts a doubt on whether the 'Business as Usual' was an option at the time the report was completed, that is, before the war. However, what is certain at this stage is that this option no longer exists in Europe, neither for the European Union nor for the rest of the continent, including Russia. Moreover, the need for the European Union, and more broadly Europe, to find a way to develop along the New Era scenario became a matter of survival.

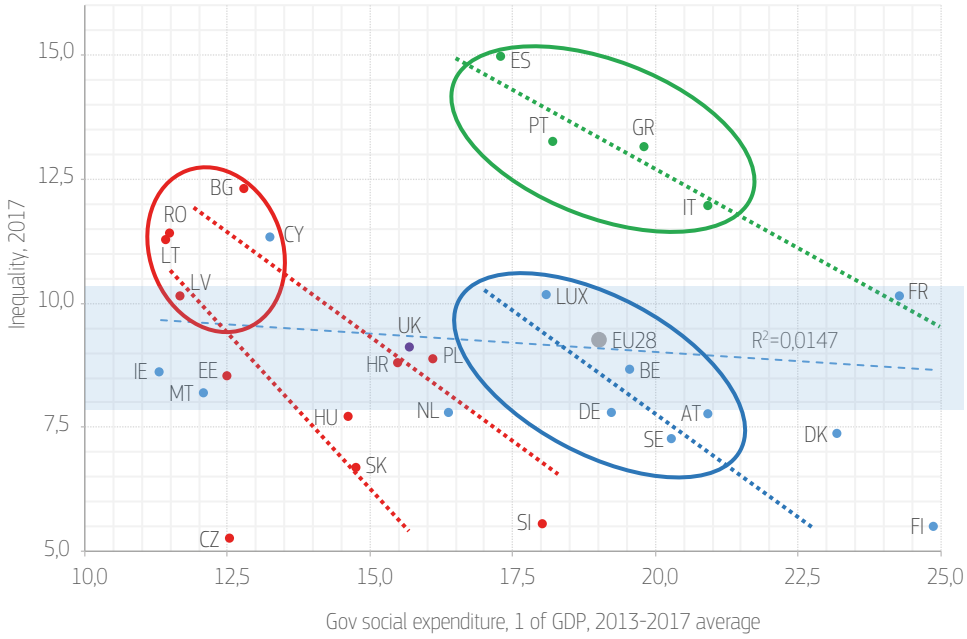
1.4. FISCAL POLICY, PUBLIC EXPENDITURE, AND SOCIAL COHESION

Unlike the 2008-2013 double crisis, the COVID crisis and the subsequent energy crisis triggered by the war on Ukraine and the sanctions on the aggressor (Russia) are primarily attributable to supply-side shocks, which are difficult to address with fiscal or monetary stimulus. The room for further fiscal expansion at this stage is also limited by public debt developments following the sizable fiscal support during the COVID crisis. Moreover, the latest energy crisis together with a major drop in the agricultural exports of Ukraine and the drought in Europe brought about an outburst of inflation not seen in Europe for long, putting pressure on the ECB to tighten monetary conditions. Besides doubts about the feasibility and/or the advisability of an expansionary fiscal policy response, Schucknecht (2023) in this volume calls attention to another issue, an increase in the share of public expenditure in GDP in Europe with an accompanying trend of declining efficiency (quality) of public expenditure.

The fiscal side can do a lot to mitigate the current crisis even if further fiscal expansion at this stage is not on the cards. As Carraro et al. (2022) and Rey (2022) in Volume I argue, smart fiscal rules (such as a Sustainability and Growth Pact) can help promote the necessary investment and the EU can help increase the efficiency of public expenditure by focusing it on the main priorities of the Union and imposing a quality threshold on the programs that are financed at the EU level (NGEU 2.0).

Maintaining social cohesion is among the biggest challenges the EU has been facing. However, as Schucknecht (2023) argues more broadly, and as Figure 1 below shows for this particular area, the efficiency of social expenditure is rather uneven across the EU (Buti and Székely, 2021). Overall, there seems to be no relationship between the share of social spending in GDP and the degree of economic and social inequality in the EU, as the regression line in Figure 1 is flat and the estimated parameter is not significantly different from zero. That is, the same size of social expenditure can result in greatly different outcomes in terms of income, health, and educational inequalities among EU Member States. Moreover, in countries where maintaining social cohesion is likely to be the biggest challenge, with the current system, a more ambitious target on fairness would require a major increase in the already sizable social expenditure, hardly an option at this stage.

Figure 1 / **Social expenditure and social inequality in the EU, 2017**



NB: Social inequality is measured by the UNDP indicator derived from the inequality-adjusted SDI calculations, which reflects inequality in income, educational achievement, and life expectancy.

Sources: Buti and Székely (2021) based on data from Eurostat for social expenditure, and UNDP for social inequality.

Therefore, one of the main challenges is to refocus public expenditure and increase its efficiency (quality). Besides income support schemes that can correct market outcomes, the focus should equally be on areas of public policies and spending that can limit the inequality in market outcomes, most importantly education and healthcare. The degree of pre-distribution inequalities produced by market outcomes tend to severely limit the extent to which public policies can limit income and social inequality (Bozio et al., 2020). Improving the quality of the dominantly government-managed and financed education system, particularly higher education is also essential for maintaining the 'cutting edge' of Europe, as universities are (or should be) major players in innovation.

1.5. SOCIAL COHESION, TRUST, AND POLITICAL DISCOURSE

Inequalities have increased in the COVID crisis (Stantcheva, 2021), stress testing the social cohesion of the EU. The energy crisis will put even more pressure on the EU and its Member States in this regard, as the impact of an energy price explosion on different social groups is highly uneven within and across Member States.

Weakening social cohesion, especially when it is widely attributed to the inability of the government to cope with a shock (such as the COVID-19 pandemic or the energy crisis) erodes trust in government (political trust). As Dhand (2022) and Eichengreen (2022) in Volume I, and Dhand et al, (2023), and Aksoy et al. (2023) in this volume argue, this in turn erodes trust in society (social trust). As in many areas, the common shock affects different societies and communities differently, depending on their relevant characteristics.

Crises tend to stress test societies and states, and public trust in government and politicians with short delays react to the (perceived) success or failures of the state to handle the crises. Using new technics to gauge shifts in public opinion in real-time, show, (Dhand et al., 2023) in this volume shows that the COVID crisis was no exception in this regard. A solid performance in terms of economic and social equality (fairness) and social cohesion equips governments with some wiggle room at the beginning, but even with a good initial position, trust in government and politicians can decline fast, should the performance of the government become poor.

The analysis in Aksoy et al. (2023) in this volume calls attention to a possible long-term negative effect of pandemics on younger cohorts. Their trust in government can be lowered for decades following a pandemic. If this happens following the current COVID epidemic, the implications can be huge in Europe and globally. First, because COVID was a truly global epidemic, the impact would be global, with regional trends likely reinforcing each other. Second, the restrictions on mobility and social contact were perhaps the most difficult to handle for younger people. Third, because young people bore the thrust of the burden of the previous crisis, their trust in the government was already damaged prior to the COVID crisis, more so than in other parts of society. Finally, public support to green transition increased, and green parties got into governments thanks to the support of younger voters. Therefore, if their trust in the government, and thus their political activity, declines, public support for the green transition may fade away.

1.6. INNOVATION AND FINANCE

The success of the EU's drive to accelerate the green and digital (twin) transition will critically hinge on its capacity to strengthen innovation and guide the EU economy toward a knowledge-based and innovation-driven economy (Buti and Szekely, 2021). One of the main lessons of the COVID crisis was that the EU needs to establish its strategic autonomy to strengthen its capacity to meet such huge challenges as a major pandemic. The brutal war Russia waged on Ukraine re-emphasized the importance of this lesson. However, public policies to accelerate innovation, both adaptive and breakthrough or disruptive, are central to achieving strategic autonomy.

Mills (2022) in Volume I points to a trend of the EU losing its 'cutting-edge'. Brousseau and Dalle (2023) in this volume argue that the innovation policies the EU and its Member States have pursued so far share responsibility for this development and, thus, are in a need of a fundamental rethinking and redesign. They focus on newly emerging innovative companies that can turn breakthrough or disruptive innovation into commercially viable products faster than their (global) competitors. They argue that the new approach the EU needs in this area should take into account the nature of breakthrough innovation and the characteristics of existing global innovation hubs, an overwhelming majority of which are now located outside the EU. They point to the critical importance of the scaling-up phase and the weaknesses of the venture capital industry in the EU to support firms in the EU in this phase. The dominance of the US and Asia in this segment does not bode well for the EU to regain its cutting edge and achieve strategic autonomy.

The EU has broadly maintained its technological leadership position in most of its traditional sectors, mostly in manufacturing. The traditionally most innovative regions of the EU (in Northern Italy, Southern Germany, and the Netherlands) also host a large portion of the globally highly competitive multinational manufacturing giants of Europe. However, in the past decades, breakthrough innovation and general-purpose technologies (Aghion et al, 2021) have tended to be concentrated in the service sector, particularly in the digital service sector. This divergence is closely related to the way EU integration has evolved. The EU has been extremely successful with creating a single market for goods, but much less so with creating a single market for services, and perhaps most importantly in this regard with creating a digital single market.

Recent trends show the EU lagging behind in venture capital financing not only the US but also Asia (CBInsights, 2023), a development related to the lack of sufficient progress with the Capital Market Union. In fact, the combination of these two developments, digital single market and CMU is likely to be at the heart of the problem as it hinders most the late scaling-up process of young firms, a phase so critical to establishing a global leading position for innovative firms in the EU. Brousseau and Dalle (2023) offer a rich analysis of these developments and identify the weaknesses of venture capital financing as a major hindrance to breakthrough innovation in the EU.

2. ECONOMIC CHALLENGES POST-COVID-19 [3]

Lucrezia Reichlin

INTRODUCTION

The papers presented at this conference – like much of the evidence so far – point to a devastating recession in 2020 related to the COVID-19 crisis. Moreover, the literature on the effects of the pandemic suggests that structural issues characterizing the economy before the crisis – inequality in income, health, gender, education and productivity across firms – have been made worse by the recession.

However, evidence also shows that policy can be effective. Interestingly, new research has uncovered new mechanisms through which policy can work. At the macroeconomic level this is demonstrated by the fact that the recovery of economic activity has been as fast as its collapse. The 2020 recession was 'V-shaped'. This is in contrast with the experience of the financial crisis when the recovery was very slow in advanced economies. The fast recovery is the result of bold policy action, and it has been to a certain extent a surprise.

Looking back at 2020-2021 and the policies that were put in place to respond to the crisis, we can draw at least four lessons: first, timeliness of policy response to crises matters; second, when the economy is shutting down, government needs to provide liquidity support indiscriminately: attempting to distinguish between viable and non-viable firms in the middle of the crisis is counterproductive; third, fiscal policy becomes very powerful because it can be targeted: with sectoral shocks such as COVID-19 fiscal policy is a better instrument than monetary policy to manage aggregate demand; finally, central bank liquidity as a backstop is a necessary complement of fiscal policy in emergency. Managed monetization as a support to fiscal action is also desirable.

[3] Paper prepared for the keynote address at the annual research conference, European Commission, 'Charting the European economy post COVID-19: unusual times require unconventional policies', November 15th 2021.

These lessons are important for crisis management, they help us to understand past mistakes and we can hope that they will be useful in handling future crises. But the lessons of the COVID-19 crisis, as important as they are, can only partially help us to understand the challenges of the next decade. They are lessons for crisis management, not a guide for designing those policies which are needed to support growth and productivity without sacrificing climate transition, in a situation in which our economies are burdened by high public debt and the likelihood of an increase in real interest rates. My talk will focus on these challenges.

My remarks are organized in three parts. First, I will focus on some key issues for the growth agenda. Second, I will talk about the new macroeconomic environment that we will be facing in the next decades and finally I will ask whether the EU is ready to face these new challenges and propose a framework to discuss reform.

I will argue that the set of policies which we need to implement in the years to come, will have to be based on a new wave of private and public investment. The consequences are that the equilibrium interest rate is likely to rise, and public debt will remain large for years. Navigating in this new macroeconomic regime will require a delicate balance of policies and the use of many instruments. The EU is not ready for this challenge and as a consequence reform is a must.

2.1. UNDERSTANDING GROWTH POST-COVID-19 AND THE GROWTH POLICY AGENDA

The growth agenda post COVID-19 is framed by two objectives. First, sustaining activity when the economy has reopened but the corporate sector is still fragile. Second, sustaining long term productivity growth by facilitating innovations and their widespread adoption. This latter is particularly important in relation to climate mitigation policies since it is only by boosting innovation that we can avoid a scenario in which pursuing sustainability implies lower growth and stressed public finance. The first objective is more immediate while the second requires a longer-term horizon.

This agenda must address both the corporate and the financial sectors. In the EU, it will require reforms aimed at enhancing the role of the capital market in financing economic activity.

2.1.1. Sustaining the economy post-COVID-19: the short run

During the pandemic, much support was given to companies that did not need it and, in some countries, to small, unproductive firms. However, overall, there is no clear evidence of misallocation. Notwithstanding indiscriminate support, there is no sign of 'zombification', but rather hibernation (see for example Coeuré, 2021, Demmou and Franco, 2021, Cros et al 2021).

This endorses the policies of indiscriminate support adopted by governments when economies were shut down. The question now is at what pace those policies should be discontinued and how they should change if not discontinued altogether.

The case for not discontinuing them is to avoid a wave of bankruptcies of companies that are economically viable but cannot obtain financing because of frictions in financial markets (Schivardi and Romano, 2020, refer to such firms as economically viable but financially fragile). A consequence of the pandemic has been an overall deterioration in the risk profile of the corporate sector and an increase in the number of companies in this category. Provided that it is possible to distinguish this group from that of non-viable firms, supporting the economically viable via a variety of schemes is justified as a way to avoid damaging productive capacity in the long run. The case for using public investment, including equity or quasi-equity, is that – given the high level of uncertainty still prevailing – private equity injections are likely to be insufficient as private agents are unlikely to recognise or value the positive macroeconomic effects of such injections. The externality here is the long-term macroeconomic effect of a wave of bankruptcies that would materialize in an economy which is still fragile.

But is the state equipped to select fragile but viable companies, especially when the relevant population is mostly composed of small firms? Clearly here there is a need for innovative policy interventions, and we can learn from some recent policy experiments. For example, in a recent French public program, the state committed to co-invest in those companies in which private banks and investors were also willing to invest. The idea here is that the state can rely on banks and other private sector intermediaries to provide information on the economic soundness of the target companies. Other private-public ventures are worth considering in schemes where the public and private sector are complementary. The recent attention given to equity instruments is an interesting direction in the development of public policy (Boot et al, 2020a and 2020b).

2.1.2. Sustaining productivity: the long run

Pre-crisis evidence shows that the 'winner takes all' characteristic of much successful commercial technological development has been a major barrier for translating technical change into widespread adoption. It also explains the apparent paradox in the fact that a wave of innovation has not led to productivity growth which, on the contrary, has been declining for 25 years and at a faster rate since 2008. The McKinsey Global Institute has calculated that Europe overall operates at only 12 percent of digital potential, and the United States at 18 percent, with large sectors lagging in both (McKinsey, 2016).

The rate of adoption of technological innovation has been found to depend on many factors, including companies' size, education, management practice, availability of digital services and so on (see, for example, Berlingeri et al., 2020 for recent evidence on OECD countries). A persuasive line of research has attributed slow adoption to the fact that once a tech company achieves market dominance,

mutually reinforcing factors make it almost impossible to displace ('winner takes all)'). Since the big tech companies are almost all located in the US, EU anti-trust policy is not sufficient to address this problem. Creative instruments and projects at the EU scale are needed.

In general, policies aimed at helping widespread adoption of technological innovation should be based on the recognition of the complementarity between labour market policies and corporate support and need to include regulation policy, public equity investment, incentives to promote collaboration between companies and universities, provision of platforms to help digitalization. Rather than a generic emphasis on the objective of digitalization, focus should be on policies which are multi-dimensional and 'place based' since delays in digitalization and adoption are typically concentrated in certain regions where there is also deficiency of human capital and poor quality of institutions.

There is little that the literature on the effect of COVID-19-related policies on productivity can tell us on this subject. Those findings are highly dependent on the nature of the support measures and the collapse of output in 2020, but, most importantly, they provide information on the short-run effect of these measures on productivity movements at the business cycle frequency, not on changes to the production function post-crisis ([4]).

2.1.3. The green transition

In thinking about productivity, the problem of the green transition should take centre stage. The EU has a comprehensive set of policies known under the label of the 'green deal'. Related to that, there is an intentional green bias in the Next Generation EU (NGEU) program and OECD data show that the latest increase in budget allocations to environmentally positive recovery measures is almost double the total allocated to measures with negative or mixed environmental consequences. This is good news.

However, the bad news is that the recovery is oriented towards business-as-usual and will do little to meet the requirements of the green transition. According to the OECD, seventy-nine per cent of recovery spending cannot be considered environmentally neutral: 10 % is specifically tagged as mixed or negative for the environment and the final 69 %, while not tagged as having direct environmental impacts, is unlikely to be benign for the environment. This is line with Carraro (2021) who shows that a large part of the Next Generation EU funds, notwithstanding the intentional green bias, are still allocated by governments to measures with likely environmentally negative or mixed impacts.

([4]) Even evidence on short-run effects is inconclusive. De Vries et al 2021 show that, after taking into account the productivity collapse in the hospitality and culture sector during 2020, there is no deviation of productivity growth from the slowing pre-pandemic productivity trend. Andrew et al, 2021 show that job reallocation did not harm productivity and Bloom et al, 2020 that 'within-firm' productivity decreased significantly as intermediate costs increased due to sanitation measures, but that there is some positive 'between-firm' effects caused by the contraction of less productive firms.

An additional concern is that the increase in green measures is dwarfed by continuing government support to fossil-fuel producers and consumers. In 2020 alone, G20 and emerging economies spent over USD 345 billion subsidising fossil-fuel use.

It is clear that more investment in the green transition will be needed in the next decade and beyond. Several estimates point to the fact that achieving the goal of net-zero greenhouse gas emissions in the EU by 2050 requires an immediate expansion of annual investment in clean and efficient energy use and transport by about 2 % % of GDP and additional annual investment needs of euros 1,040 billion. This is the investment needed to reach 55 % emissions reduction by 2030 compared to 1990, which is almost double the average reduction of the last decade (European Commission, 2020, Darvas and Wolff, 2021 and their citations of other sources).

These targets are likely to be achieved by a mix of public and private investment. Bruegel estimates a public-private ratio going from 1:4 to 1:5 (Darvas and Wolff, 2020) which implies that public investment will have to amount to between 0.5 percent and 1 percent of GDP.

Although most economists favour incentives for private investment such as the carbon tax as a mechanism to make private investment in climate infrastructure more profitable and thereby relieve the need for public investment, it must be recognized that there are limits to the political feasibility of the carbon tax. Recognising this, a Bruegel study (Laenaert et al, 2021) has estimated that public spending for the green transition in the EU will have to increase by some €100 billion per year.

This is a major fiscal effort that will need to be financed. Financing will require the economy to grow at a sustained rate but this should not come at the expense of the climate targets. We need to grow while reducing the energy intensity of production and/or the emissions intensity of energy. The ability to do so will in turn depend on innovation.

This is why a strategic policy agenda will need to include different measures, involving incentives such as taxation, initiatives that would help mobilize private capital such as standards and regulations, market finance and public-private ventures to support innovation, but also public investment. This complex agenda will have to be implemented in a macroeconomic regime that is likely to be very different than that pre-crisis (we will discuss this in Part 2).

2.1.4. Enhancing the role of capital market

For all the key items in the growth and sustainability agenda – supporting fragile firms, helping the widespread adoption of technological innovation, public-private ventures to finance the green transition, etc. – the EU needs reform of its financial sector in order to widen and deepen access to risk capital.

The EU is highly dependent on financial intermediation via banks. One-third of household financial assets in the EU27 sit in the banks, earning zero interest ([5]). The development of the European capital market as a real competitor to bank based finance is important both to improve the allocation of investment and to increase its volume.

There is an urgent agenda at the EU level for deepening the capital market union which involves the reform of the supervisory architecture, the reduction of cross-border barriers and enhancing convergence and transparency. Reform at the national level is also important and this involves pension reform and tax policy (see the Final Report of the High-Level Forum on the Capital Markets Union, 2020). The upside from mobilizing private capital could be large and significant for the growth challenges I have been discussing.

2.2. NEW MACRO ENVIRONMENT: INCREASING INTEREST RATES AND PERSISTENT LARGE PUBLIC DEBT

Even without looking far in the future, global investment is expected to grow by 8.1 % this year, the fastest in 25 years. It is likely that the advanced world will shift from decades of declining and low investment to a new regime of sustained higher investment. This conjecture is not uncontroversial since persistent uncertainty may have a negative effect on aggregate demand and hence on investment, but it is worth exploring. Since I delivered this speech the EU was hit by the the war in Ukraine and the energy crisis. Private investment in the EU has been very weak as a consequence. The high investment- high equilibrium real rate scenario is therefore quite unlikely in the near term. The discussion that follows, however, still stands.

An increase in world investment implies that, other things being equal, the equilibrium real interest rate will be pushed up. To the extent that part of this increase in investment will be public, it is likely that it will be partially financed by new debt rather than taxes and this in a situation in which public debt has already reached post war record levels. In 2021, the public debt to GDP ratio reached 257 % in Japan, 125 % in the US and 99 % for the euro area in total, but with seven of its Member States having reached a ratio of above 100 %.

In the long run, as long as investment is put to productive use, both the real interest rate and GDP growth will increase. Whether debt will be sustainable without requiring a sharp increase in the primary surplus will depend on the relationship between these two variables, which in turn will depend on the credibility of public policy. In the short and medium term, the fiscal and monetary

([5]) Note that there is a lot of heterogeneity across countries on the extent of capital market finance with France and the Netherlands doing better than Italy, Germany and Spain. The difference is partly explained by differences in the pension system and partly by the average size of firms.

policy mix will determine the pace at which interest rates, inflation and the rate of growth will adjust as the equilibrium real rate increases. Much can go wrong.

2.2.1. Public debt sustainability and fiscal space

Is the high level of public debt in advanced economies sustainable and can we possibly envisage additional debt financed public investment without jeopardizing financial stability?

The answer to this question is not straightforward. As Blanchard (2019) has forcefully argued, if – as has been the historical norm – the interest rate on government debt remains below the growth rate for a long time, debt rollovers and the issuance of new debt without a later increase in taxes will be possible. But in a less than efficient economy the returns on private investment may differ from the rate on government debt and that difference is a key variable to evaluate the fiscal space. Historically, the difference has been positive, which is one of the reasons that has allowed many countries to sustain small or negative primary surpluses and high public debt (Reis, 2021).

This can be understood by writing the government budget constraint as the sum of the future discounted primary surplus plus another term which represents the service flow of public debt arising from its safety. This 'bubble term' can be written as the difference between the marginal product of capital and the interest on government debt as in Reis, 2021 but more broadly can be related to a variety of different mechanisms which make public debt desirable ('safe')' (see for example Brunnemeier et al, 2021 and Sims, 2019). We can understand this as a form of seignorage that the government enjoys because its ability of raising future taxes. These mechanisms explain why governments in advanced economies have in general enjoyed a premium which has provided some fiscal space.

But in thinking about sustainability in the current circumstances, one has to be aware of mechanisms that can erode that fiscal space. For example, risk premia are likely to be affected by the level of public debt: at high levels of debt, additional debt, even if it leaves the average interest rate below the growth rate of the real economy, may put upward pressure on the effective interest rate because it increases the risk of default. As is widely documented, marginal borrowing costs often spike in the run-up to sovereign defaults (e.g., Arellano, 2008).

Moreover, in a non-deterministic environment, even if public debt is risk free, there is bound to be uncertainty about future primary surpluses as they are related to economic activity and should therefore be discounted with a risk premium (see for example Jiang et al, 2020). Volatility of inflation also matters although unexpected inflation fuels the seignorage term and provides some additional fiscal space.

This is not the place to do justice to a complex literature, or to attempt to derive from it the conditions under which the safety and efficiency of public debt will be preserved in an environment in which debt financed public investment will increase. Many of the insights of that literature are nonetheless useful.

They warn against a simplistic view of the government budget constraint as the sum of future discounted primary surplus and highlight the need to include a 'bubble term' in that constraint, arising from uncertainty and incomplete markets. They also point to the possibility of different equilibria, some of which are compatible with increasing public debt for long periods of time, but some which are not.

The main lesson is that, although it may be possible to sustain high levels of public debt for long periods of time, there are nevertheless limits to debt expansion. These limits are ultimately explained by the fact that the preservation of the safety of public debt cannot be independent of the ability of the state to maintain fiscal capacity (i.e., its ability to tax). As pointed out by Brunnemeier et al, 2021, 'non-safe' equilibria can emerge endogenously. When they do, taxation needs to be used to kill these non-safe bubbles. In essence, this says what we knew all along, that the reason why the state can enjoy seignorage, that is the privilege of financing itself at a low rate (what in the literature is called the safe bubble), is its credibility and its credibility ultimately derives from its ability to tax. I will return to this point below.

2.2.2. Public debt to finance climate transition

Private and public investment will push up the equilibrium real rate, but, if not misused, should create fiscal space by generating growth.

As for debt-financed public investment for climate transition, there are several reasons why the inter-temporal government budget constraint will be less binding. That investment is motivated by a market failure and it should generate social returns which are additional to any private returns. Moreover, public and private capital should be complements rather than substitutes in this case. Consequently, it is conceivable that there will be crowding-in rather than crowding-out.

In addition, insofar as this investment is intended to mitigate climate risk, it will dampen future output and inflation volatility and therefore reduce risk.

2.2.3. The political economy of public debt

The discussion so far tells us that public debt should not be demonized: it has its uses. We have emphasized climate transition since reaching net zero emissions by 2050 is an existential and strategic goal and one the EU is committed to. But the considerations on Part 1 of my remarks suggest that there is a broader motivation for public investment to support the growth agenda.

Historically, public debt has been an instrument of state building. We could argue that investing for the climate transition today and accumulating debt for that purpose should be thought of in the same way as accumulating debt to win wars or to build state capacity.

But accumulating public debt while maintaining its safety and supporting growth (which is the condition for its sustainability), requires, as we have argued, that both the central bank and the fiscal authority maintain credibility and that credibility ultimately rests on the state's ability to raise taxes which, in turn, depends on the perceived legitimacy of public policy. In other words, public debt must be perceived as generating public goods. The green transition agenda is certainly an appropriate project around which to build that consensus, but the effect of the transition will weigh differently on different parts of society so that public expenditure, taxation and perhaps debt will have to be used to compensate the losers.

From an historical perspective, the safety of sovereign debt depends on three factors (see again Eichengreen, 2021). First, good governance, policy and institutions – which are conditions for limiting the bad use of debt. Second, the existence of legal contracts to protect creditors and a clear framework of debt restructuring should a sovereign crisis occur. Finally, a central bank that is known to be willing to act to stabilize prices of government securities in case of liquidity crises.

In advanced economies the second condition can generally be taken as given, while assuring the first and the third must be central to the public policy discussion, especially in the EU.

2.2.4. Public policy implications

So far, I have talked about government without distinguishing between the central bank and the fiscal authority. However, that distinction matters in practice and especially for short term and medium-term dynamics.

The economic governance regulating the relationship between the central bank and the fiscal authority must ensure that credibility of policy action which is a condition for debt safety. Independent central banks, commitment to a quantitative objective of price stability and fiscal discipline were seen as a successful model from the 1990s until the great financial crisis of 2008. It is not obvious that that model will still work in a period of high debt and large central bank balance sheets, but some principles are still important today.

With high levels of public debt, any change in monetary policy has significant fiscal implications since, by affecting debt refinancing conditions, it has an impact on fiscal space. Large central bank balance sheets, on the other hand, mean larger fluctuations in central banks' net income and large dividends paid to national treasuries. While it is always the case that inflation is the result of both monetary and fiscal policies, the interactions between the two policies have become more sizeable and the case for coordinated monetary and fiscal policies stronger.

This is also due to the fact that the case for fiscal activism has grown in the current economic circumstances. Before COVID-19, the zero lower bound limited the effectiveness of monetary policy while making fiscal policy more powerful. Post

COVID-19, sectoral shocks and supply constrains call for fiscal policy which, as an instrument that can be more targeted than monetary policy, is more effective in optimising trade-offs between inflation and unemployment. But COVID-19 has also shown that there are circumstances where fiscal policy intervention must be done decisively (see Part 1) and, to ensure that this is not financially destabilising, monetary policy must be supporting – if necessary to the extent of allowing temporary monetary financing.

With the equilibrium interest rate increasing and inflationary pressures coming from supply disruptions (COVID-19 related today and climate transition related tomorrow), fiscal-monetary coordination will be important to ensure that slow debt consolidation will be possible without affecting the safety of government debt. Governments will have to commit to credible long-term fiscal targets while central banks will have to gradually adjust financial conditions to the new higher equilibrium interest rate, tolerating above target inflation in the short run but committing to price stability in the medium term. Moreover, a world which is vulnerable to occasional large negative shocks needs monetary and fiscal authorities to stand ready to implement aggressive fiscal action supported by liquidity provision, as COVID-19 has demonstrated.

This suggests that economic governance should explicitly allow for monetary-fiscal coordination rather than be based on a rigid separation between the two policies.

The policy mix will have to stay away from extreme solutions, defined as a steep increase in primary surplus or an inflation flare-up. This implies tolerating some temporary inflation and a gradual adjustment of the primary deficit. As Eichengreen et al, 2021 show, in history, 'staying in the middle' has characterized the policy of those countries that, starting from high levels of public debt, have been able to achieve slow fiscal consolidation. Condition for that is maintaining the credibility of medium to long-term fiscal and monetary targets.

2.3. IS THE EU READY?

Let me summarize what I have said so far about the challenges of the next decades. Managing public debt will remain a central challenge for at least three reasons: (i) the large size of legacy debt; (ii) the need to support the recovery; (iii) the need of public investment to finance the energy transformation, including innovation and compensation for those which are penalized by the transition. I have also identified some factors which will be critical to ensure that a stock of debt which is likely to remain very large can be sustained. In other words, factors which will preserve the safety of government paper. These are related to the good use of incremental debt, which will have to be seen to deliver future growth, a fairer society and the provision of public goods. I also argued that to achieve this, while also managing the volatility triggered by the various shocks that will inevitably hit our economies, it will be necessary to implement coordinated monetary and fiscal policy.

The EU, with its peculiar mixture of common and devolved policy responsibilities, is fundamentally unprepared to meet this challenge. All the factors that I have identified as key for dealing with a regime of high public debt and increasing interest rates while preventing financial instability, are either lacking or not secured. Following are some important pillars of the framework that need to be revised.

2.3.1. EU safe asset

Fundamentally, euro area Member States' public debt cannot enjoy the safety premium of a unitary system in which each country has sovereignty over money creation. Without transfers, a member of the monetary union has a more stringent budget constraint, other things being equal. This creates a situation in which either individual countries are forced into fast consolidation or the balance sheet of the central bank becomes a vehicle for risk sharing. The solution to that problem would be to create an EU safe asset – i.e., debt issued with the collective backing of the Member States – but the obstacles to doing so are both legal (the Treaty forbids it) and political (it would imply a federalist structure). The lack of a EU safe asset is also an obstacle for the development of the capital market union, an important factor for financing the growth agenda via mobilization of private capital as we have argued in Part 1.

2.3.2. Monetary-fiscal coordination

It is also not possible at present for the EU to implement any systematic monetary-fiscal coordination. This is due to a very strict interpretation of the concept of central bank independence which rules out any coordination that would constrain the ECB's decision-making power. Unlike for the case of common debt, however, there are no legal barriers to soft coordination arrangements involving dialogue, exchange of views, the creation of a common analytical basis with other policy institutions, etc. – i.e., initiatives that might make a meaningful contribution while not committing the ECB. Institutionally, such exchanges could take place through a dedicated board, a permanent forum, or the European Semester process (see the proposal in Reichlin et al., 2021).

2.3.3. No monetary financing

The prohibition of monetary financing is a bigger concern which could limit the ECB's effectiveness in present circumstances. Article 123 of the Treaty, which states the principle of prohibition of monetary financing, provides an extra bulwark against any pressures that might lead to public debt monetisation, but the scope of this prohibition is uncertain. In Maduro et al., 2021 we stress the need to provide legal certainty and focus on the objective of the central bank's policy actions and the preservation of incentives to budget discipline rather than implementation of the specific modalities applied in previous cases such as the level or share of purchases of bonds in relation to the capital key. Bond purchases should not be considered monetary financing so long as (1) the ECB can provide

a clear rationale for why they are essential in the pursuit of its price stability mandate, and (2) the bond purchases do not lift the pressure on Member States to pursue sound budgetary policies (see also Steinbach 2017).

2.3.4. Fiscal framework

The stability and growth pact involves rules which look increasingly anachronistic in the present context. In Maduro et al., 2021 we argue for a reform that gives higher priority to debt sustainability, creates room for stabilization and allows for differentiated medium-term debt anchors and risk-based debt reduction objectives. This can be done. Some room for manoeuvre exists under current rules with regard to greater attention to debt sustainability analysis or the use of escape clauses. More far-reaching deviations from the current fixation on uniform numerical reference values (i.e. 3 % deficit, 60 % debt ratio) could be implemented via special legislative procedure outlined in Article 126(14) TFEU and changes to EU secondary legislation, which would be less cumbersome than ordinary Treaty changes.

To conclude, the stability and adequacy of the monetary and fiscal frameworks of the euro area (and the EU) are increasingly challenged by persistent changes in the economic environment. The original legal architecture of the EMU has largely remained unchanged but the system has had to adapt to respond to the multiple crises that we have experienced. True, the system has shown an ability to adapt in a flexible way to changed circumstances, but it is increasingly stretched from both economic and legal points of view and this is likely to limit its ability to respond to future challenges. Indeed, it is likely that the system will be stretched more and more in the future and will therefore become increasingly vulnerable to legal challenges and political contestation. Will the pragmatic response to COVID-19 – common debt, suspension of fiscal rules, de facto monetary-fiscal policy coordination – continue to serve us well or will we need deeper governance reform? In other words, can we continue to adjust the rules in reaction to events or do we need to make changes in order to be prepared for future challenges? I believe that a proper assessment of the adequacy of the governance arrangements designed in the 1990s in the light of the challenges we are likely to face over the next decade and beyond will support the case for pre-emptive rather than reactive reform of those arrangements.

Elsewhere (Maduro et al., 2021) we have argued that the limits to reform are essentially political rather than legal. However, legal obstacles for creating an EU safe asset remain. Fundamentally, the reason is that the EU currently does not have taxing powers and this restricts its capacity to issue debt (the collateral for which is the ability to raise taxes in the future). However, the NGEU demonstrated that, as long as there is unanimous agreement, a solution can be found under particular circumstances. For example, the political agreement within the European Council opens the way to the introduction of permanent new own resources. The Recovery and Resilience Facility, through which financial support is provided by the Union on the condition that Member States prioritise certain investments, meet certain targets and implement certain reforms, has a more permanent mechanism.

Building on this logic, there are some proposals to create new mechanisms for vertical policy coordination (Buti and Messori, 2021 and Maduro et al, 2021). These have the potential to add a new *modus operandi* to the EU policy toolkit. For example, conditional matching grants whereby the EU co-finances policy actions, subject to coherent initiatives on the part of national governments, could provide a new template for vertical cooperation between levels of government. Potential fields for implementation include for example the next vintage of Structural Funds, as well as the green and digital transitions. A similar approach could be used for reforming the fiscal framework by granting preferential treatment to certain investments that contribute to meeting jointly defined goals. Subject to sustainability requirements, Member States could, for example, be authorised to borrow over and above standard limits for the financing of specified programmes of common European interest.

An alternative would be to create a new facility for the purpose of climate related investments that can benefit from the safety of common debt. Recently, Garicano 2022 has proposed a new European Climate Investment Facility to provide grants and loans to fight climate change until 2050, when the Union must reach net zero emissions. This would be financed by the issuance of common debt guaranteed by increasing the ceiling of new own resources (such as the new Carbon Border Adjustment Mechanism and the extension of the Emissions Trading System). Such facility would be complemented by an independent European Fiscal Agency to assess the good standing of different Member States to access the Facility which would depend on compliance with fiscal conditions, drawing inspiration from the Recovery and Resilience Facility Regulation, which laid down the rules to assess and approve recovery plans based on compliance with certain conditions.

The common characteristics of these proposals is that the institution building would be related to a specific purpose: an EU public good around which political cohesion can be built. Relating this to our discussion on the political economy of public debt, this seems to be a promising strategy as it links the accumulation of debt to a purpose. The delivery of the related public good, in turn, provides legitimacy for the risk sharing that all those proposals imply.

What will eventually be possible to do depends on the collective political will of Member States. Although the response to the COVID-19 crisis was not quite that Hamiltonian moment that some had hoped for, there is a lesson that can be learned from it: progress can be made when there is a shared purpose.

3. HOW WILL COVID-19 AFFECT TRUST IN THE EUROPEAN UNION? ([6])

Cevat Giray Aksoy, Barry Eichengreen and Orkun Saka

INTRODUCTION

For Europe, an important question about the legacy of COVID-19 is how this experience, including the response of officials and institutions, will affect trust in the European Union. Some commentary (e.g. Charlemagne 2021), informed by European institutions' initial response to the pandemic, predicts that the legacy will be profoundly negative. The European Union initially allocated for vaccine development only a small fraction of the funding mobilized by the U.S. government (€2.7 versus $18 billion), owing to a lack of perceived urgency and lack of resources (Kirkegaard 2021). Early on, EU countries then vaccinated a smaller proportion of its population than the United States, Britain or Israel ([7]). Blame was placed initially on the European Commission, which refused to allow an informal 'Vaccine Alliance' of France, Germany, Italy and the Netherlands to finalize an agreement with the pharmaceutical company AstraZeneca, took its time in signing contracts for COVID vaccines, and made over-optimistic assumptions about vaccine delivery ([8]). A threat to apply export controls to vaccines, implying the imposition of a hard Irish border, tarnished the Commission's reputation as a defender of a rules-based trading system. The European Medicines Agency and French and German governments disagreed publicly about whether the AstraZeneca vaccine was safe for individuals aged 65-74 ([9]). Given these issues around the performance of EU institutions, questions were then raised about the adequacy of the process through which Commissioners are chosen (and by implication about the structure of relations between national governments and the European Commission), as well as about oversight of the EU's executive branch by the European Parliament.

([6]) We thank Massimiliano Mascherini, Sanna Nivakoski, Daphne Ahrendt and Tadas Leoncikas for helpful comments.

([7]) As late as June 4, 2021, EU countries had administered only two-thirds as many vaccine doses as the United States (60 versus 90 doses per hundred population).

([8]) As European Commission President Ursula von der Leyen put it in February 2021, 'We were late to authorize. We were too optimistic when it came to massive production, and perhaps too confident that what we ordered would actually be delivered on time.' BBC News (2021).

([9]) I return to this particular episode below.

Subsequent experience suggests a more positive reading. The EU largely succeeded in preventing European governments from fighting one another for scarce vaccine supplies (in the manner that U.S. state governments fought one another for scarce personal protective equipment). The Commission ensured that pharmaceutical companies remained liable for health risks. It was more vigilant than governments outside Europe in requiring safety protocols to be followed. The resulting confidence mean that vaccine scepticism was limited and take-up was greater than otherwise ([10]). Vaccine administration accelerated in the course of 2021; by September of the year, the 27 EU Member States had administered more doses per 100 people than the United States. On the financial side, meanwhile, the decision to launch an unprecedented €750 billion Recovery Plan for Europe indicated that the EU had the capacity to respond constructively and creatively to the economic and public health emergency ([11]).

This contribution to the deliberations of the High-Level Advisory Group will consider the impact of the pandemic on trust in the EU and its institutions. It will then suggest steps that can be taken to regain trust where it has been lost and enhance trust where it has been maintained. It will start by reviewing survey data on the evolution of public opinion regarding trust and confidence in the institutions of the European Union, both prior to and since the pandemic. This longer-term perspective will build on the analysis of Dustmann et al. (2017), who documented and analysed the secular deterioration in trust and confidence in the institutions of the European Union.

Where this analysis looks at the evolution of trust in general, the next section of the paper will then consider what we know about the impact of epidemic exposure specifically on citizens' trust in government, its leaders, and their selection. The most directly-relevant work is Aksoy, Eichengreen and Saka (2020), where my co-authors and I find that epidemic exposure has a persistent negative impact on trust in government, national leaders and elections, particularly among individuals in their impressionable years (ages 18 to 25) when an epidemic struck their country.

In addition to reviewing these results, attention will be paid to two problems of external validity. First, can one extrapolate from the effects of past epidemics to the global pandemic that is COVID-19? Second, can we apply findings about changes in attitudes toward national governments to attitudes about the European Union? Caution is of course appropriate on both scores.

The penultimate section will then offer recommendations for changes that would enhance trust in the EU and its institutions and help to repair any damage wrought by COVID-19.

([10]) This hypothesis leaves aside health (blood-clot) concerns that arose in conjunction with the AstraZenica vaccine, with whose development the EU was involved. I leave this issue aside for the moment.

([11]) In addition to the pharmaceutical interventions discussed in these first two paragraphs, one might also consider how trust in government was affected my non-pharmaceutical interventions, such as lockdowns and school closures. However, unlike vaccine procurement, decisions regarding non-pharmaceutical interventions were taken by national governments, which are not the subjects of this paper.

3.1. TRUST IN EUROPE

Several earlier studies have described trends in trust in European institutions and discussed their determinants. Mungiu-Pippidi (2015) is a useful example, in that it focuses on the impact of the Global Financial Crisis, the largest economic shock affecting the European economy prior to COVID-19. Using country-level Eurobarometer data, Mungiu-Pippidi documents a significant decline in trust in the EU in Southern European countries over the course of the crisis, together with a somewhat smaller decline in the UK and most Central and Eastern European countries as well as in certain Northern European countries that weathered the crisis relatively well. For the 2008-2013 period, she shows that trends in trust are positively associated with economic growth (trust in the EU falling with recession and rising with growth). The observed decline in confidence in the European Parliament is more muted, perhaps less because any positive performance of the Parliament during the crisis period than lack of knowledge of its role. Roth, Nowak-Lehmann and Otter (2011) report a similar cross-country analysis of the impact of macroeconomic variables, concluding that growth and unemployment affect trust in the Commission and the Parliament positively and negatively, respectively, and finding that high government debt levels have a negative impact on trust in both European institutions, both before and during the Global Financial Crisis ([12]).

Whereas the preceding studies consider Eurobarometer data aggregated to the national level, Arnold, Sapir and Soprano (2012) use individual Eurobarometer survey responses to show how personal characteristics and country conditions interact to shape trust in EU institutions. They identify personal traits that are positively associated with the trust respondents place in the EU: their satisfaction with the way democracy functions, their general satisfaction with life, political ideology (where an individual places him- or herself on the left-right wing-political spectrum), and general interest in politics. In addition, they identify a role for country characteristics: people living in countries with low levels of corruption, low public expenditures on welfare and (somewhat peculiarly) relatively heavy influence over decisions taken by the European Union are less likely to trust EU institutions ([13]).

Another analysis speaking to these concerns is Dustmann et al. (2017). The authors use the European Social Survey to analyse trends in trust in the European Union. They confirm that individual characteristics matter: younger cohorts, urban dwellers, immigrants and the more educated place more trust in the European Parliament and are more supportive of the European Union. Trust in the Parliament and political support for the EU weaken as economic conditions deteriorate, but more slowly than trust in national parliaments and

([12]) Roth, Nowak-Lehmann and Otter (2013) extend the sample period and emphasize high unemployment as a major factor driving the ongoing erosion of trust in EU institutions in Southern Europe in particular.

([13]) This is peculiar in that intuition suggests that respondents would be inclined to anticipate happy outcomes from EU deliberations when their own directly-elected and appointed national representatives are influential in the deliberations of EU institutions.

national political systems, presumably reflecting the perception that it is mainly national parliaments and systems that are responsible for managing the response to macroeconomic shocks. What matters more for trust in EU institutions is the perceived ability of the latter to deliver regional and global public goods that enhance personal and national security and are difficult to supply at the national level. This finding is relevant to the case of COVID-19, where national governments played an important role in mounting the response to the public health emergency but where successful suppression of a contagious virus is a regional or global public good.

The authors then analyse the secular decline in trust in the European Parliament since 2002 ([14]). Declining trust in the European Parliament appears to be symptomatic of declining trust in government generally: where trust in national parliaments declined, trust in the European Parliament also declined ([15]). Indeed, in some countries, mainly in Southern Europe, trust in national governments went down even more. Although there is no comparable question regarding trust in the European Commission, the European Social Survey does ask about attitudes toward European integration, the broad project overseen by the Commission. Here there are no Europe-wide trends, although in a subset of countries – Italy, Greece, Ireland and the UK – favourability ratings declined over the 15-year period considered by the authors.

Eurostat (2020) provides analogous survey results for questions about both the Parliament and the Commission, annually through 2019 ([16]). These show the same secular decline in confidence in the European Parliament, from 58 per cent of those surveyed in 2007 to 54 per cent in 2019. The decline in confidence in the Commission is nearly twice as large, from 54 to 47 per cent ([17]). For the Commission, most of the decline was centred at the time of the Euro Crisis (starting in 2010), consistent with earlier findings of Roth, Nowak-Lehmann and Otter (2011) and Mungiu-Pippidi (2015), with a partial recovery starting in 2015. This is in contrast to survey results concerning trust in the Parliament, for which the decline was ongoing starting in roughly 2006, but where the decline in confidence slowed and then stopped following the outbreak of the Euro Crisis.

Moving to COVID-19, Eurofound (2020, 2021) conducted e-surveys of EU residents in April and July 2020, and then again in March 2021, inquiring into attitudes regarding trust in national governments, the EU and other institutions ([18]). Trust in the EU was found to have risen slightly between April and July, most sharply in Italy and Spain, two EU countries severely affected by the pandemic. This rise is consistent with the rally-round-the-flag hypothesis, but

([14]) They also highlight the existence a limited number of exceptions; Sweden, for example, seems to buck the trend, displaying more trust in the European Parliament over time.
([15]) The relationship between trust in national governments and trust in the EU clearly is complex. While the series discussed here appear to move in parallel (they display what Munoz, Torcal and Bonet refer to as 'congruence'), one can imagine also different relationships.
([16]) These are based on surveys of roughly 1 000 respondents per European country.
([17]) Percentages are averages for a constant set of 27 countries.
([18]) The other institutions in question include the police and media.

also with the Commission's €750 billion NextGenerationEU recovery package, which was successfully negotiated around this time (Italy and Spain being among the countries expected to benefit most from this emergency economic tool). In the July survey, trust in the EU was on average slightly higher than trust in national governments ([19]). Levels of trust in the EU are also more tightly bunched across countries compared to trust in national governments.

There is some sign in the Eurofound survey of the pattern emphasized by Dustmann et al. (2017) that where trust in national governments is low, trust in the EU tends to be low as well ([20]). In addition, there is some indication that trust in the EU continues to be shaped by historical experience. Thus, Greece reports the lowest level of trust in the EU in 2019, plausibly reflecting its difficult experience with the Troika after 2009 ([21]). Trust in the EU is highest in Ireland, presumably reflecting the perception that the Commission went to bat for the country in its exit negotiations with the United Kingdom. At the same time, there was a decline in trust in the EU between April and July 2020 in Denmark, Finland, the Netherlands and Sweden, four members of the 'Frugal Five' who opposed an expanded European Union budget in the EU's July negotiations ([22]). This suggests that the ongoing fiscal impact of the crisis has a role in the evolution of public opinion.

The third Eurofound survey conducted in March 2021 showed trust in the EU falling back to spring 2020 levels and even, to an extent, below. This third survey presumably reflects the impact on trust of a full year of restrictions on economic activity, mobility and social interactions, including for the residents of some countries full lockdowns. The timing of this third survey wave also reflected news of vaccine side-effects and a new wave of COVID-19 infections ([23]). In addition, there may have been some disappointment that the effects of NextGenerationEU money was not yet more visible. Not surprisingly, the decline in trust in the EU was largest and most significant among the unemployed and those who lost their jobs during the pandemic.

Although available survey data do not yet definitively speak to the question of how the experience of COVID-19 will affect trust and confidence in the EU, early data and analysis thus point to the following provisional conclusions.

([19]) This is in contrast to the April survey, in which trust in the EU was on average slightly lower than trust in national governments. It would be interesting to know how such patterns were affected by subsequent events such as the vaccine controversy – if only such data were available.

([20]) Though there are exceptions. For instance, contrary to the general pattern, Poland, where responses indicate the lowest level of trust in the national government, has one of the highest reported levels of trust in the EU. The survey also finds that trust in government is highly correlated with satisfaction with the way democracy functions, which provides a hint about what the EU must to do restore and maintain trust.

([21]) It is tied with Croatia, actually, for lowest level of trust in the EU.

([22]) Austria being the fifth member.

([23]) Conceivably, it could have also reflected questions about the safety of the AstraZeneca vaccine and public disagreement among European agencies. Nivakoski (2021) leverages the fact that the March survey was conducted both before and after the AstraZeneca controversy. She finds no evidence that there was no noticeable change in the average level of trust around the time of the relevant announcements.

First, if the main impact of the COVID crisis, as frequently suggested, is to accelerate ongoing trends, then it is likely to affect trust and confidence in the EU differently in different countries. In Germany, the Netherlands and Austria, for example, the trend in confidence in the Commission was strongly positive in recent years ([24]). In France, in contrast, there is no visible trend for COVID to accelerate.

Second, confidence in EU institutions fluctuates with economic, financial and social conditions. This was evident, for example, in the impact of the Greek crisis on trust of that country's residents in the EU. Looking across countries, we see this in the impact of the Global Financial Crisis and Euro Crisis more generally. Since COVID-19 has created yet another economic crisis, this points to the possibility of a further erosion of trust in the EU as a result of worsening economic conditions. The good news is that national governments and the EU have taken ambitious steps to provide relief to households and firms, and that trust in government is higher among respondents who receive financial support from their national governments, according to Eurofound (2020). To the extent that the EU represents a further source of financial support for European households courtesy of the Recovery Fund, it can bask in this glory.

Third, the findings in Dustmann et al. (2017) suggest that publics regard these economic variables as mainly under the control of and as the responsibility of national governments. The institutions of the EU are seen as more heavily responsible for regional and global public goods that help to ensure personal and regional security, deliverables with cross border spillovers and that national governments are less well positioned to provide. This provides an opening for EU institutions to build 'output legitimacy' (Scharpf 1999). The public good of health security can't be ensured purely at the national level in a pandemic-prone world where the virus can mutate and where national borders can't be completely sealed against new mutations. Similarly, small Member States acting alone lack resources to invest in accelerating vaccine development. New infections can be prevented only if the virus is suppressed in all countries in contact with one another, in the European context first and foremost EU Member States. Similarly, vaccine development can be accelerated only if Member States work together. This means that the EU is likely to experience unusually sharp gains in trust and legitimacy as a result of steps that enhance public health region-wide, while it is at risk of unusually severe reputational damage if it stumbles.

3.2. EFFECT OF EPIDEMICS

A limitation of the preceding survey evidence is that it is hard (to put it mildly) to pick out the effects of the pandemic as opposed to other things going on at the same time. To cite just one example, in the spring and summer of 2021 there was not only a resurgence of COVID cases but also increased tension on the external

([24]) Between, say, 2013 and 2019.

border between Poland, Lithuania and Latvia on the one hand and Belarus on the other, where the EU could play a supportive role. Thus, it would be useful to be able to say more about the impact of epidemic and pandemic exposure specifically on confidence in government institutions.

Indeed, whether such an impact exists is not obvious. And even if it does it is not clear whether that impact is positive or negative. One can imagine a 'rally 'round the flag' response where members of the public fall into line behind their leaders in a show of political solidarity in the face of a public-health emergency (Schraff 2020). At the same time, one can imagine a public show of anger and declining confidence due to the authorities' failure to anticipate and head off the emergency. Either way, we know little about the persistence of the effects. Some authors (e.g. Gozgor 2021) suggest that the rally-round-the-flag response should dominate in the short run, but this will fade and possibly give way to a negative reaction ([25]).

In addition, some observers (e.g. Amat et al. 2020, Bol et al. 2020) suggest that we are likely to see opposing responses to 'socio-tropic' and 'ego-tropic' factors. In other words, the spread of infection in society (a socio-tropic event) tends to induce a rally 'round the flag response, while exposure of a close family member, a friend or oneself (an ego-tropic factor) tends to induce anger and alienation.

Some insight into these questions may be gleaned from Edelman (2021), which surveyed respondents in 11 countries in January 2020 (before the pandemic), in May 2020 (as the first wave was building), and again in January 2021 (during the second wave). Ranking countries on a 100 point scale, it reports a six point increase in trust in government (from 55 to 61) between January and May 1920 but then a five point fall (from 61 to 56) between May 2020 and January 2021. This is consistent with the hypothesis that the rally-'round-the-flag response dominates in the short run but gives way thereafter to declining trust ([26]).

The spring 2021 Eurobarometer survey (DG Comm 2021) conducted in the second half of March and first half of April provides further evidence on how views of the EU evolved over the first year of the pandemic. The proportion of respondents saying that their views of the EU had deteriorated increased by 10

([25]) Gozgor (2021) uses a survey of very short-term reactions to COVD-19, conducted online in 178 countries in the March 20-April 16 2020 period (i.e. immediately following the outbreak of the pandemic), and finds a positive response of trust in government that rises with the severity of the health emergency (number of confirmed cases, etc.). Using smaller surveys of Swedish and Dutch respondents administered in March 2020, Esaiasson, Sohlberg, Ghersetti and Johansson (2020) and Scharff (2020) report similar results.

([26]) The increase in the first period is evident everywhere except in Japan, where confidence in the government fell by five points, while the fall in trust in government in the second period is evident everywhere but in France (where there is a marginal increase). In addition, it is plausible that publics were reassured initially by their governments' non-pharmaceutical interventions (lockdowns, school closings, social-distancing conventions) but grew less trusting when these measures failed to present further spread. One can object, of course, that these comparisons don't control for other factors affecting trust in government, such as for example the controversy in the United States over the validity of the November 2020 election. It is interesting to observe that in fact the decline in confidence in government in the U.S. between May 2020 and January 2021 was small by international standards, although trust declined by much more among Trump voters than Biden voters.

points to 34 per cent overall, while the proportion saying that their views had improved decorated by 7 points to 9 per cent. Respondents most frequently cited public health when asked what should be the priorities for the European Parliament. This may imply that the deterioration in overall views of the EU reflects the feeling that its institutions, including but not limited to the Parliament, are not delivering on this priority. In response to the question 'In general, how satisfied are you with the measures taken to fight the Coronavirus pandemic by the European Union?' opinions were almost exactly evenly divided ([27]).

We also have evidence on the impact of epidemic exposure on trust in governments, leaders and political institutions via Aksoy, Eichengreen and Saka (2020). We use data from the Gallup World Polls, which surveyed some 750 000 respondents in 142 countries between 2005 and 2018, inquiring into confidence in the government, in the honesty of elections, and in the national leader, three dimensions of the broad issue of trust or confidence in government. We combine individual responses with data on 47 epidemics and pandemics experienced in 137 countries starting in 1970, drawn from the EM-DAT International Disaster Database ([28]). Conveniently, Gallup World Polls provide large amounts of additional information about the individual respondents – income and labour market status, demographic characteristics and so forth – permitting these variables to be used as controls ([29]).

The results point to a large, significant and persistent negative impact of epidemic exposure on trust in government, elections and political leaders ([30]). Its persistence is striking: it is evident for as long as 20 years following the time of the epidemic exposure. However, this effect is limited to individuals in their so-called 'impressionable years' (ages 18 to 25) at the time of exposure. Individuals who are either younger or older show no analogous deterioration in trust ([31]).

The distinctive nature of the impressionable years has been rationalized in various ways. Some scholars draw on Mannheim's (1928) concept of the 'fresh encounter', suggesting that views are durably formed when late adolescents and early adults first encounter new ideas or events. Others invoke Erikson (1968) to suggest that individuals at this age are open to new influences because they are at the stage of life when they are forming their sense of self and identity. Still others

([27]) 50 per cent not satisfied, 48 per cent satisfied, 2 per cent didn't know.

([28]) For EM-DAT to classify an episode of disease-related morbidity or mortality as an epidemic, 10 or more people must die, 100 or more people must be affected, the government must declare a state of emergency, or there must be a call for international assistance.

([29]) The analysis controls also for country, cohort, year and related fixed effects.

([30]) These results are not incompatible with the positive impact on trust in the very short run reported by inter alia Gozgor (2021), Bol, Giani, Blais and Loewen (2020) and Schaff (2020), since in the Gallup World Polls data the timing of the survey and epidemic exposure can be and generally are separated by years.

([31]) Previous authors (e.g. Krosnick and Alwin 1989, Giuliano and Spilimbergo 2014) have similarly shown that experiencing economic and other shocks at this stage of the lifecycle has a durable and enduring impact on an individual's outlook and attitudes. Other studies similarly establishing this fact include Etchegaray et al. (2019), Akbulut-Yuksel, Okoye and Yuksel (2018) and Farzanegan and Gholipour (2019).

suggest that attitudes are pliable at this stage of the lifecycle because views have not yet been hardened by confirmatory information (Converse, 1976). Spear (2000) links the literature on the impressionable years to work in neurology describing neurochemical and anatomical differences between the adolescent and adult brain, suggesting that these neurochemical and anatomical changes are associated with durable attitude formation. Niemi and Sobieszek (1977, p. 221 et seq) suggest that only in the late adolescent years do young people develop 'the cognitive capacity to deal with political ideas, while the same can be said to some extent of individuals in their university years (p. 222).

Although epidemic exposure also affects a range of other self-reported attitudes and opinions (see for example Aksoy, Eichengreen and Saka 2020b), the impact on actual economic choices is not limited to individuals in their impressionable years ([32]). As an example of actual economic behaviour, Aksoy, Eichengreen and Saka (2021) consider online and internet banking, using data for 2011, 2014 and 2017 from Gallup World Pools and Global Findex surveys for some 250 000 individuals in 140 countries, merged again with EM-DAT epidemic data. One would expect the outbreak of an epidemic to cause respondents to shift from bank-branch-based to ATM-based, online and internet banking in order to avoid close inter-personal contact and potential infection. This shift is evident in the data, and, plausibly, the effects are largest for individuals in regions with 3G signal coverage sufficient to support internet browsing.

But in this case the effect is evident for individuals of all ages at the time of epidemic exposure; it is not limited to those in their impressionable years. It would appear that epidemic exposure has different impacts on attitudes and actions: when faced with an epidemic and infection risk, all individuals are equally likely to change their physical behaviour; but only those in their impressionable years are apt to modify their attitudes toward institutions. Trust in the EU is matter of attitudes. This is a suggestion that messaging intended to rebuild trust in EU institutions in the wake of COVID-19 could usefully target Generation Z (individuals born since the late 1990s).

The Aksoy et al. study of trust in government shows also that the negative impact of impressionable-year epidemic exposure is largest in democracies. In democracies, respondents sharply and persistently revise downward their trust in government in the wake of impressionable-year epidemic exposure. The same is not true, however, in autocracies. Evidently, citizens expect democratic governments to be responsive to their health concerns, and where that response is not sufficient to head off the epidemic they revise their views unfavourably ([33]).

([32]) Using 2018 data from the Wellcome Trust, Eichengreen, Aksoy and Saka (2020) consider the impact of epidemic exposure on trust in scientists and in the safety of vaccination, finding a negative revision of trust that is again limited to respondents in their impressionable years.

([33]) Consistent with this, Economist (2020) discusses that democracies typically respond more effectively to epidemics; our results suggest that when they disappoint this expectation, they are more severely punished. Below we address and dismiss the alternative interpretation that respondents in autocracies are more reluctant to volunteer a lack of trust or confidence in government.

In autocracies, in contrast, there may not exist a comparable expectation of responsiveness and hence little impact on political trust.

In addition, democratic regimes may find consistent messaging more difficult. Because such regimes are open, they may allow for a cacophony of conflicting official views. This may result in a larger impact on trust when things go wrong. Both observations – the tendency toward a cacophony of messages and the expectation of responsiveness – apply to the European Union.

In an initial effort to shed light on these issues, we combined the same EM-DAT data on epidemics since 1970 with data on trust in the European Parliament from successive waves of the European Social Survey (ESS) conducted between 2002 and 2018. These surveys are fielded bi-annually in more than two dozen European countries and include questions on a range of topics. Our sample includes more than 200 000 individual respondents, aged 18 and older, from 27 European countries.

To assess the effect of past epidemic exposure on trust on EU institutions, we estimate the following specification:

$$Y_{i,c,t,a,b} = \beta_1 \text{ Exposure to epidemic (18-25)}_{icb} + \beta_2 X_i + \\ + \beta_3 \text{ Number of people affected}_{ct-1} + \beta_1 C_c + \beta_5 T_t + \beta_a A_a + \varepsilon_{ict} \quad (1)$$

where Y_{ictab} is a dummy variable for whether or not respondent i of age a and birth year b in country c at time t has trust in a particular EU institution. We estimate linear probability models for ease of interpretation.

To measure the *Exposure to epidemic (18-25)*, we calculate for each respondent the number of persons affected by an epidemic as a share of the population, averaged over the 8 years when the respondent was aged 18 to 25, consistent with the 'impressionable years' hypothesis. *Number of people affected* controls for whether or not the individual is also exposed to an epidemic contemporaneously. This is also calculated as the number of individuals affected by an epidemic as a share of the population in the country of residence in the year immediately prior to the interview.

The vector of individual controls X_i includes indicator variables for urban residence and the presence of children in the household (any child under 15), and dummy variables for gender, marital status, employment status, religion, educational attainment, and within-country-year income deciles. We include fixed effects at the levels of country (C_c), year (T_t), and age (A_a). The country dummies control for time-invariant variation in the outcome variable caused by factors that vary cross-nationally. Year dummies capture the impact of global shocks that affect all countries simultaneously. Age dummies control for the variation in the outcome variable caused by factors that are heterogeneous across (but homogenous within) age groups. We cluster standard errors by country.

Table 1 shows the results for trust in the European Parliament. The two columns differ by the number of individual controls included in the question. But

both estimates show a significant negative impact of past impressionable-year epidemic exposure on trust in the Parliament. The negative impact is even larger when controlling for the longer list of individual economic and demographic characteristics. Note that we do not find the same thing for concurrent epidemic exposure: the estimated coefficient on the number of people affected in the immediately preceding year does not differ significantly from zero at standard confidence levels. Again, it is impressionable year exposure that appears to matter ([34]).

The resulting reduction is in trust in the Parliament is relatively small, however, compared to what we found elsewhere for trust in national governments and leaders. It may be that respondents regard the public-policy response to epidemics as mainly a matter for national governments rather than EU institutions. It also may be that epidemics affecting Europe prior to COVID-19 were relatively mild (involved relatively few infections and deaths) compared to epidemics affecting other parts of the world.

This reference to how COVID differs points to the question of external validity. There are a number of reasons for scepticism that results obtained using a data set of 47 epidemics and pandemics experienced since 1970 apply equally to COVID-19. COVID is different in that it affected countries around the world without exception, where earlier epidemics and pandemics were at least somewhat more limited in their incidence ([35]). Aksoy, Eichengreen and Saka (2020) in fact ask whether the size of an epidemic is important for their results. They look alternatively at the impact of epidemic exposure of any kind in an individual's impressionable years, versus the extent of epidemic exposure in an individual's impressionable years (calculated for each respondent as the number of persons affected by an epidemic as a share of the population, averaged over the eight years when the respondent was aged 18 to 25). The results are stronger (the impact on trust is larger and more significant statistically) when including the extent of epidemic exposure. If the impact on trust rises with the severity of the pandemic, then the results reported there should represent a lower bound on the impact on trust in government.

When we replicate the analysis with trust in the European Parliament as the dependent variable, we find the same thing. Here we distinguish the intensive and extensive margins of the treatment. By the extensive margin, we mean whether the effect is due to any level of epidemic exposure. To capture this, we construct a binary variable based on whether the number of persons affected by epidemics during the individual's impressionable years is positive or zero. For the intensive margin, we limit the sample to individuals with positive epidemic exposure in their impressionable years. Approximately 55 percent of respondents in our surveys have no exposure to epidemics when impressionable and hence are dropped.

Table 2 shows that the treatment works via the intensive margin. It is not simply being exposed to an epidemic that generates the effect; rather, conditional on being exposed, the severity of the epidemic drives the results. When individuals

([34]) We tested for similar responses among individuals older and younger than their impressionable years at the time of epidemic exposure and did not find an effect.

([35]) COVID-19 may also differ by the extent of press coverage and presence on social media.

with no epidemic exposure are excluded from the sample, the estimated effects of past exposure are, if anything, larger than in the full sample.

Finally, we can corroborate these findings using responses to an online survey we conducted in the summer of 2020. The survey was conducted in nine EU Member States in August. We inquired how trust in the European Commission and the European Parliament, as well as in the World Health Organisation, were affected by information about the severity of the COVID-19 pandemic. Respondents in the treatment group were told that the COVID-19 pandemic is causing large-scale loss of life and severe human suffering. Next, they were asked whether they think that the number of confirmed COVID-19 deaths per million people in their country by July 1, 2020, was higher, lower or around the same as in the EU as a whole. Respondents in the control group were informed about a neutral fact that is not expected to influence any of their later answers in the survey: we asked them to guess their country's population density in 2019 and then informed them about the correct number.

Table 3 shows summary statistics for the respondents, while Table 4 reports regression results, where the observations are divided into those from countries with above- and below-average COVID-19 deaths at that point in time ([36]). Respondents in countries with above-average COVID deaths are significantly less likely to trust the European Commission and the European Parliament when primed by information about extensive loss of life ([37]). Respondents from countries with below-average COVID deaths are significantly more likely to trust the Commission and the Parliament. Again, this suggests that the success or failure of EU institutions in limiting the number of COVID-related deaths is a significant determinant of the evolution of trust in EU institutions ([38]).

3.3. STEPS FORWARD

What steps can be taken to enhance trust in the institutions of the European Union in the wake of COVID-19? The answers will seem obvious when stated, but it is worth stating them anyway.

First and most obviously, output legitimacy is a source of trust. Thus, EU institutions that promise to procure safe and effective vaccines in a timely manner and that deliver on that promise will be seen as more trustworthy than EU institutions whose procurement efforts disappoint. Rebuilding trust thus means engaging in a retrospective analysis of why things went wrong and reassuring the public that the problem has been not only identified but corrected. monetary and fiscal authorities to stand ready to implement not aware that the Commission has engaged in this kind of retrospective analysis of its actions during the pandemic, much less published its findings.

([36]) Above and below average refers to above and below EU average.
([37]) The same holds for trust in the World Health Organization.
([38]) The pre-analysis plan was registered as AEARCTR-0006164: https://www.socialscienceregistry.org/trials/6164

Second, the Commission needs to demonstrate to the public that it possesses adequate institutional capacity in the relevant areas. It is argued that one reason the Commission found it difficult to negotiate vaccine procurement contracts is that negotiators had too little experience dealing with the politics and economics of novel pharmaceuticals (Charlemagne 2021). But it is not as if the possibility of a pandemic was a Rumsfeldian 'unknown unknown.' Rebuilding trust requires identifying 'known unknowns' and building up institutional capacity in those areas in advance of when they are needed.

It is reassuring that the Commission has acknowledged the relevance of these considerations by proposing the creation of a Health Emergency Preparedness and Response Authority (HERA) to detect and address new COVID-related variants and future pandemic threats. How HERA will be structured and staffed is yet to be seen, however. Currently, the Commission foresees tabling a legislative proposal in the fourth quarter of 2021, after which the Parliament will weigh in on that legislation. Kirkegaard (2021) suggests that such legislation should specify that HERA will be headed by an externally appointed person with 'relevant healthcare sector management and/or investment experience.' In addition, it is also necessary to address the financial and institutional constraints that prevented a more forceful response to the urgent need to fund vaccine development (that the EU itself had limited budgetary resources and limited ability to borrow, and that all 27 governments had to agree to any action taken). Here Kirkegaard suggests that Member States should preapprove €20 billion or more EU debt earmarked for vaccine development, and authorize HERA to allocate it unilaterally.

This would solve the last problem, namely that of pandemic response, but not the next one, be it from climate change, a foreign government, or wherever. Regaining trust requires the EU to demonstrate that it has the resources and structures, including the internal decision-making and rules and financial resources, to respond quickly and effectively to the next crisis that comes down the pike.

Third, evidence of clear thinking and systematic decision-making is important. Decisions regarding both public health and the Commission's proposal for the €750 billion Recovery Fund were made at the last minute; incomplete plans were rolled out under pressure of time. With advance planning, the President of the Commission could have consulted a broader range of experts and made more extensive use of the Commission's seasoned staff (Mortera-Martinez 2021). In addition, how decisions are reached, and in consultation with whom, could be better communicated to the public. Transparency is an important mechanism for rebuilding trust. The point applies as much to the Council as the Commission; the Council takes most decisions without a formal vote, obscuring the positions and arguments of participants (Novak 2021).

Fourth, messaging needs to be consistent over time and across sources; the episode where mixed messages were sent regarding the efficacy of the AstraZeneca vaccine for individuals over the age of 65 was a counterexample. In this case, some of the mixed messaging came from national leaders, who contradicted the position

of the Commission. This highlights the need to closer and more continuous communication and coordination between Brussels and national capitals.

Moving from COVID-19-related steps to general measures to enhance trust, it would be helpful to adopt a transparent, merit- and qualification-based process for selecting the most visible EU leader, the Commission president. The Spitzenkandidaten process, in which the nominee of the largest political grouping in the incoming European Parliament becomes president, does not make for a merit- and qualification-based competition. Rather, the position tends to go to the candidate who attracts the least opposition. Moreover, the nominee of the largest Parliamentary grouping may not represent the views and values of the EU as a whole or its median voter. Given expectations that other top positions will then be distributed to other political groupings, countries and regions, there can then be a cascade effect, as the selection of one less-than-ideal candidate results in the selection of other less-than-ideal candidates.

These procedures create a lack of accountability for the Commission. Trust would be enhanced by evidence that EU officials suffer visible consequences from policy failures. In principle, the Commission can be dismissed by a majority vote of the European Parliament. In practice, this is a rare event because different party groupings in the Parliament have consorted in allocating important posts to their nominees, all of which would be lost were the Commission to be dismissed, implying that a portion of the failure fell on their own shoulders ([39]).

Finally, accountability would be strengthened and trust would be enhanced by shrinking the democratic deficit that plagues EU politics. Two proposals for doing so are enhancing the powers of the European Parliament, whose members are the citizenry's directly elected representatives, and moving to direct election of the president of the Commission ([40]). The Parliament could be given the power to initiate legislation, an agenda-setting prerogative that currently resides with the Commission. The range of Commission proposals and directives requiring Parliamentary approval could be expanded; presently, most EU legislation is adopted via a procedure under which the Commission must only consult with the Parliament, and the latter has only the power of delay ([41]). In the limit, all directives issued by the Commission could be required to receive the support of two-thirds of Members of Parliament, or of the members of the relevant subcommittee, as opposed to just the support of the heads of state and government of countries holding two-thirds of the votes in the Council. All Europeans would then have a voice in EU decision-making, insofar as all significant parties have members in the European Parliament – as opposed to the current situation, where only voters who supported the national head of state, or the coalition standing behind her, have a voice.

([39]) Even in 1999, when the Commission was subjected to a motion of censure over allegations of fraud, the Parliament voted against dismissing the Commission.

([40]) As proposed by Eichengreen (2018), from where the next couple of paragraphs are drawn.

([41]) This is known for self-evident reasons as the 'consultation procedure.' There is also a 'co-decision' or 'ordinary' procedure under which the Parliament must approve the legislative initiatives of the Commission, but it applies only in certain areas.

Critics of the European Parliament will object that it isn't capable of providing the democratic accountability after which Europeans hanker. Voters don't pay attention to the Parliament; turnout in European elections is rarely above 50 per cent. Members do their business far removed from their constituents and are known mainly for their lavish expenses and for shuttling between Brussels and Strasbourg. But if the Parliament had more power to initiate legislation and to approve or reject directives and other decisions directly affecting the people, voters would pay attention. They would have an incentive to elect members who more effectively represented their interests.

Direct election of the Commission President would be complex – which is not the same as saying that it would be impossible, or undesirable. One approach would be approval voting. Under approval voting, each voter may select (or 'approve') any number of candidates. The winner is the candidate with the largest number of approvals. This approach has the strength of simplicity. It leads to the selection of the candidate with broad appeal to the electorate (the 'consensus winner') as opposed to the candidate with a simple plurality or majority, where plurality or majority voting with runoffs when there is a large field of candidates including a number that do not have sharply differentiated views. Outcomes are relatively insensitive to the number of candidates. Approval voting gives minority candidates their due, since their supporters are not discouraged from voting for them because another candidate is generally considered stronger. Hence voters from specific region or constituency would still have the opportunity to vote for a candidate from that region or constituency. All this would be desirable in the EU context.

CONCLUSION

The COVID-19 pandemic creates both opportunities and perils for the European Union. While the outbreak of the pandemic produced a rally-'round-the-flag effect where support for EU institutions increased, that initial change appears to have reversed subsequently with failure to contain the virus. This failure occurred against the backdrop of an ongoing, secular decline in trust in governmental institutions in Europe. If COVID accelerates ongoing trends, then this should set off alarm bells. So should the fact that past epidemics have been associated with diminished trust in government, leaders and elections, specifically on the part of those in their impressionable years at the time of epidemic exposure – today meaning members of Generation Z – the youth of today being the voters of tomorrow. The EU faces daunting challenges, not just the pandemic but also managing and coordinating the green and digital transitions. Lack of trust in EU institutions would greatly weaken the effectiveness of their leadership.

Europe is not helpless in the face of this erosion of trust. Institutions such as the Commission can enhance their output legitimacy by building the capacity to respond quickly and effectively to emergencies, starting with public-health emergencies. It can assess its failures, report on them publicly, and take corrective action. The EU can see that those responsible are held politically accountable for

missteps. EU institutions can be more transparent and strengthen the consistency of their messaging, which means strengthening coordination with national capitals.

Finally, enhancing trust in the institutions of the European Union requires shrinking the democratic deficit. Two routes are by increasing the powers of the European Parliament and changing selection procedures for the European Commission. These issues have been on the table for a long time. The COVID-19 episode points up the urgency of addressing them.

Table 1 / **The Impact of Exposure to Epidemic (18-25) on Trust in the European Parliament**

Outcome →	(1) Trust in the European Parliament	(2) Trust in the European Parliament
Exposure to Epidemic (18-25)	-0.015**	-0.017**
	(0.006)	(0.006)
The number of people affected$_{t-1}$	-0.014	-0.012
	(0.012)	(0.012)
Year FE	Yes	Yes
Country FE	Yes	Yes
Age FE	Yes	Yes
Employment controls	No	Yes
Marital status controls	No	Yes
Religion controls	No	Yes
Education controls	No	Yes
Gender dummy	No	Yes
Income decile controls	No	Yes
Presence of children dummy	No	Yes
Urban dummy	No	Yes
R-squared	0.014	0.016
N	200918	158926

NB: * significant at 10 %; ** significant at 5 %; *** significant at 1. Exposure to epidemic (18-25) defined as the average per capita number of people affected by an epidemic when the respondent was in their impressionable years (18-25 years). The number of people affected refers to people requiring immediate assistance during a period of emergency (that is, requiring basic survival needs such as food, water, shelter, sanitation, and immediate medical assistance). Demographic characteristics include: a male dummy, a dummy for each age group, dummy variables for marital status (single, married), educational attainment (tertiary education, secondary education), religion dummies (Christian, Muslim, and other religions), employment status (full-time employed, part-time employed, unemployed), a dummy variable for living in an urban area and presence of children in the household (any child under 15). Income decile fixed-effects are constructed by grouping individuals into deciles based on their income relative to other individuals within the same country and year. Robust standard errors are clustered at the country level. Source: European Social Survey, 2002-2018 and EM-DAT International Disaster Database, 1970-2017.

Table 2 / **Impact of Exposure to Epidemics (Ages 18-25) on Trust in the European Parliament – Intensive and Extensive Margins**

Outcome ➔	(1) Intensive margin Trust in the European Parliament	(2) Extensive margin Have confidence in national government
Exposure to Epidemic (18-25)	-0.021***	-0.001
	(0.005)	(0.004)
The number of people affected $_{t-1}$	-0.014	0.582
	(0.008)	(1.257)
Observations	78102	158926
R^2	0.032	0.021

NB: * significant at 10 %; ** significant at 5 %; *** significant at 1 %. For intensive margin, the sample is restricted to respondents with any epidemic experience in their impressionable years, and models are re-estimated as in Column 2 of Table 1. For extensive margin, ***Exposure to Epidemic (18-25)*** is re-defined as a dummy taking the value of 1 when the continuous version is positive and zero otherwise; and models are re-estimated over the full sample as in Column 2 of Table 1. See notes to Table 1. Robust standard errors are clustered at the country level. Source: European Social Survey, 2002-2018 and EM-DAT International Disaster Database, 1970-2017.

Table 3 / **Summary statistics**

	Pooled sample				Above EU average				Below EU average			
	Mean	SD	Max	Min	Mean	SD	Max	Min	Mean	SD	Max	Min
Trust in European Commission	4.76	2.62	10.00	0.00	4.67	2.53	10.00	0.00	4.87	2.73	10.00	0.00
Trust in European Parliament	4.77	2.65	10.00	0.00	4.65	2.55	10.00	0.00	4.92	2.75	10.00	0.00
Trust in World Health Organization	5.42	2.74	10.00	0.00	5.44	2.66	10.00	0.00	5.39	2.84	10.00	0.00
Observations	14224				7902				6322			

Table 4 / **Trust in EU Institutions and the WHO**

Outcome (on a score of 1-10) (1 means no trust at all and 10 means complete trust)	Pooled Sample	Above EU average	Below EU average
	sample	COVID-19 deaths	COVID-19 deaths
How much do you trust the European Commission?	0.0788	-0.123*	0.603***
	(0.0670)	(0.0679)	(0.111)
How much do you trust the European Parliament?	0.0459	-0.132*	0.525***
	(0.0710)	(0.0756)	(0.126)
How much do you trust the World Health Organization?	-0.0959	-0.293***	0.423***
	(0.0700)	(0.0756)	(0.115)
Observations	14224	7902	6322

NB: The treatment is the randomized information treatment on COVID-19. Respondents were told that the COVID-19 pandemic is causing large-scale loss of life and severe human suffering. Next, they were asked whether they think that the number of confirmed COVID-19 deaths per million people in their country by July 1, 2020, was higher, lower or around the same as in the EU as a whole. Respondents in the control group were informed about a neutral fact that is not expected to influence any of their later answers in the survey: we asked them to guess their country's population density in 2019 and then informed them about the correct number. The sample covers nine EU member countries (France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Spain, Sweden). Germany, Greece, Hungary and Poland are the four EU countries in our sample which had a COVID-19 death toll below the EU average by July 1, 2020, while the number of COVID-19 deaths was above the EU average in France, Italy, the Netherlands, Spain and Sweden. The survey was conducted in August, 2020.

4. TRACKING GOVERNMENT TRUST WITH REAL-TIME OPEN-SOURCE DATA: CASE STUDY OF SPAIN AND GERMANY DURING THE COVID-19 PANDEMIC

Otilia Dhand, Lucia Husenicova, Dominic Vincent Ligot, Peter Spisiak, Frances Claire Tayco, Mark Toledo, Kilian Vega

INTRODUCTION

The COVID-19 pandemic, which hit the EU in January 2020, brought unprecedented challenges and measures to contain the contagion. Difficult and unpopular decisions were taken to limit European citizens' freedom of movement, assembly, and simply meeting each other. Economic activities in many sectors were suspended. Lockdowns were imposed. Yet, all these measures could only slow down the spread of the virus, and thousands still died in the space of months.

Vaccines were developed in late 2020 and started to be administered, not without shortcomings, in early 2021. However, public opinion was strained by then with successive waves of the virus, recurrent restrictions and obligations to wear masks. Protest movements arose in many EU Member States by mid-2021, particularly against vaccination and mask-wearing obligations.

In this context, it is reasonable to expect that the trust in governments and public institutions would decline. This paper explores changes in trust in governments during the COVID-19 pandemic, using real-time open-source data.

The research presented aimed at identifying changes in trust in governments throughout the crisis, determining if these can be linked to the pandemic development and containment and if they have the potential to impact electoral results. Two case studies, Spain and Germany, were selected for their diverging experiences of the pandemic.

Public discussions on social media were searched for relevant conversations related to the trust in political leaders as proxies for governments, as posts on

the social media are usually personalised, naming leaders rather than referring to institutions. These posts were then analysed for sentiment, particularly trust. Finally, topics were modelled to establish whether the social media posts were related to the pandemic and its management.

The results that the research brought are limited, given the focus on just two case studies, but encouraging both on their findings and on the method, which allows for inexpensive, real-time analysis of public opinion, particularly at the time of crisis when surveys may not be practical.

4.1. LITERATURE REVIEW: THE EFFECT OF CRISES ON TRUST IN POLITICS

Trust is an important concept in practical politics and political theory as it reflects how people perceive politicians, institutions, and political systems. In this context, trust expresses the level of legitimacy of political institutions as well as leaders, and it can serve as a litmus test of the stability of political systems.

Trust has been a well-researched concept in political science already since the 1970s. However, the financial crisis of 2008 sparked a renewed interest in the issue of trust with academics scrutinising, in particular, trust in political institutions in the EU on the national as well as union level. (Morrone et.al 2009, Arnold et.al 2012, Drakos et al. 2019, Kroknes et al. 2016, Roth et al. 2011) The COVID-19 pandemic is yet again sparking the debate about trust in politics, especially with the measures adopted that strongly affected rights and freedoms of people all around the world.

In general, trust can be approached from two main perspectives, individual or social and political or systemic. (Blind 2006, Morrone et al. 2009, Mungiu-Pippidi et. al 2015) On the individual level, it reflects a belief people have that others will behave in accordance with their expectations.

Systemic or political trust is the one we are interested in, as it is considered a key element of any social, political, and economic system. (Roth 2009, Drakos et al. 2019, Arnold et al. 2012, Kroknes et al. 2015) Political trust has two levels, macro and micro. (Blind 2006, Morrone et al. 2009) The macro-level represents the trust for institutions, political systems, and political parties. The micro-level is equal to the trust in individual politicians. Naturally, the trust on both levels increases and decreases depending on how the population perceives how their expectations are being addressed.

Trust is an important element in the long-term stability of political systems, having a crucial effect on the future expectations that individuals hold in a given society. By the same token, the continued distrust and disenchantment by important parts of the population towards the political elites of a country is a highly important factor in the emergence of populism (see Eichengreen, 2018). Long-term trust levels have great importance in shaping macro-level political

narratives, having an important impact over public opinion, the media reporting on government performance, and government stability or lack thereof.

Blind (2006) concludes that trust often transcends partisan or ideological preferences, especially when it comes to the trust in individual politicians. In general political trust depends on how the interests of citizens are addressed by the government, that is what Blind calls the first-order political trust. The second-order political trust is psychological. It is based on how people assess the moral values of the government and its representatives. Here the trustworthiness of a leader plays a significant role. The surveys used by the available literature on trust suggest that the trust in political institutions is gradually decreasing since the 1960s (Blind 2006), this is often related to the economic and social development of societies on national but also regional level that is mainly observable in the case of the EU and its institutions. The literature (Drakos et al. 2019, Roth et al. 2011) suggests there is an ongoing discussion-based on changing trends on how strong the factor of unemployment and conditions on the labour market may affect the trust in government or institutions in general. As Roth et al. (2011) observe that in some cases – Portugal, Greece, Spain, Ireland – there seems to be a strong correlation between the trust towards institutions and their ability to handle the economic situation, especially in the aftermath of the financial crisis. In other countries, such as Germany, the initial reaction of the population is to 'rally around the flag', and an increase in unemployment does not seem to have a significant impact on the trust of the government, at least initially (Kroknes et al. 2016, Roth et al. 2011).

For our research purposes, we use Blind's micro-level definition of political trust (Blind 2006). We consider politicians and trust in them as a proxy for the overall trust towards the government they represent. In times of crisis, political leadership is important, and the trustworthiness of politicians has an important effect on how people accept changes that affect their lives. The factor of addressing the interests, worries and expectations of the people correlates strongly with how the politician is perceived when it comes to their ethics and moral principles.

Most crises generally cause a significant amount of uncertainty, fuel political debates and exacerbate tensions in societies. Nevertheless, despite their polarising effect on public opinion, they also present an opportunity to act as a catalyst to moving forward, affecting change that otherwise could be untenable. The COVID-19 pandemic's long-term effects are still unknown. The research conducted since the pandemic tends to point towards the trend of reinforcing the political status quo. Particularly in Western Europe, lockdowns have increased vote intentions for the party of a prime minister or president, trust in government, and satisfaction in democracy.

The main policy instrument during the pandemic was a lockdown. Literature (Leininger and Shaub 2020, Amat et al. 2020, Bol et al. 2020) suggests that using such measures during crises can either rally citizens around the state institutions or alter their support by shifting their views, ultimately leading to regime change. Eventually, the measures cause both of these trends. Part of the population supports

the institutions and their decisions whilst the other part opposes and protests vocally against the actions and the government. The result is a more profound polarisation.

Although no consensus exists in the literature about the consequences of the COVID-19 pandemic on trust in political institutions, the trend, recorded very early after the start of the pandemic, favours the strengthening of the ruling parties' support as was the case in Canada. Leininger and Shaub (2020) confirm that the crisis benefited the dominant party in Bavaria. However, the data the paper is based on were collected at the very start of the first wave in February 2020. As they suggest, the long-term effect on party support will depend significantly on how the governmental parties handled the crisis. In this regard, voters can punish or reward the parties based on their performance.

According to Bol et al. (2020), the lockdowns adopted in the first wave of the pandemic have led to increased support for ruling parties. Their research suggests that the vote intentions for the ruling party (the one of the president or prime minister) have gone up by about 4 %, while the trust in the government increased by 3 %. In addition, it seems that the population understood the necessity of pandemic measures and rewarded those who imposed them. However, we can see a change in voters' attitudes as the pandemic progressed and the second wave started. As lockdowns were re-imposed in many countries, the waves of protests sparked, which suggests that people were willing to comply with imposed limitations only for a limited time. In addition, the fears of the economic impact of the second lockdown, together with social distancing rules, compulsory masks, cancellation of public events etc. may have contributed to the change of governments following elections that took place in 2021 in different countries (Bulgaria, Moldova, Norway and Germany).

4.2. METHODOLOGY

Ever increasing use of social media produces big unstructured data at a fast pace. This allows for opinion mining online, which aids in the detection of developing societal trends and the analysis of public reactions to legislation or public policies.

Research presented here focuses on two EU Member States, Germany and Spain. The two case studies were selected for their divergent economic trajectories in the decade prior to the pandemic in political stability and economic performance.

Both countries have had a very different evolution since the Great Recession of 2008. On the one hand, Germany remained rather stable economically and politically in the years before the pandemic. No major government collapse was witnessed for Germany over the decade that followed the Eurozone crisis and its political system was characterised by normal electoral cycles. On the other hand, Spain witnessed a strong fragmentation of its parliament after the Great Recession. The traditional two-party system developed into a more complex political landscape with minority governments. A vote of no confidence prospered for the first time in Spain against the government led by Spanish PM Mariano Rajoy; elections had to be repeated in

2019 due to an inability to form a government, and a pro-independence movement produced important tensions in Catalonia. In Germany, the economic situation has been stable, while Spain experienced a difficult economic situation that has included very high unemployment rates, a high-risk premium, and an important banking crisis after the Great Recession of 2008.

Therefore, the selection of Spain and Germany, as cases with a highly differentiated economic evolution and political trajectory over the last decade, may help to identify common trends that could build the basis for future research in additional case studies. At the same time, the two cases shared an important commonality: in both countries, health is a competence of the regions (that is, the federal states in Germany and the Autonomous Communities in Spain) allowing for a similar logic in decision-making at the national level during the pandemic.

While it would certainly be worthwhile to conduct more studies across a larger number of Member States, for example, Italy or France, the time and resource constraints in preparation of this paper did not allow for it. Both case studies examine the impact on the trust of political institutions' proxies; in addition, the German case study also looks at the impact of the pandemic and measures to manage it on the federal elections in September 2021.

This paper draws on the public data on the social media platform Facebook. Facebook was selected because it has been and remains the most popular online social network platform as of October 2021 (Statista Research Department, 2022) and is the leading platform used in Germany (Statcounter GlobalStats 2022a) and Spain (Statcounter GlobalStats 2022b).

The research was conducted for the period starting with January 2020, which saw the first COVID-19 cases confirmed in the EU and ending in September 2021, which was the month when the German federal elections took place.

To analyse online users' discourse in relation to key political figures in Germany and Spain, post content and interaction numbers from public Facebook Pages and Groups were extracted using CrowdTangle, a Meta-owned social media tracking tool of public content (CrowdTangle Team 2022).

Only public posts on Facebook were used in this research. Posts analysed were not selected based on groups or users but on the basis of the use of keywords. Keywords used to collect public posts data in CrowdTangle followed on our definition of trust in its micro-level political sense (Blind 2006) and focused on the political leaders as proxies for institutions – 'Merkel' for Angela Merkel in Germany, and 'Sánchez' for Pedro Sánchez in Spain. Additional research on the impact of the pandemic on elections in the German case study used keywords 'Scholz' (for Olaf Scholz the chancellor candidate for the SPD), 'Laschet' (for Amin Laschet from the CDU/CSU) and 'Baerbock' (for Annalena Baerbock, the leader of the Greens).

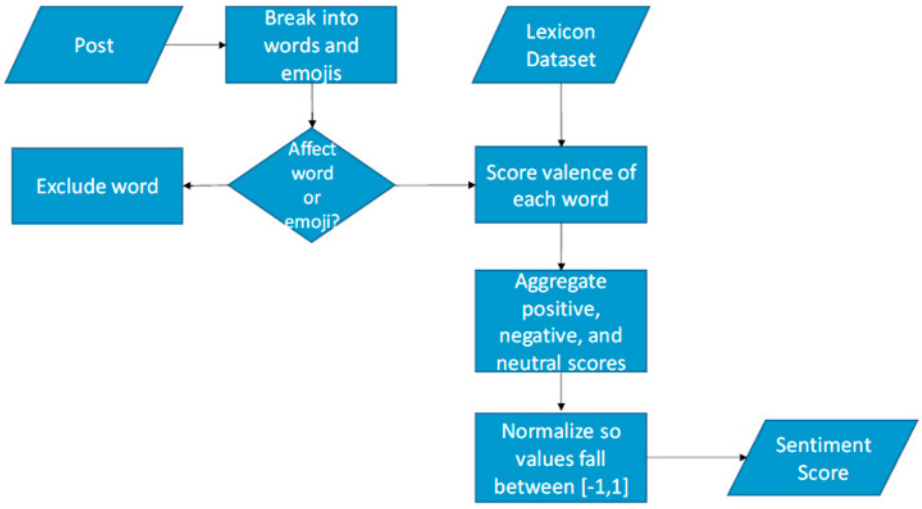
Sentiment analysis (i.e., detection of a piece of text's valence, emotion, and other effectual states) and topic modelling (i.e., automatic identification of latent topics based on patterns in co-occurrences of words in a collection of texts) were then performed on the posts to assess attitudes, appraisals, and emotions towards the

public figures of interest (Aggarwal & Zhai 2012). Posts were grouped into topic baskets, their number and number of interactions with them were recorded and visualised. While sentiment analysis includes all posts collected in the researched period, the topic analysis focuses only on the topics related to the COVID-19 pandemic.

Since most techniques in sentiment analysis and topic modelling are well-researched in the English language, as a pre-processing step, posts in German and Spanish were translated to English using Google Translate (GT). While translation may affect the accuracy of sentiment detection, English sentiment analysis via machine translation is an acceptable alternative to language-specific methods when deployment speed and cost and effort for the development of language-specific resources are considerations (Shalunts et al. 2016). Additionally, an updated evaluation of GT showed that German and Spanish are one of the languages in which it is most accurate (Aiken 2019).

Sentiment scores of posts (range from -1 to 1) were calculated using Valence Aware Dictionary for Sentiment Reasoning (VADER) – a lexicon and rule-based sentiment analysis tool that is specifically attuned to sentiments expressed in social media (Hutto & Gilbert 2014). Figure 2 illustrates the VADER scoring process. Table 5 shows sentiment classification based on the scores. Net promoter score (NPS), derived by subtracting the percentage of detractors (i.e., negative posts) from the percentage of promoters (i.e., positive posts), is computed, based on the derived polarity of the posts (Reichheld 2004). Since passives (i.e., neutral posts) are excluded in NPS' calculation, it could be a good indicator to quantify polarisation of political opinions.

Figure 2 / **VADER Sentiment Scoring Process**



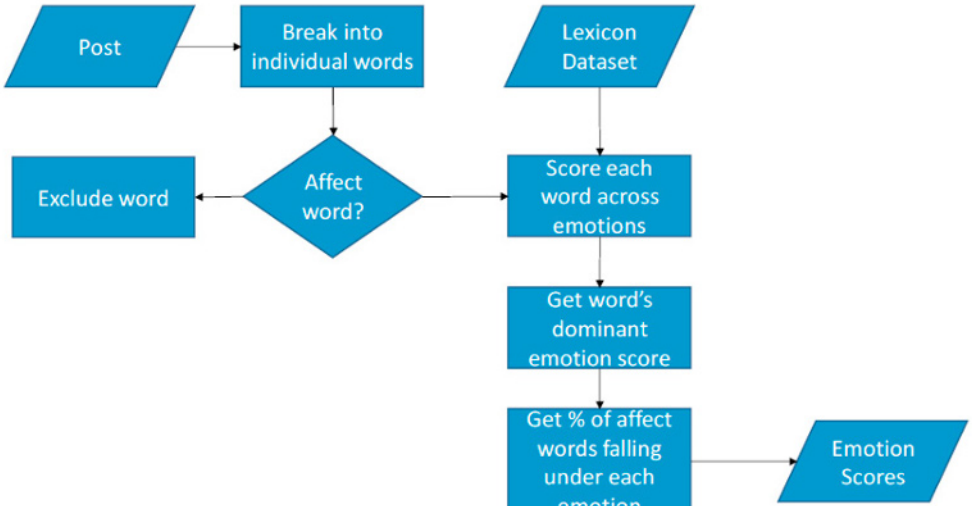
Adapted from 'VADER: A Parsimonious Rule-based Model for Sentiment Analysis of Social Media Text' by C. Hutto & E. Gilbert, 2014, *Eighth International Conference on Weblogs and Social Media (ICWSM-14).* Copyright 2014 by Hutto & Gilbert.

Table 5 / **Mapping of VADER Scores to Sentiment Polarity**

Scores	Sentiment Polarity
Less than -0.3333	Negative
-0.3333 to 0.3333	Neutral
>0.3333	Positive

Emotional tone of posts was also evaluated using National Research Council Canada (NRC) Emotion Lexicon (EmoLex), which is based on the association of words with eight emotions — anger, fear, anticipation, trust, surprise, sadness, disgust, and joy (Mohammad & Turney, 2012). NRC EmoLex was used as it performed better than other available emotion lexicons (Savaroglu Tabak & Evrim 2016, Kušen et al 2017)]. Trust score, which is the percentage of trust-evoking words among all sentiment-bearing words used in a post, was computed for all posts (Figure 3). The higher the score, the higher the intensity of that emotion in the text.

Figure 3 / **NRC Emotion Scoring Process**



Adapted from 'NRCLex' [Source Code] by M. Bailey, Ph.D., 2019, https://github.com/metalcorebear/NRCLex. Copyright 2019 by Dr Bailey.

To gauge the usability of NPS and trust scores, specifically for Germany, their trends were compared against the results of opinion polls for the 2021 Federal Election (Opinion polling for the 2021 German federal election, n.d.) as ground truth. Rolling 4-week averages of NPS and trust scores of Scholz, Laschet, and Baerbock, were analysed against the weighted average of poll results for Social Democratic Party (SPD), Christian Democratic Union (CDU), and The Greens, respectively.

Lastly, topic modelling was performed to surface the themes of discussions on Facebook about the political figures of interest. To aid in the inference of labels, latent topics were visualised using word clouds, which display clusters of words with varying sizes that represent the weight of the relevant terms in the topics (Hagestad & Nader, n.d.). Top posts under each topic were also examined for labelling. Topic trends over time, in terms of the number of posts and interactions (e.g., reactions, comments, shares) were then analysed and correlated with significant events or news in-country.

It should be noted that the topics, sentiments, emotions, and trends surfaced were only based on the posts of the public pages and groups. Private posts, which form a major part of Facebook discourse, were not included and may have differed in content and sentiment. Also, political themes and sentiments from the texts in the comments associated with the posts were not covered, since comments data cannot be extracted from CrowdTangle.

4.3. PRIMARY RESEARCH GERMANY

The German political and party system has been generally stable since the Great Recession of 2008 when compared to some other EU Member States such as Greece, Belgium, Czech Republic, Slovakia, Spain or Italy. Even though in the last few years there has been a slight shift of support from two traditionally dominant parties: CDU/CSU and SPD to smaller parties such as Alliance '90/The Greens (Bündnis '90/Die Grünen) and FDP (Freie Demokratische Partei/ Free Democratic Party). This has led to the necessity to form new types of coalitions in order to form a stable government, such as the so-called 'traffic-light-coalition' (SPD, the Greens and FDP).

In addition, especially since the migration crisis of 2015, Germany has seen a steady growth of support for right-wing AfD (Alternative für Deutschland/ Alternative for Germany created in 2013) primarily in states of former East Germany, where the support continues growing. Although, on the federal level, the AFD's position has somewhat weakened recently (in the 2017 federal elections, AfD received 12,6 % compared to 2021 when it was 10,3 %).

Over the sixteen years of Angela Merkel's rule, Germany experienced various events that could have impacted the shape of the political landscape: the financial crisis, the subsequent euro-crisis, migrant crisis, pandemic and environmental crisis.

Nevertheless, the first female chancellor managed to retain steady support thanks to a steady performance of the German economy and low unemployment rates despite all mentioned crises. (Kurbjuweit 2021) The Pew Research Attitude Survey 2020 confirms this assertion showing over 70 % support for the chancellor in most of the years from 2006 to 2020, reaching 81 % last time in 2020, the year of the pandemic. A slight drop of support to 69 and 68 is shown in 2011 and 2018, respectively. (Schumacher & Fagan 2020) The 2011 poll might reflect the

opinions after the 2010 euro crisis and the dissatisfaction of German voters with how Merkel handled it. The 2018 drop could be a consequence of the 2017 federal election. The possibility of forming a coalition government with the SPD for another term left people dissatisfied as they expected a change in policy and a push for the necessary reforms that Merkel was not keen on pursuing since the financial crisis.

4.3.1. COVID-19 pandemic in the national political context

Popular trust towards the federal and the state governments has been relatively stable during the ongoing COVID-19 pandemic. However, slight changes and variations occurred as the pandemic evolved and different measures were discussed, imposed or eased. The federal character of German statehood that was also preserved during the pandemic needs to be emphasised here. Meetings between chancellor Merkel and the Minister presidents of the individual states led to implementation of measures on the federal level. However, the individual states had the final say on how they chose to manage the pandemic. Consequently, a variety of different rules were in place, especially in the first wave of the pandemic. Moreover, the easing of the pandemic measures varied after the first and the second lockdown.

4.3.2. Pandemic events

By the end of 2021, Germany reported four waves of the pandemic ([42]). The first wave started gradually with the first confirmed positive case at the end of January 2020 in Munich, Bavaria. After that, the virus also started to spread slowly into the other states. By March, all German states recorded positive cases, and numbers grew. Initially, there was a lack of coordination of efforts to curb the spread of the virus among the governments of Bundesländer and the federal government. The change came in March when a coordinated approach was pursued, leading to the adoption of 'Law to protect the population in the event of an epidemic situation of national concern' by the federal Bundestag. Subsequently, the first partial lockdown was introduced in the country; social contacts were limited, people were encouraged to work from home, social distancing in public spaces came into force. In addition, German borders were closed to neighbouring countries. As with other countries, the German government was helping to bring stranded citizens around the world back home with the assistance of Lufthansa.

The general obligation to wear masks was introduced only at the end of April, with slight differences in individual federal states (Die Bundesregierung 2020). The relatively late introduction of masks compared to other EU countries (such as Slovakia, where it was one of the first pandemic measures) was due to a discussion among virologists on the effectiveness of masks. Moreover, there were worries about the potential lack of protective equipment for medical personnel.

([42]) Figure 4 shows the most important developments in Germany in the course of pandemic from March 2020 to October 2021.

Similarly to other countries, some Germans started to make homemade fabric face coverings. In the second wave, Germany introduced compulsory medical masks of FFP2 masks in supermarkets and public transport. As of December 2020, every citizen older than 60 years was eligible to receive 2 FFP2 masks for free. (Tagesschau.de 2020)

Overall, the first wave in Germany was relatively mild compared to other EU countries such as Italy. The healthcare system held up during this period, and the support for the government was relatively high, thanks to the financial rescue package adopted in April. In addition, the strict lockdown gradually eased from May onwards, with services, shops and restaurants reopening with somewhat detailed contact tracing rules. Contact tracing mobile app Luca was introduced over the course of 2021 and used in most of the states. As of January 2022, many of the states opted for cancelling the contract with the app provider and the obligation to check-in with the app is not anymore required with Hamburg being an exception. (Beres, Brosel, Laufen 2022)

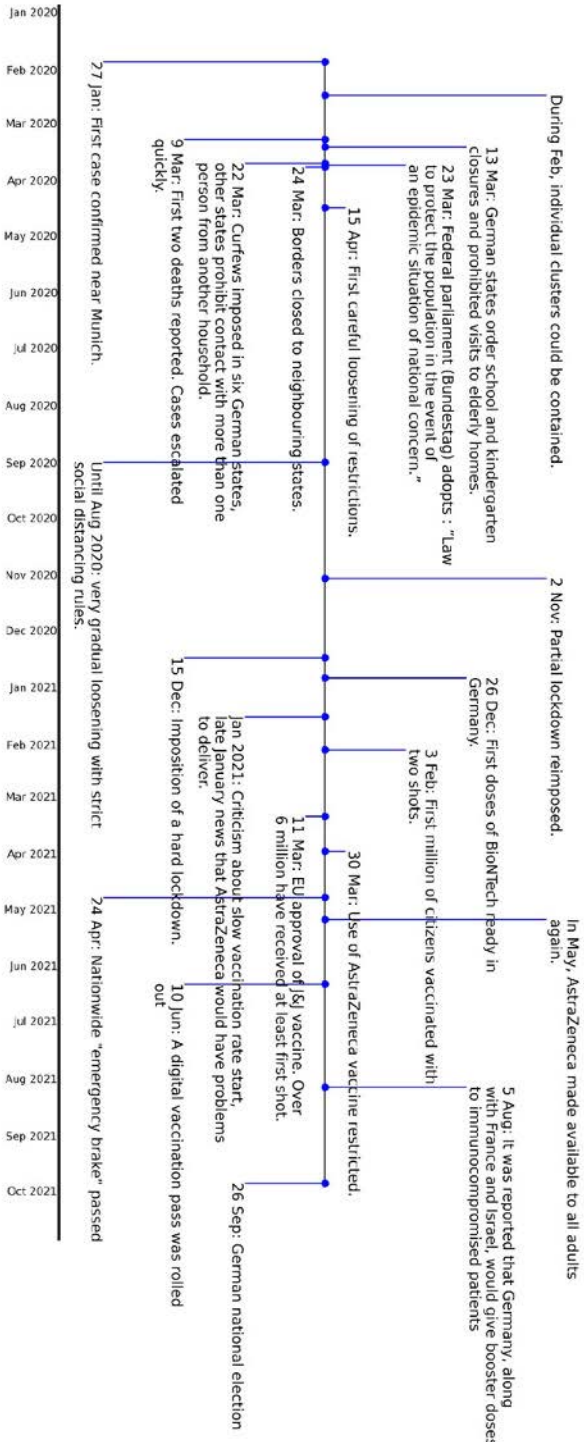
The second pandemic wave had a gradual start in Germany, with numbers rising as the year progressed towards the cold autumn and winter months. In November, the first partial lockdowns re-started, with a margin of positive cases on 100 thousand citizens defined. This wave hit Germany the strongest regarding the number of casualties when over 60 thousand people died between November 2020 and March 2021 (Statista 2022a). At the beginning of December, a hard lockdown was imposed on a national scale which remained in place until April/ May of 2021. Again, the number of positive cases was set as a benchmark for easing restrictions. During this period, pandemic fatigue became increasingly apparent. (COSMO 2021b)

Together with other EU states, Germany started the vaccination with pre-defined priority groups in December 2020. However, the vaccine rollout was relatively slow, often disproportional among different states and within particular states. Moreover, on 15 March 2021, the German government stopped using AstraZeneca's Vaxzevria vaccine, as suspicion arose that it caused rare blood clots. (Martini 2021) The government restricted its use only to those older than 60. At the same time, Pfizer/BioNTech announced production changes that led to lower distribution levels of the Comirnaty vaccine into the EU Member States. These issues sparked a debate about EU solidarity in Germany, especially when compared with the speed of the vaccination process in the UK and Israel. (Stalinski 2021)

The vaccination took a faster pace in May 2021; by June, any citizen willing to get vaccinated could have registered and received a vaccination appointment.

With vaccinations underway, test centres opened all around the country, testing citizens with antigen/lateral flow tests for free. Following on, the public attention slowly shifted to the ongoing election campaign, especially when all major parties announced their candidates for chancellor. At the same time, the third wave started, and the Delta variant became dominant in Germany over the summer. As a result, a renewed discussion about further measures occurred but led to no further lockdown imposition in Germany.

Figure 4 / **Timeline of key developments in Germany during the pandemic**



4.3.3. Political events

The most important political events in Germany since the start of the pandemic are elections on federal and also state levels. Germany is a federal state, and as such, there are elections in individual states and on the federal level. The federal elections tend to be considered more important; however, the local elections also deserve attention.

The elections in 2021 showed an interesting trend that has been pointed out since the start of the COVID-19 pandemic. (Schütz 2020) The right-wing AfD was losing support. On 14 March 2021 elections took place in 3 states: Baden-Württemberg, Rhineland-Palatinate and Hessen. Compared to the previous elections, AfD lost 6 seats in regional parliament in Baden-Württemberg (Baden-Württemberg Statistisches Landesamt 2021) and 5 seats in Rhineland-Palatinate (Statista 2022b, Pokorny 2016). In Hessen, AfD lost a total of 91 seats in the communal election in cities, villages and communities. The same trend continued on 6 June in Saxony-Anhalt, one of the more traditional strongholds of AfD, where the party lost 2 seats (-3.4 %). (Landtag von Sachsen-Anhalt 2021) Additionally, the party lost seats on the federal level in Bundestag after the election on 26 September (-2.3 %).

One of the reasons might be the fact that the government partially tackled the traditional topics of protection of national interests and borders as the borders were closed in the first wave, social packages were adopted to help those most affected, and national solidarity was emphasised. The AfD leadership supported the government policies. However, at the start of the second wave, the AfD position changed as they started referring to pandemic management measures as 'corona dictatorship', an attack on the rights and freedoms of citizens by the government. That might have left supporters confused about the party's true position. Nevertheless, the party still represents a considerable opposition player in some states, although it has lost seats in every state election since 2020.

The most significant political event was the federal elections of 26 September 2021, as the winner would replace Angela Merkel in the position of chancellor after 16 years. The main issue for the CDU party was to select a leader who could capitalise on this situation. Out of three candidates (Markus Söder from CSU, Friedrich Mertz and Armin Lachet), the party chose the one who did not live up to the expectations, Amin Lachet.

The second traditionally strong party, SPD, chose the Vice-Chancellor and Finance Minister Olaf Scholz as a leader and future candidate for chancellor. Over the summer months, despite the uncertainty of just how far left a potential Chancellor Sholz government would go, German voters increasingly believed his moment to succeed Angel Merkel had arrived. Moreover, only 16 per cent (Burchard 2021) of Germans believed Lachet or Baerbock were competent enough in foreign policy; a topic that has become more prominent after the Afghanistan crisis.

Finally, the Greens were growing from early 2021 until the late spring. For a short time, they were leading the opinion poll. Moreover, in contrast to the

two dominant parties, Greens elected a woman as their leader and chancellor candidate. However, Annalena Bearbock did not manage to win support from the people, primarily due to her inexperience that showed during televised discussions with other candidates for chancellor. (Karnitschnig 2021, Schuler 2021)

In addition, two candidates were involved in what we can call political scandals. Regarding Green's candidate Annalena Bearbock, information appeared regarding discrepancies in her declaration of extra incomes and relevant tax payments. Suspicions were raised regarding her CV published on the official party website with inaccuracies regarding her membership in the German Marshall Fund. She was criticised for lack of experience, as she never held any governmental office. In addition, her book was scrutinised, and she was accused of plagiarism as several pages were exact transcripts of other sources.

The CDU/CSU chancellor candidate was a known person in German party politics, as he served as a Member of the European Parliament and a Minister-president of North Rhine-Westphalia. The reactions to his election as chairman of CDU were initially sceptical and hesitant. His popularity further sank after he was seen on video laughing during a visit in an area of North Rhine-Westphalia, which was hit by severe floods.

In the middle of July (night from 14th to 15th) two German states (North Rhine-Westphalia and Rhineland-Palatinate) were hit by severe floods that the German media compared to hundreds of years of water. Around 180 people have died, infrastructure (railroads, bridges, streets, telephone towers) was destroyed. The change in environment and climate crisis was discussed as a main reason for the floods. What is interesting is the political impact of the floods which we will address in the next section.

4.3.4. Research findings

Throughout the pandemic, chancellor Merkel and the German federal government enjoyed relatively stable support from the population. Therefore, analysing the trust signal for search term 'Merkel' as a proxy for the federal government, we conclude that regardless of the development of the pandemic, trust in the government remained practically unchanged, except August 2020, when it showed a slight downturn likely due to the start of the second wave and discussions about the necessity of imposing stricter measures after a somewhat restrictions free summer.

4.3.5. Trust signal analysis

Analysing the data collected for Germany, four out of ten modelled topics were related to the COVID-19 pandemic. The remaining six topics were rather general and related to Angela Merkel and her 16-year rule as a Chancellor.

The four selected topics were centred on specific words directly related to pandemic events and that became broadly used by German politicians, media, and

the general population. Some of them feature in the list provided by the Leibniz Institute for the German language that reported over 1 200 words being newly introduced into the German language throughout the pandemic. These include coronavirus, COVID-19, lockdown, measures, masks (Maskenpflicht), incidence (Inzidenzwert). In our word clouds, they often accompany words such as government, state, citizen, crisis, health, death, freedom, test, vaccine, vaccination, and life.

The four selected topics can be combined into two distinctive groups based on the time frame when they peaked in interactions and when they experienced a downturn.

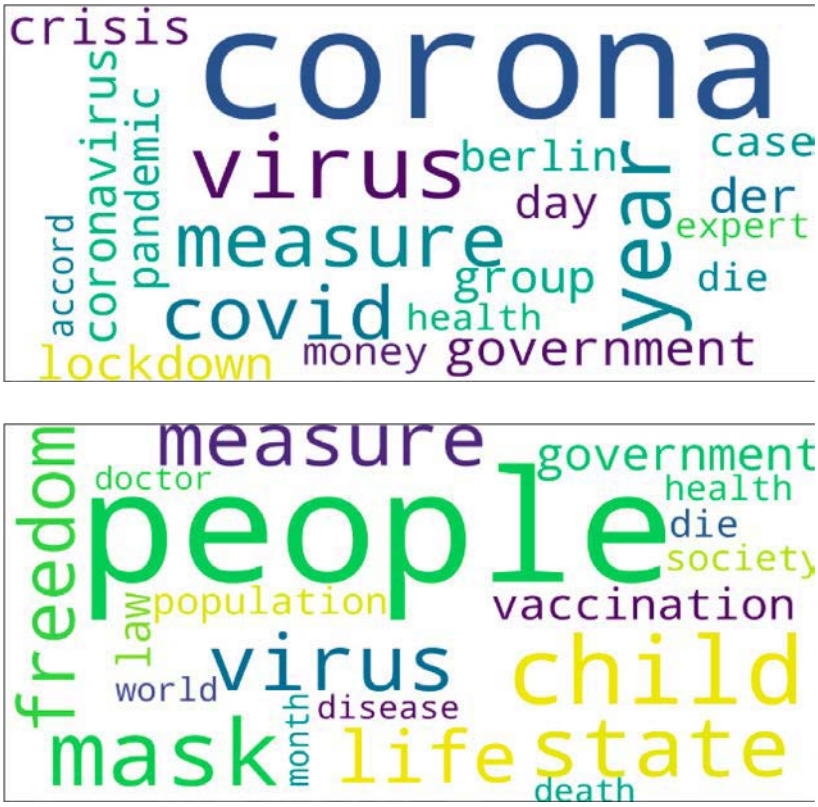
In March 2020, the first wave started in Germany, the first pandemic containment measures were introduced and then the lockdown was imposed (see Figure 5). Our data shows the appearance and rise of the use of words corona, virus, pandemic, measures, lockdown, and freedom, as people were asked to stay at home and keep social distancing already from February 2020. In April, compulsory masks were introduced in Germany, and the *Maskenpflicht* became an everyday reality which then also started to appear in online interactions and word clouds. The interactions started to increase again from September 2020 when the second wave started in Germany.

We can see a peak in interactions related to this group of word clouds for the second time in December 2020 and the first three months of 2021 when the second wave was relatively strong in Germany and public discourse on the necessity of strengthening the measures was very active, especially in January 2021. The next increase in March suggests the discussions were ongoing, but in this period, the population was tired of the measures, and lengthy lockdowns and demands to ease the measures were growing. A downturn in this group came in the summer months of 2020 when the first wave was over, and measures were eased. We observed a second downturn in June 2021, when the pandemic tiredness was growing, and election campaigns started to gain German media and public attention.

The second group (see Figure 6 for more details) of modelled topics related to the pandemic includes words such as a vaccine, vaccination, citizens, RKI (Robert Koch Institute), virus, death and health, infection, incidence, test. The peak in interactions shows that these had the most substantial impact on the discussions in April and May 2020 ([43]), when the first wave ended. In this period, a need for a vaccine to stop the pandemic was discussed in Germany by scientists, analysts, and political leaders.

([43]) total interactions for both Topic 8 and 5 in Apr and May 2020 are 4,847 and 8,935, respectively.

Figure 5 / **Word cloud for Germany (group 1)**



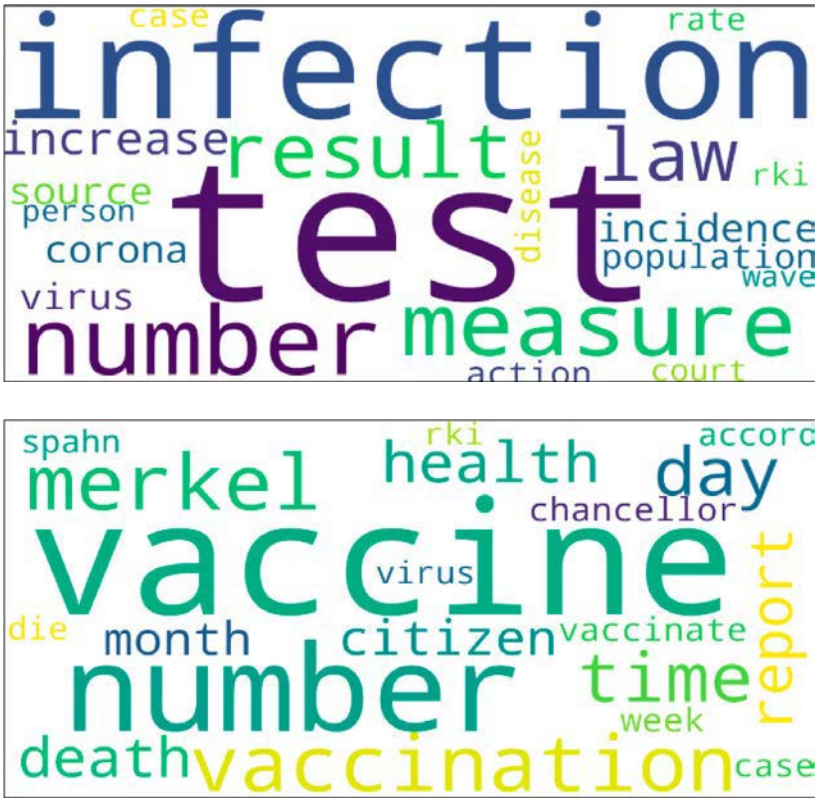
Source: data from own research

At the same time, the incidence became an essential benchmark for easing the restrictions in the country, the so-called *locker Ung.* The second peak occurred from February to April 2021. The vaccine campaign was taking a slow pace in Germany; simultaneously, criticism appeared related to the slow rollout of the vaccines due to the joint EU effort. In addition, citizens could buy fast tests in every pharmacy and supermarket, and testing became an instrument for slow easing of the restrictions. In the Northern German states, which are holiday destinations, especially in spring months, hotels required tests every other day in order for guests to keep their room.

In May and June 2021, there was a noticeable downturn in the interactions related to the vaccination topics. June's interactions were almost 30 % lower than the average levels throughout the research period ([44]). It can be related to the fact that any adult citizen interested in vaccination could register, and the testing became an everyday reality for the population.

([44]) total interactions for both Topic 8 and 5 in May and Jun 2021 are 1,237 and 1,130, respectively. These are lower than the average of 1,627 for the time frame considered in our study

Figure 6 / **Word clouds for Germany (group 2)**



Source: data from own research

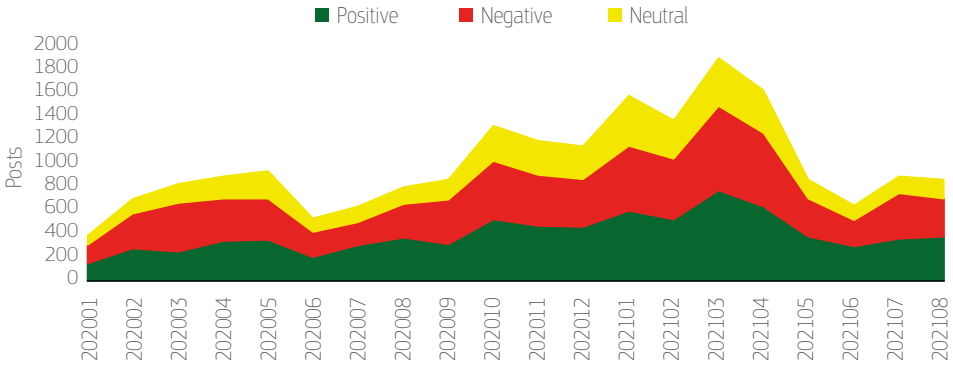
The data also suggests that the pandemic outbreak increased negative emotions, particularly in the early months (for more details consult Figure 7). For example, in March 2020, the percentage of negative posts increased from 41 % in February to 50 % ([45]). It can be related to the fear of the unknown; the virus and the disease it causes create high levels of uncertainty. However, following the initial concerns, as the population started to get used to the restrictions, some positive reactions gradually emerged, amid the general trend towards negativity, as the first wave in Germany was not as severe as initially thought, compared to other EU countries.

As the second wave started to gather speed in the winter months of 2020 and 2021 and another lockdown was imposed in the country, the negative emotions were increasing again. However, at the same time, some people saw the pandemic containment measures as necessary to prevent the collapse of the healthcare system

([45]) The percentage of negative posts increased significantly in Mar 2020 (from 41 % in Feb 2020 to 50 %), in Sep 2020 (from 36 % in Aug 2020 to 43 %), and in Jul 2021 (from 34 % in Jun 2021 to 44 %). I am not sure I understand the last statement

in the country. The negative emotions were the highest in the early spring of 2021 when the population expected the lockdown to ease and return to everyday life. The return to normality, however, was more complex, as the decisions about easing restrictions were more gradual, and relatively slow. Moreover, they varied in individual states. The associations of restaurant and hotel owners (DEHOGA – Deutschen Hotel und Gaststättenverband) on 9 March 2021 criticised the government for lack of support, coordination, and unclear rules for easing the measures as individual states announced their own pace of returning to 'normality'. (Aktuelle DEHOGA Umfrage 2021)

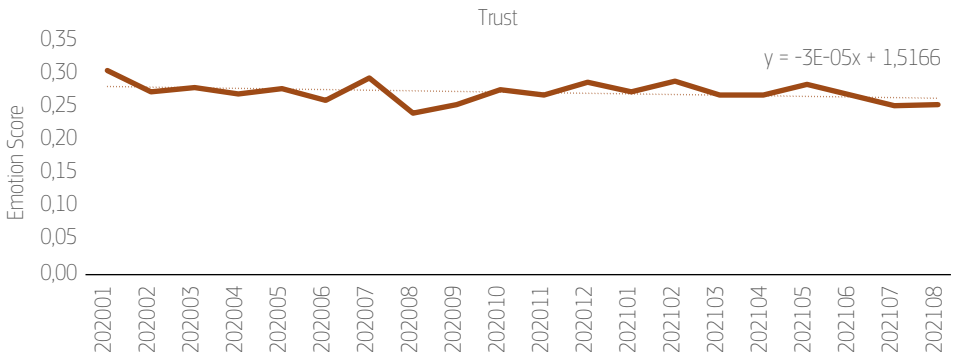
Figure 7 / **Sentiment evolution in Facebook groups in Germany during pandemic**



Source: data from own research

When analysing the proxy institutional trust signal, there is a noticeable trend suggesting relatively high stability, as shown in Figure 8. From the outset of the pandemic, the federal government opted for open communication. Chancellor Merkel was herself open about uncertainties related to the novel coronavirus. She regularly attended press conferences with scientists and explained the necessity for measures adopted, as well as for the lockdown. The communication openness, while likely contributing to the relatively stable trust signal, may also be responsible for the slight decrease in summer 2021 when the public debate focused on possible need for a new set of measures to tackle the likely second wave. After the rather restrictions-free summer, the population showed frustration with the likely renewal of containment measures to tackle a new wave. However, as the second wave progressed, the trust signal increased again, dipping only in summer 2021 amid the disastrous floods in July.

Figure 8 / **Trust level for chancellor Merkel**



Source: data from own research

Remaining 6 topics peaked at the onset of the pandemic, and later in periods between waves or imposed lockdowns. Most of them could appear at any other time as the word clouds were general and related to economic, political and social development in Germany. From the most dominant words, to name a few: refugee, freedom, citizen, government, people, woman, Europe, democracy, Russia, China, policy, energy, euro, costs, country, money, family, party, CDU, CSU. It is possible that some might be related to the pandemic and the impact of lockdowns, especially on the economy, primarily in the first months of the pandemic, and after the second lockdown. Nevertheless, they do not seem to have a significant impact on the overall trust score for Merkel.

4.3.6. Chancellor candidates' trust signals and topics

In the case of all three candidates, the word clouds identified are not primarily related to the coronavirus and pandemic but more to the election topics. This suggests that the pandemic itself had a low effect on the campaign and the election in Germany.

Out of six word clouds related to Scholz, one contains pandemic-related words (see Figure 9), which is likely related to his position as finance minister in Angela Merkel's government when the pandemic hit. The peaks in interactions in this word cloud are precisely at the start of the pandemic in March, later in November 2020, when the measures and lockdowns were introduced and again in spring 2021.

Figure 9 / **Word cloud related to Scholz with pandemic-related keywords**

In the case of Amin Laschet, a minister-president of North Rhine-Westphalia, the pandemic-related word cloud (one of eight) started to grow for the first time in March and April 2020, declining in summer and rising again in December 2020 when a second lockdown started. (see Figure 10) The peak was recorded in April 2021, possibly coinciding with his selection as a CDU/CSU candidate for chancellor.

Figure 10 / **Word cloud related to Laschet with pandemic related keywords**

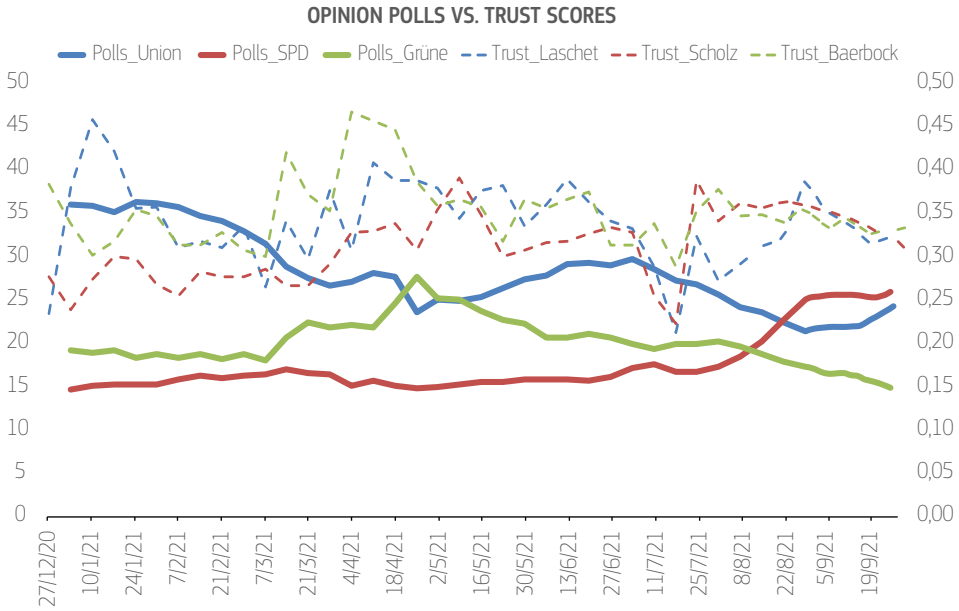
Source: data from own research

Finally, for Annalena Baerbock, interactions in all word clouds increased in spring 2021, when she was selected as a chancellor candidate of the Greens. The six word clouds include mainly topics related to the election and the campaign topics, which in her case were related to environmental issues and protection. Climate and protection are words appearing in our word clouds, together with price, energy, country, candidate, woman, chancellor. Plagiarism appears also, related to the accusations involving her book.

When we look at the trust scores of all three candidates, we see how they have changed over time since the end of 2020, shown in Figure 11. Interestingly, while Baerbock and Laschet's trust scores peaked significantly in January and April respectively, Scholz's trust score was, in comparison, without major peaks and lower than that of his opponents until mid-July. Despite SPD winning the federal elections in September, Scholz's score dipped below that of his competitors just a week ahead of the vote again.

However, the individual trust levels do not seem to be a good predictor of the final election result. This might be the case because of a variety of reasons. Firstly, in parliamentary systems, voters decide on the party and not the candidate on the ballots. Second, Germany does not represent a two-party system, making the picture more complex. In fact, the same voter may have high trust scores for several of the candidates but, in the end, can only vote for one party. This picture might be different in two-party and presidential systems that are more typical outside of Europe.

Figure 11 / **Trust score of chancellor candidates**



Source: data from own research

All candidates visibly outperform the popularity of their parties. This seems to be a longer lasting trend in Germany, as the support and votes casted for traditional parties are declining. However, there are districts where strong, well-known candidates outperform the party (the candidate from a traditional party performs well and wins in the First Vote (Erststimme) while the party does not gain or win in the Second Vote (Zweitstimme). (Shure et al. 2021)

We see a similar happening with Olaf Scholz as his trust signal suggests that his popularity exceeds the support in polls of his party, the SPD. This may be related to his position as a finance minister, when he was in charge of designing, announcing and implementing financial support programs. for the ailing economy. It is likely that the voters saw him as better prepared for the position of chancellor, based on his experiences.

Armin Laschet's dip well below the polls support of his party suggests a significant political misstep, possibly after he was recorded laughing and joking with colleagues while president Frank-Walter Steinmeir held a briefing for journalists about the extent of damages in Erftstadt, the city severely hit by the summer floods that hit two German states leaving significant damages and high death toll.

It seems that Annalena Baerbock's emergency-driven discourse on climate may have gradually cost her the popularity won early on in the campaign as it may have exacerbated rather than reduced the sense of social anxiety.

We can see a drop in trust scores for all three candidates in the summer. This development is likely connected to the floods that hit the country. Our research results do not suggest that the pandemic impacted the election in any significant way. It is difficult to assess how much the decisions Scholz made in the position of finance minister impacted the election results. He was certainly more experienced in governance than his opponents.

4.3.7. Analysis

The research findings suggest relatively stable and high support and trust of the German government during the pandemic waves. During the pandemic, the chancellor opted for direct communication throughout her public addresses and regular press conferences attended by scientists and the RKI president, which could have contributed to the consistent support for the chancellor and the government. These might be the reasons for the stable support for the government. Opinion polls conducted by different institutions, such as Pew Research or the University of Erfurt (COSMO), confirm this and corroborate our research findings of the stable trust for the government and other state institutions.

At the beginning of the pandemic, the German government imposed pandemic management measures relatively swiftly, and the country was not affected as strongly as some other EU Member States or the US and the UK. The initial measures announced by the government were clear and supported by 50-70 % of the general population as shown in the research done by the University of Erfurt (COSMO 2021a). The trust score for Merkel as a proxy for the federal government remained stable throughout the first wave. It is possible that the fact that these measures were considered temporary also affected the overall expectations and moods within the population. This may explain the slight downturn in the trust score in August 2020 when, after restriction-free summer, another wave and reimposition of pandemic containment measures were foreseen and discussed publicly.

The research data shows that the topics related to pandemics had specific periods when they dominated the online discussions. These periods were related to the progress of waves of the pandemic. In the periods between, other issues were discussed related to the everyday life of society and politics. For example, from the spring of 2021, the election, candidates, and campaign topics gained attention, together with the natural catastrophe that hit western states, and environmental crisis and related issues that appeared in discussions related to both institutional trust and elections.

Based on the collected data, we can conclude that regardless of pandemic and all related measures, the trust chancellor Merkel as a proxy for the federal government remained relatively constant. The changes in trust score for all three candidates could be related to changing expectations the German population had from them, as they were fairly unknown on the federal level, except O. Scholz. His low trust score in the first half of 2021 could be related to societal fatigue with the ongoing pandemic, in which the second wave hit the country much stronger than the first wave. Towards the end of the campaign cycle, Scholz's trust score and support grew, as his two opponents did not recover from the scandals they faced.

In the summer of 2021, we can see a decline in trust in all three candidates as a likely reaction to the floods that have hit the western part of the country. As all candidates were affected, we can argue that this type of reaction to a natural catastrophe reflects a general drop in trust of the population when the response of the institutions is not fast and decisive. It is confirmed by the fact that at the same time, we see a drop in trust in Merkel for the first time since the start of the pandemic.

4.4. PRIMARY RESEARCH SPAIN

The socioeconomic and political landscape in Spain had already been highly turbulent before the outbreak of the COVID-19 pandemic. From the economic crisis of 2008, Spain had experienced major economic challenges: an unprecedented financial sector crisis, very high unemployment rates (which were extreme for the age group below 30), a high risk premium that negatively impacted investment in the country, as well as very high government debt levels (Royo, 2014).

The social impacts that followed the economic crisis have been a key factor in the increase in political instability in the country (Cuadrado-Roura & Maroto, 2016). The political challenges that emerged were manifold and included the end of the two-party-system on the national level, the emergence of populist parties, weaker majorities in the national legislative chambers, the use of votes of no confidence in the parliament, and snap elections. Further, the political situation further deteriorated as a result of large corruption scandals (Villoria et al., 2013), and major internal tensions within political parties (Orriols & Cordero, 2016).

In this context, the governability of Spain had become more complex in the decade before the global pandemic, producing a situation where it was more

difficult to gain clear majorities in the Spanish parliament. Government formation was increasingly associated with weak coalitions, and there has even been a debate around potential reforms of the political system to move towards some elements of presidentialism over the current model of parliamentary democracy. Therefore, the pandemic arrived at a time when the political and economic reality of Spain was already fragmented, polarised and prone towards instability.

4.4.1. COVID-19 pandemic in the national political context

Spain was one of the first countries in Europe to be severely hit by the global pandemic, leading to high levels of uncertainty and risks to the country's economy, political stability and the functioning of the health system. It was one of the first Western countries to impose national lockdown and other severe restrictions on mobility and travel, the closure of external borders and the limitation of non-essential economic activity (Marcos, 2020; Hernández & Piña, 2020).

Lockdown measures were highly restrictive in the first wave of the pandemic, given the high uncertainties at the time on the precise health consequences of the coronavirus, the lack of effective medical treatments, and the great risk to the elderly population. At later stages of the pandemic, restrictions were eased as cases dropped, vaccines became available, and Spain attained one of the highest vaccination rates in Europe. In the subsequent waves of the virus, softer policies like curfews, social distancing and mask-wearing obligations were adopted, adapting to specific regional developments of the pandemic.

Politically, the pandemic arrived at a critical time, when the social-democratic party led by Prime Minister Pedro Sanchez had just formed its second Government. The social-democrats have led the country in a minority government after the vote of no confidence against conservative Prime Minister Mariano Rajoy in 2018. After two general elections in 2019, a coalition agreement between the social-democrats and left-wing parties (mainly Podemos and Izquierda Unida) prospered with the formation of a joint cabinet on 13 January 2020 (Casqueiro & Pérez, 2020).

4.4.2. Pandemic events

The pandemic produced disastrous effects in Spain ([46]), as one of the Western countries that were first hit by the outbreak of the coronavirus and, therefore, it had less time to prepare for the adverse effects of the pandemic and the unfolding of a major economic crisis that was attached to the disruption of non-essential economic activity. Further, the Spanish economy was heavily affected by the decrease of mobility and international travel, given the key importance of tourism in the Spanish economy.

The first diagnosed case of coronavirus was in late January 2020 and the first deaths were recorded in mid-February 2020. During the month of February, there

([46]) Figure 12 shows a timeline of the most important events of pandemic development in Spain.

was a very rapid rise and already in mid-March all of the 50 Spanish provinces had confirmed cases of COVID-19. Given critical pressures on the national health system, the rapid rise of deaths, and the observation of a critical situation in Italy (where the coronavirus outbreak had commenced earlier), Spanish authorities imposed a nation-wide lockdown on 14 March 2020 and on 29 March 2020 policies were implemented for non-essential workers to stay at home (Marcos, 2020).

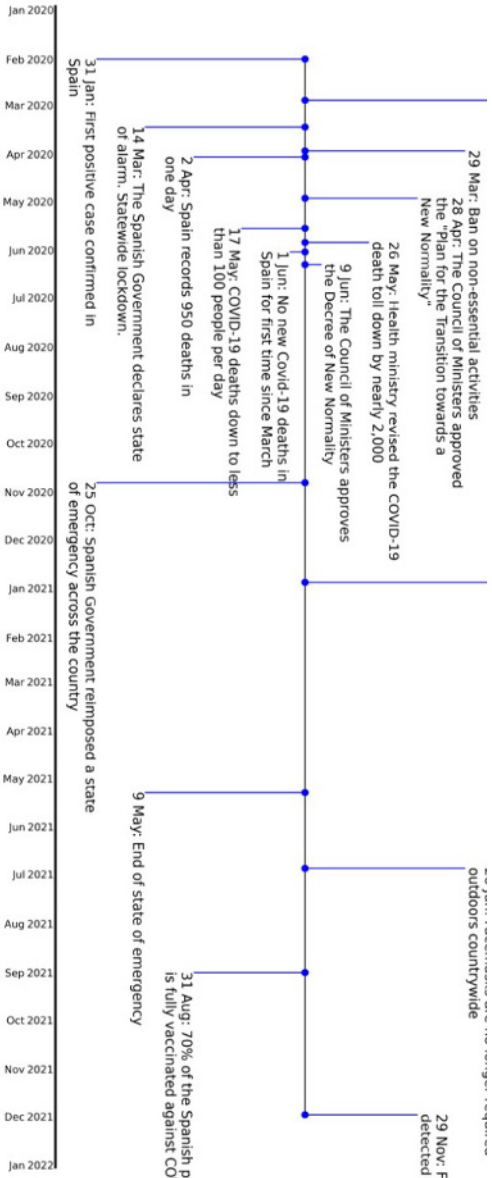
At the peak of the pandemic, on 2 April 2020, more than 950 people died from COVID-19 on a single day (Rodriguez Martinez, 2020), with an important share of casualties occurring in elderly homes. Only on 17 May 2020 less than 100 people died per day. The lockdown measures led to a steady reduction of COVID-19 cases and deaths, and 1 June 2020 was the first day in the Spanish territory where no COVID-19-related deaths were recorded since the imposition of national lockdown. Twenty days later, the lockdown was lifted in favour of softer distancing rules that were maintained until the outbreak of the second wave in October 2020, when the Spanish government reimposed a state of emergency and opted for a national curfew over a lockdown (Calvo Poyato, 2020).

A successful vaccination campaign during the winter of late 2020 and the spring of 2021 placed Spain amongst the EU countries with the highest vaccination rates (Amiel, 2021). As a result, restrictive measures were eased again on 9 May 2021, ending the state of emergency as well as the nation-wide curfew. Subsequent waves, such as the one caused by the Omicron variant in the late 2021 and the early 2022, have seen a much milder impact, leading to a situation where restrictions and mask obligations have been reduced significantly.

Over the entire period, there has been no further general election and Spain has been governed by the Sanchez government that was initiated in January 2020 in the coalition with left-wing parties discussed in the section above. On the policy level, Spain responded to the economic crisis that followed the pandemic with large demand-side stimulus packages in order to compensate for the drastic reduction of economic activity during the national lockdown. Large financial packages were adopted both at national and EU level to smoothen the effects of the pandemic on the Spanish economy. Spain was an important beneficiary of the ECB's pandemic emergency purchase programme (PEPP). Further, Spain has been amongst the largest beneficiaries of the Next Generation EU recovery instrument.

The large sums of spending that were made available by EU institutions for Spain aimed to respond to the situation where Spain was heavily affected by the economic effects of the pandemic (see above). So far, the Next Generation EU recovery instrument has received a lot of public attention in Spain and it is being promoted as a key opportunity to turn the pandemic crisis into a long-term opportunity for Spain to modernise its economy through an acceleration of the green and digital transition (see Chislett, 2021). While the EU funds have been met with great optimism, it is yet to be seen how the implementation of the Spanish National Recovery and Resilience Plan will shape the post-pandemic social and economic reality of Spain.

Figure 12 / **Timeline of key developments in Spain during the pandemic**



4.4.3. Primary research findings

Data was collected for a variety of topic areas that were relevant to the pandemic events. As shown in Figure 13 there was a high volume of debates related to the government and the state and directly linked to the management of the COVID-19 pandemic.

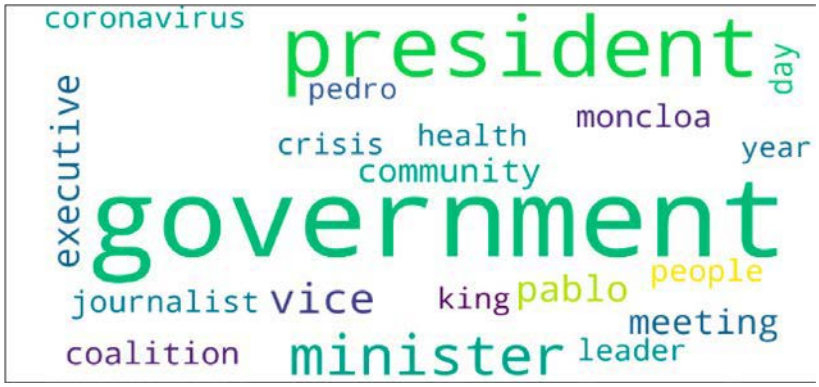
This indicates that pandemic events and related measures played a significant role in the analysed social media conversations, and the observed sentiment and trust signals. It should also be noted that at the start of the pandemic, Spain was at a very important institutional moment with the recent formation of a Spanish government based on a coalition between the social democratic PSOE and left-wing parties (mainly Podemos and Izquierda Unida).

The data confirms that the coronavirus had a strong impact on the terminology and types of debates that were being held on social media. The language and narratives employed by online users pivoted around a few key concepts and terms that were related to the management of the coronavirus pandemic. Amongst the most recurrent terminology that was used by online users, key concepts included the *state of alarm* ('estado de alarma' in Spanish) ([47]), as well as other key terms such as *health*, *crisis*, and *recovery*.

The collected data indicates a strong effect of the pandemic on online discussions in Spain (see Figure 13). Further, there is a strong direct connection to institutional terminology such as ministers, state, executive, president, government, coalition, and the presidential office of Moncloa, reinforcing the idea that the debates were driven by individuals expressing opinions and claims on the management of the crisis by political and institutional actors. This suggests a strong basis for analysing the impact of the pandemic on trust in the governing institutions.

Figure 13 / **Word clouds for Spain during the pandemic**

([47]) In Spain, the 'state of alarm' is a softer version of a state of emergency.

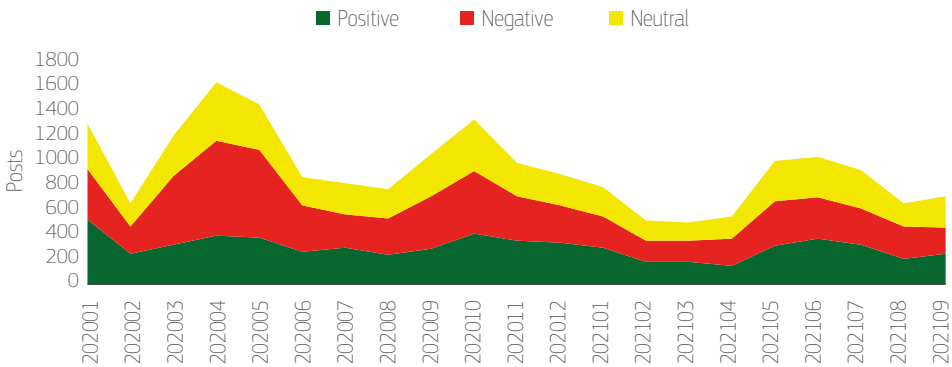


Source: data from own research

On the level of the volume of debates, the major peak of posts occurred at the onset of the pandemic, coinciding with the months of highest uncertainty. After the first wave, the volume decreased again but recorded an important rise again once the second wave of the coronavirus pandemic commenced.

During these times of crisis management, it is notable that the negative sentiment in the online discussions augments significantly, while the rise of positive comments is only marginal in comparison (see Figure 14). As the vaccination campaign advanced and produced very positive outcomes in Spain (Amiel, 2021) the negative sentiment decreased visibly. However, the volume of positive comments also decreased in absolute terms, while it increased in relative terms to neutral and negative sentiment. It can be concluded that on the sentiment level, peaks of negative sentiment are closely related to waves of the pandemic in Spain.

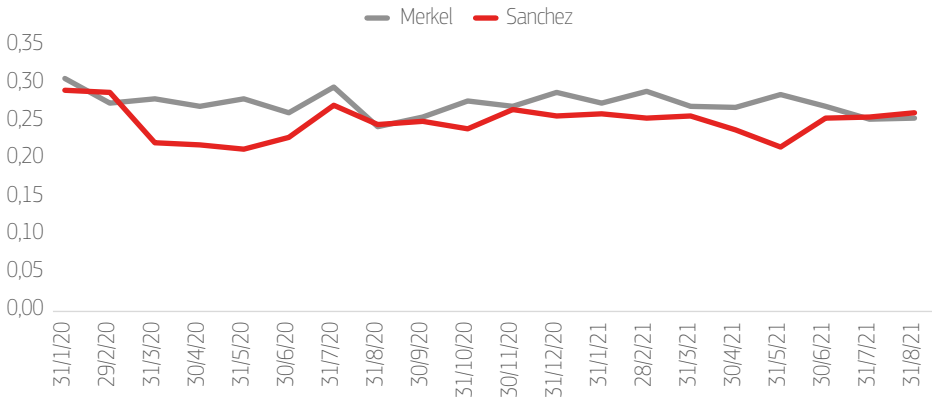
Figure 14 / **Sentiment evolution in Facebook groups during the pandemic in Spain**



Source: data from own research

The analysis of trust scores within sampled conversations, suggests the most significant negative impact occurred at the very beginning of the pandemic, as Figure 15 shows. A major loss in trust is visible during the first wave of the coronavirus. As the full lockdown ended, the trust levels increased again and remained rather stable during the subsequent phases of the pandemic. However, there is a significant trust decline around May 2021. As analysed below, by this stage of the pandemic, internal political developments in Spain had eclipsed the influence of the virus incidence or containment measures that are shaping the trajectory of trust for Sanchez.

Figure 15 / **Compared trust levels for Merkel and Sanchez.**



Source: data from own research

4.4.4. Analysis

The first phases of the pandemic had a clear impact on the trust levels of the Spanish government, as the negative sentiment in the sampled conversations increased significantly. While in the first wave of the pandemic, debates around the government measures had a very strong impact on trust scores, the direct impact of the pandemic on the debates of the online posts analysed decreased visibly for the second and further waves of the pandemic, as the virus context had become a 'new normal' over time and other political themes and topics emerged. The sampled conversations related to the government show increased importance of topics other than the pandemic-related concerns throughout 2021.

At the beginning of the recorded data, Prime Minister Sanchez had just managed to form a new government and therefore enjoyed higher trust scores. In February, the situation complicated dramatically as the pandemic reached Spain, causing major economic turbulence, the rise of uncertainties and risks that were widely commented as being particularly detrimental in the case of Spain (Chislett, 2021). Facebook conversations had a major role in spreading mistrust and negative sentiments towards the government policies to contain the pandemic (Fernández-Torres et al., 2021).

The sudden loss of trust during the first wave of the pandemic is significant and is sustained at low levels throughout the majority of the period of full lockdown. In depth analysis of the wording of individual posts suggests that the overall sentiment of conversations deteriorated significantly, adding to a heated debate. Nonetheless, the gradual improvement of the situation and the visible reduction of COVID-19 cases and deaths as a result of the lockdown measures mitigated the negativity of the online posts analysed, producing a significant improvement of trust scores from May 2020 onward.

One of the key readings of the trajectory of the sentiment and trust levels is that while the pandemic heavily affected trust at the beginning of the crisis, other items gained increased priority at later stages of the pandemic. This trend could be described as a gradual normalisation of the pandemic in the public discourse, whereby the focus shifts back to other policy areas. The speed of this normalisation may be dependent on two critical factors, namely, the improvement of the sanitary situation (i.e., factual reduction of the crisis) as well as the co-existence of the initial crisis with other critical issues that capture the public attention.

The data analysed in our research supports the view that, at later stages of the pandemic, the public focus shifted importantly and the pandemic loses influence at determining the sentiment and trust scores. As such, the second major low in the trust scores around May 2021 is mostly explained by non-pandemic events as Spain entered a period of major foreign policy crisis with Morocco that created significant tensions in the Spanish enclaves in Northern Africa, including an immigration crisis that provoked heated debates in Spain. Other discussions that became prominent over the course of 2021 were the blockage of the renovation of the members of the Supreme Court, as well as the pardons granted by the Spanish government to a variety of Catalan independence leaders. The volatility in trust scores from April to August 2021 are influenced more by the latter events than the pandemic. Nonetheless, while being reduced on the aggregate, events like the end of the obligation to wear masks still bear importance in explaining the rise and fall of trust.

DISCUSSION

The trust levels of the figures analysed above ([48]) show several interesting developments. First, it seems that, while the initial uncertainty of the pandemic significantly impacts trust, it takes a small amount of time for other factors (beyond the pandemic) to regain importance in the public debate and explain the trust fluctuations of government leaders ([49]).

Therefore, one can distinguish a first phase where the direct effect of the pandemic severity on political trust is evident (see case study of Spain). In a second phase,

([48]) Recall the figures in the analysis section as well as figures 16 and 17 in the Annex.
([49]) Refer back to word clouds in the case studies of Germany and Spain.

however, new severe waves of the pandemic do not show a direct effect on trust levels. This does not mean that the pandemic is not affecting the trust scores; instead, it seems that there is a normalisation of the pandemic in the public discourse, which leads to a situation where other topics become prevalent and have a more significant immediate impact on trust scores. Nevertheless, a direct proportional movement between pandemic severity and trust levels cannot be established over time. Further, it remains hard to measure how recurrent pandemic waves affect trust levels in the long run.

Hypothetically, it might be possible that, while at the beginning of a pandemic crisis the effect on trust is immediate and tangible, subsequent waves might contain the rise of trust levels that might otherwise be higher. It would be thinkable that the effect of the pandemic on trust levels becomes more subtle and it becomes more challenging to measure the effect of the pandemic on trust as other political debates re-enter the public discourse.

One of the reasons why there is a different behaviour of trust levels among the various waves of the pandemic might be that the initial moment of a pandemic is the one that produces the highest levels of uncertainty and social anxieties as the nature of the imminent risks are not yet fully understood. Recall that Europe had not experienced a major pandemic (other than flu) for decades prior to the COVID-19 outbreak. Therefore, the beginning of a pandemic is a political moment where the previous expectations by social actors about their future are put in question, in a situation where there is no clear answer on what the pandemic will mean for the economy, for individual livelihoods and the political systems overall. This might explain why, despite a lower incidence level than at later waves, the first wave had a great impact on trust levels. Furthermore, one should take into account that the mortality rate of the virus decreased over time and that there was time to reinforce the health system from one wave to another.

One should note that trust is a very abstract concept that is often long-term oriented and constructed by a multitude of events and intersubjective interpretations of a given reality. As such, trust scores might be reasonably immune to daily political and economic events. However, the exception to this is when a major political or economic crisis begins. In the initial period of highest uncertainty, trust is significantly affected by the severity of the crisis, as social actors' previous expectations about the future are shattered, and a reformulation of their expectations about the future becomes necessary in a relatively short amount of time, under conditions of imperfect and asymmetric information.

The level of uncertainties kept reducing over the development of the crisis (e.g., systemic collapse did not seem likely anymore, several vaccines were developed, and telework helped to avoid a complete shutdown of economic activity), yet important risks and uncertainties about the future remained in place. While it can be perceived that the initial extreme uncertainty had a detrimental effect on trust levels in Spain given the severity of the crisis, by the same token, the reduction of uncertainties over time through public spending led to a normalisation of trust. Moreover, in Germany, when looking at the data for Scholz, whilst serving as

German Minister of Finance, one can identify a situation where his popularity witnessed a notable increase right after his decision to adopt large government spending programs that helped to calm markets and reduce market and social uncertainties.

Both the published polls and studies and our research findings suggest that in the case of Germany, the government had enjoyed relatively stable support throughout the pandemic. As Figure 16 suggests, the trust was not declining even though the number of cases grew. Therefore, we can conclude that the pandemic did not significantly impact the stability of the German political system and the support of the population for the institutions. The change in power after the elections in September 2021 appears more related to the fact that Chancellor Merkel decided not to run for re-election, and her successor did not manage to gain enough support from voters that would allow him to start the coalition talks.

As the literature suggests, trust represents a base for the stability of the political, economic and social system. In both case studies, we can observe a decline in trust at the onset of the pandemic; the following months brought some levelling off and even a gradual increase. Thus, governments' decisions to adopt mitigating measures were perceived as necessary by the population. As the literature suggests, meeting the population's needs correlates with the trust for the institutions, in our case the governments of Spain and Germany.

The pandemic's first wave characteristics were the lack of knowledge about the novel virus, which is why the measures adopted by governments to prevent its spreading were perceived positively by the population or its portion. Throughout the pandemic, demonstrations took place all over Europe as the pandemic fatigue increased and the trend of waves started. Nevertheless, in our two case studies, this did not impact the overall trust for the government in a significant way. One can argue that in the case of Germany, it led to a change in the government. However, the development there might not necessarily be related to the pandemic, but more to Chancellor Merkel's announcement of not running for re-election. In this case, the German voters faced a new situation after 16 years. As the election showed, they opted for a member of the previous government. We can only assume that his experience and decisions as a finance minister have impacted the voters, who then found him more suitable to lead the country.

CONCLUSION

The COVID-19 pandemic has had a significant impact on societies worldwide, causing crises in health services, economic and social instability and the increase of societal divisions. The immediate impact on politics has been diverse; in some countries, it strengthened the position of institutions and government; in others, it had the opposite effect. The lasting impact of the pandemic on democratic countries of the EU is yet to be seen, even though there is still another crisis looming in Europe related to the war waged by Russia in Ukraine.

When looking at how the pandemic impacted the trust of the population in the government in the two selected countries of this study, we have to conclude that primary data analysed suggests a less pronounced impact of the pandemic on trust levels than expected. The initial decrease in trust in both countries at the pandemic's onset is understandable due to the associated uncertainties. However, after the first month, the trust grew, possibly because populations found the policies and measures adequate. In our selected countries, the increasing number of infected did not correlate with the decrease in trust as might have been expected.

Judging from the results of our research, we can conclude that the two governments performed well in the first year of the pandemic, and decisions were in line with the voters' expectations. That would suggest that the voters would not have a reason to vote for other parties in the upcoming elections. The German case may suggest otherwise, but the change in power appears linked to causes other than the pandemic. (Deutsche Welle 2021) Answering how and to what extent the pandemic impacted the upcoming election can be evaluated in the case of Spain in the next election cycle.

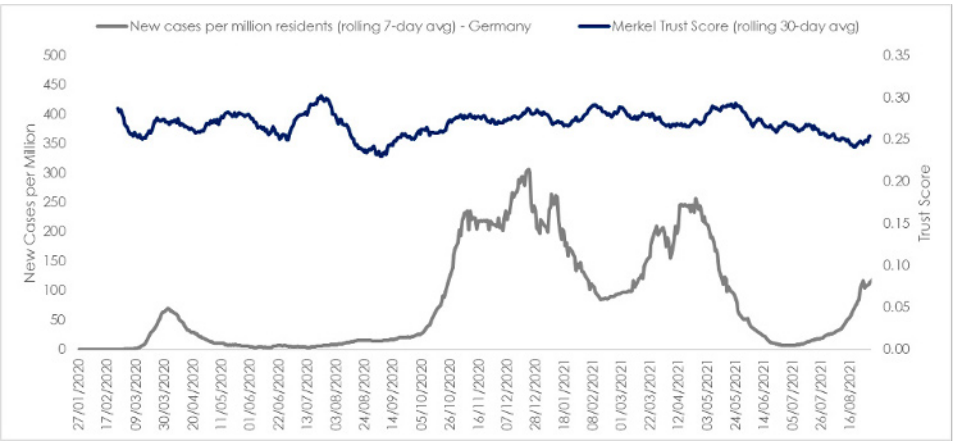
In future research, that can build on studies published recently, such as Aksoy et. al. (2022), we would suggest analysing equivalent data for other European countries to carry out a larger scale comparative study of the behaviour of trust scores during the pandemic. The higher the number of cases analysed, the more likely that the specific findings will be generalizable. Further, given that the pandemic is still ongoing, it would be interesting to perform an ex-post analysis once the pandemic has been proclaimed to be over. Finally, further research could look into a comparison of government trust levels across different types of crises, comparing, for instance, the trust during the pandemic to trust levels after a major economic and financial crisis.

The method for sentiment analysis based on open-source data developed here offers a fast and cost-effective way of research providing an alternative to the more traditional means of measuring public opinions, such as online surveys, questionnaires or telephone polls. It allows us to analyse close to real-time data using a variety of datasets that could be applied to analyse the sentiments in other EU Member States.

In the future, one of the main benefits of big data use also involves the possibility of automating the process by creating algorithms analysing the data in real-time. Limitations would obviously apply and tools would need to be geography specific, adjusting to the proliferation of certain types of media, legal frameworks and other circumstances. However, combining data sources from the social media, online news databases (e.g., GDELT) and other open-source data (e.g., ICEWS or Google Trends), would likely allow, with some adjustments, for an integrated real time sentiment analysis evaluating public reactions on various events or policy decisions.

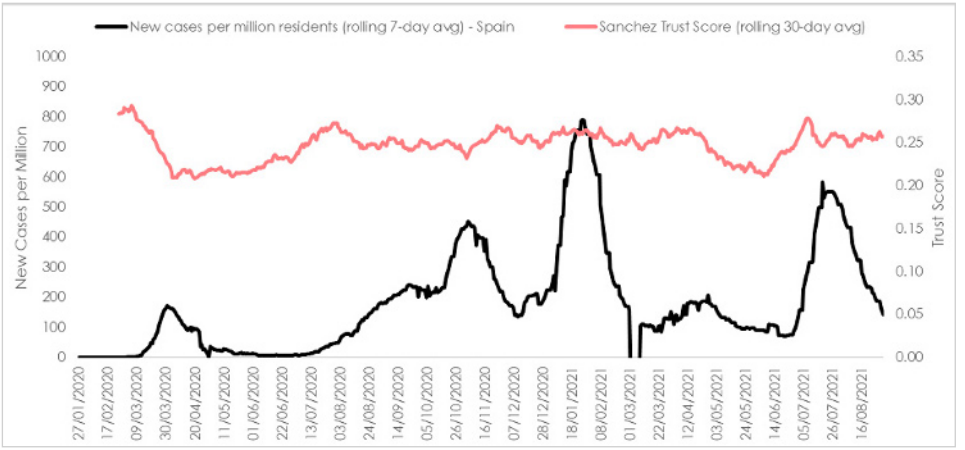
ANNEX

Figure 16 / **Comparison of Merkel's trust scores and COVID-19 incidence levels during the pandemic.**



Source: data from own research

Figure 17 / **Comparison of Sanchez' trust scores and COVID-19 incidence levels during the pandemic.**



Source: data from own research

5. THE MACROECONOMIC IMPLICATIONS OF THE GREEN TRANSITION

Andrea Mairate ([50])

INTRODUCTION

The concept of 'green transition' has been at the centre of policy debates in recent years. It builds on the promise of a new growth paradigm that is compatible with the environment and contributes to alleviate inequality and poverty. From that perspective, it is compatible with the older concept of sustainable development and its more recent version of the UN Sustainable Development Goals that provide the framework for policy action to respond to multiple crises – climate, food and economic crises. The Paris agreement has reshaped the global economy by setting the common goal to limit global warming by mid-century to well below 2 °C, preferably to 1.5 °C, compared to pre-industrial levels. Scientific evidence shows that human activity is changing the climate in unprecedented and sometimes irreversible ways (IPCC 2021). The latest assessment by the IPCC (2022) also warns that t the window to limit the most destructive impacts of climate change is 'rapidly closing'. Damages from climate change will continue to be large in many regions of the world, including Europe. The world economy will have to undergo a far-reaching transformation on an unprecedented scale to reach the Paris goals. At the heart of this process, is the need to cut radically greenhouse gas emissions (GHG) over this decade ([51]).

The European Green Deal put forward by the European Commission (2019) builds on a different narrative of economic growth defined ' as 'strong, sustainable, inclusive, resilient' (EC, 2020). It provides a comprehensive framework with a

([50]) The views expressed in this chapter are those of the author and do not necessarily reflect the positions of the European Commission. This chapter has benefited from feedback and comments from Bruno Castanheira, Marco Ratto, Istvan Szekely and Janos Varda.

([51]) According to the United Nations, global emissions would need to drop by 7.6 % each year between 2020 and 2030 to reach the Paris target (UNEP 2019). By way of comparison, in 2020, when global economic activity went to a recession due to the pandemic crisis, emissions fell by only 5.8 %. The latest IPCC report (2022) underscores the need to peak global greenhouse gas emissions by 2025 and to decline rapidly thereafter.

detailed road map to 'transform the European Union into a sustainable, fair and prosperous society, with a modern, circular and competitive economy and zero net emissions of greenhouse gases in 2050'. It encompasses a set of policy instruments, regulatory and non-regulatory as well as a Sustainable Investment plan and compensatory measures to ensure a just transition. As part of this framework, the so-called 'Fit for 55' package includes a revision of existing policy instruments (Emission Trading Schemes (ETS); energy taxation) as well as accompanying measures (e.g. Climate Social Fund) to meet the EU climate goals, i.e. reduce average greenhouse gas emissions (GHG) by 55 % in 2030 and net zero by 2050 compared to 1990 levels (EC 2021).

The climate crisis coupled with the pandemic crisis have changed the European economic landscape.). The policy focus has shifted on tackling the COVID crisis and its economic and social fallout. Governments supported massively their economies during lockdowns with state-backed loans, furlough schemes and other support mechanisms. While the return to a pre-COVID scenario with low growth and high inequality is not an option, the economic recovery process reinforced the case for accelerating the green transition and integrating climate change into current plans and programmes, such as Next Generation EU (NGEU). However, the war in Ukraine and its fallout on the global economy in terms of rising commodity and energy prices have created new challenges for the green transition as the world emerges from the pandemic. The EU is confronted with the need to diversify its gas supply to reduce its dependency from Russia, while also moving away from fossil fuels and accelerating the green transition (EC 2022).

Bearing in mind this context with a mix of environmental and geopolitical factors, this chapter explores the economic and financial implications of the green transition. It looks at the green transition as a process of structural change with potential trade-offs and complementarities between policy objectives and actions. It highlights some macroeconomic issues that are central to this process. It also examines climate risks and their broad implications for the financial system. Finally, it discusses some policy issues, in particular how economic policy tools can pave a road toward net zero emissions by 2050, in a way that supports economic growth, employment and income equality.

5.1. GREEN TRANSITION AS A PROCESS OF STRUCTURAL CHANGE

In his masterful book 'The Spirit of Green', W. Nordhaus (2021) examines a wide array of social, economic and political questions related to a 'green economy'. Economic thinking about the green economy from the 90s (Pearce et al 1989, Jacobs, 1993) has evolved over the last few decades from a branch of economics dealing with the environment, pollution and the treatment of externalities to a much broader vision that 'emphasises the behaviour of the non-market systems that humans affect' (Nordhaus, 2021 p. 74,). A major shortcoming of mainstream economics is that public goods such as environmental goods and services or

climate change are undervalued. In fact, many prices such as the price of carbon dioxide emissions in most sectors and most countries is very low or even zero and therefore well below the social cost. Economists view this as the result of a fundamental market failure: carbon fuel prices do not properly account for climate change costs (N. Stern 2008). A number of market failure arguments favour government intervention to support the green transition. There are negative externalities because of the damage caused by greenhouse gas (GHG) emissions but there are also potential positive externalities stemming from knowledge spillovers and innovation in new technologies. Hence, the existence of multiple market failures justifies several policy instruments, as in the case of climate change.

The narrative around the green transition challenges the old paradigm according to which growth and the environment are fundamentally incompatible objectives and that there are significant trade-offs between the two. What characterises the concepts of green economy and green growth is the understanding that the benefits of environmental sustainability outweighs the costs of investing and protecting the ecosystems as well as for climate adaptation and mitigation. In this logic, it is possible to have a ' double dividend' ([52]) strategy or even a 'triple dividend' if we include social equity.

The green transition is generally viewed as a process of structural change from one state of the economy based on a widespread use of fossil fuels to another state based principally on the use of clean energy, mainly renewable energy. In other words, it entails moving away from a system that allowed, and at times generated climate and environmental crises to a system that proactively addresses and prevents them (Ocampo 2010). Such transition requires a deep transformation not only of the energy systems but also of the entire productive system for achieving a net zero, i.e. a climate neutral economy ([53]). This implies significant changes in the patterns of production and consumption, jobs and skills that must be put in place in the transition to the green economy, which in this regard can be characterized as no less than a new technological or industrial revolution. Driven by climate policies, the green transition also requires social changes, government and institutions capacity to adopt mitigation and adaptation measures ([54]).

The 'structuralist' view is that these changes are not just a by-product of growth but are inherent to the process of development itself as the capacity of an economy to generate new dynamic activities. New activities are generally accompanied by the decline of others, in the process that Schumpeter (1962) characterized

([52]) The double-dividend hypothesis' suggests that a carbon tax can provide two kinds of benefits. The first is an improvement in the environment, and the second is an improvement in economic efficiency from the use of environmental tax revenues to reduce other taxes such as income taxes that distort labour supply and saving decisions (Goulder 1995, Fullerton- Metcalf 1997).

([53]) There is a notable difference between carbon neutrality and net zero. The two terms might appear indistinguishable to anyone who is not familiar with carbon accounting. Climate scientists fear that a carbon neutral label might lead to a watered down definition of the net zero.

([54]) t K. Polanyi (1944) described this transformation as a change of human institutions and human nature resulting from the development of market economies.

as 'creative destruction' the 'process of industrial mutation that continuously revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one'. This concept has become popular since the 50s as a theory of economic innovation and business cycles. In a more recent version, Ph. Aghion et al. (2021) provides a cutting-edge analysis of what drives economic growth and the power of disruptive innovation to ensure a fair and prosperous economy of the 21st century. The process of creative destruction can have distributive impacts across and within countries. The essential issues here are who benefits from technological change, in terms of being at the centre of research and development efforts, and generating new economic activities and demand effects (linkages) with the rest of their economies, and who will be negatively affected by the activities for which there will be reduced demand. Acemoglu et al. (2012) suggest that the need for policies to redirect technical change from dirty to clean industries may only be transitory. Once such policies have been in place for a sufficient period, innovation in these new technologies could become self-sustaining.

The green transition goes hand in hand with the complexity of the energy, technological and social systems. Yet there are no structured solutions yet on how to manage the underlying complexity of such transformation. In its World Energy Outlook (2021), the International Energy Agency shows that the transition to cleaner energy sources is occurring at a rapid pace, but it also highlights that it is still not aligned to a path that would stabilize global temperature increases at 1.5 °C and achieve other energy-related sustainable-development goals. Current technologies do provide solutions to decarbonise the economy at the required pace between now and 2030. However in 2050, 'almost half the reductions (in CO2 emissions will come from technologies that are currently only at the demonstration or prototype phase.' (IEA 2021).

An early transition to a carbon-neutral economy will require countries to substantially increase the level of investments and step up innovation in key technologies and sectors. The main argument is that public return on innovation is many times larger than private returns, given also the externalities associated with low carbon innovations (Nordhaus, 2021). A delayed transition will entail higher social costs that will be felt unevenly across the society and more difficult to bear for poorest communities and populations.

5.2. MACROECONOMIC DIMENSIONS OF THE GREEN TRANSITION

This section focuses on the macroeconomic dimensions looking at issues regarding the effects of climate change or climate policies on the economy as a whole. This is a difficult task as most of the literature tended to focus on microeconomic dimensions, such the role of externalities and different market failures, on sectoral aspects (e.g. the role of the energy sector) and territorial dimensions (e.g. the role of regions and cities).

In recent years, climate policy has become macro-critical as ' decarbonisation was regarded as a topic for the long term, beyond the usual macroeconomic horizon' (Pisani-Ferry 2021). Adding climate change mitigation as a macroeconomic policy goal gives rise to a series of questions on the interaction with other policy goals such as business cycle stabilisation, financial stability or price stability. Political economy considerations on welfare issues complicate these questions and the literature does not provide precise answers yet.

Early attempts ([55]) to examine the relationship between climate and growth have been made with the help of Integrated Assessment Models (IAM). These models have demonstrated their utility in analysing pathways to achieve a pre-determined level of climate stabilization (such as 2 °C) in a cost- effectiveness framework. One common use of these models is the analysis of policies to confront climate change – which can be labelled as the 'costs of action'. However, these models are often not adapted to capture the transition dynamics and the role of technological change (Stern, Stiglitz, 2021).

The economic impacts of climate change are difficult to quantify, especially in the long run. In his Nobel prize lecture, W. Nordhaus (2018) argued that 'projecting future climate change impacts is the most difficult task and has the greatest uncertainties of all the processes associated with global warming'. According to the IMF (2020), while short-run costs to the global economy can be modest, long-run impacts could be sizeable, with global output losses ranging from -2.1 % to -7.2 % by 2050 in unmitigated scenarios, although with significant differences across countries. The most exposed countries tend to be poorer, more densely populated, coastal, and nearer the equator.

There is a large body of research on the costs of the green transition. The Stern Review (2005) estimated that mitigation costs of around 1 % of GDP are highly worthwhile to limit damage costs of around 5 % of world GDP by 2050. Global public adaptation needs in 2030 are estimated at around ¼ percent of world per year with large disparities across countries and high uncertainty (Aligishiev Z., Bellon M., Massetti E. (2022). According to the IPCC (2021), transition costs consistent with emissions trajectories towards stabilization between 430 and 480 ppm CO_2 equivalent, i.e. in the case of an orderly scenario, represent a loss of annual GDP between 0.01 and 0.03 per cent from now to 2030 ([56]).

Other modelling scenarios point to the relatively modest size of transition costs for many parts of the world**.** The IMF (2020) examined different policy scenarios aiming to quantify transition costs in a regional macroeconomic model. Under unchanged policies, global carbon emissions would keep rising, and global growth would progressively decline. The IMF estimated that under a comprehensive policy package, net emissions could be brought to zero by around 2050, and temperature increases could be kept to 2 °C, with global output in 2050 only

([55]) The most prominent example of a neoclassical climate-economy growth model is the Dynamic Integrated model of Climate and the Economy (DICE), which has become a benchmark for IAMs (Nordhaus, 2008 and 2017).

([56]) For an informed discussion on the macroeconomic costs of decarbonisation, see Carraro (2022).

deviating by -1.2 % from the level of baseline growth. However, the analysis unveils variation in costs for different countries. The European Central Bank (2021) states that 'the short-term costs of the transition pale in comparison to the costs of unfettered climate change in the medium to long term.'

There are, however, large uncertainties about both cost estimates far into the future and the optimal path to achieve the required level of mitigation. Logically, the costs of action have to be confronted with the 'costs of inaction' ([57]).In this regard the disruptions generated by environmental damages can also be interpreted as a reduction in the aggregate productivity of the economy. IPCC reports reflect the large divergence of views on these damages as well as the difficulty in costing non-market damages. Assessing climate change impacts and mitigation and adaptation policies involves a comparison of economic flows that occur in different points in time. However, the choice of the social discount rate ([58]) (i.e. the opportunity cost of capital) has a large effect on the result of cost benefit analyses. A recent study (Drouet, Bosetti, Tavoni 2021) has estimated global net benefits of attaining well below 2 °C using a 3 % social discount rate (higher than the 1,4 % used in the Stern review) at 204 trillion dollars, so well above the transition costs.

5.2.1. A negative supply shock and other shocks

In macroeconomic terms, climate related shocks could be considered as a *negative supply shock* as they affect output, prices as well as potential growth. For example, droughts and heat waves often lead to crop shortfalls, putting upward pressure on food prices. Hurricanes and floods destroy production capacity, thereby raising input and output prices. A range of sectors including agriculture, energy, transport, are likely to be directly or indirectly affected by climate change impacts. At the same time, climate change may turn into adverse demand shocks. While damages to infrastructure may boost investment, expectations of weaker growth and income prospects, as well as high uncertainty, may lead firms and households to increase their saving rate and reduce consumption in the medium term. However, there are also broader impacts on the economy in terms of lower productivity due to output losses, the capital stock due to damage to physical capital, labour market due to job reallocation, trade patterns and welfare.

Action to mitigate climate change will entail significant negative supply shocks, as it will translate into increases in energy costs, which will then have adverse effects on global output. According to Pisani-Ferry (2021), this supply shock might be similar to the oil shock of the 70s, which led to stagflation, although they differ in terms of their demand-side effects.

([57]) The COACCH (Co-designing the assessment of climate change costs) project funded under the Horizon 2020 programme provides an innovative framework to assess the costs of policy inaction, including at regional level. It shows that macroeconomic costs are relevant on aggregate and that there are huge direct adaptation costs for a large number of European regions (Bosello et al 2021)

([58]) Discounting is a relatively controversial issue in climate economics due to the ethical implications of valuing future generations less than the present ones (Stern, 2008).

The European Commission (2020) assessed the macroeconomic impacts of climate policies under different modelling scenarios and variants according to the policy set up and tools used to achieve the 2030 climate target (see Table 1). Given the interaction with the rest of the world in particular exports and the share of output of sectors open to international trade, it is assumed that policy commitments set out in the Nationally Determined Contributions (NDCs) under the Paris Agreement are met (' fragmented action') or that mitigations actions are deployed in line with the 1,5 °C target ('global action'). The results are quite divergent, ranging from a GDP loss of about 0,40 % due to the repercussions of output losses outside the EU to a more positive impact (+ 0,50 %) resulting from higher investment needs and a relative increase of consumption due to the use of carbon revenues to reduce VAT and support energy efficiency investments.

Table 6 / **Impact of climate policies on GDP to achieve 55 % GHG reductions (*Deviations from baseline, %*)**

Policy setup	- Lump sum transfers - Imperfect labour market - Free allocation ETS - Scope extension ETS - No carbon pricing non- ETS	- Tax recycling - Imperfect labour market - Free allocation ETS - Scope extension ETS - No carbon pricing non- ETS	- Tax recycling - Imperfect labour market - Free allocation ETS - Scope extension ETS - Carbon pricing non-ETS
JRC-GEM-E3*	-0.39	-0.27	-0.27
Policy setup	- Lump sum transfers - Free allocation ETS - No carbon pricing non-ETS	- Tax recycling - Free allocation ETS - Carbon pricing non-ETS	- Tax recycling - Auctioning ETS - Carbon pricing non-ETS
E3ME	0.19	0.42	0.50
Policy setup	Lump sum transfers	Lower taxation low- skilled labour	Support green invest.
E-QUEST	-0.29	0.00	0.13

* All JRC-GEM-E3 scenarios assume free allocation in ETS industry and auctioning in the power sector (as well as buildings and road transport in case of scope extension ETS). For industrial sectors it is assumed companies cannot incorporate the opportunity cost of free allocation and thus optimise market share.

Source: European Commission (2020) based on modelling scenarios, Joint Research Centre (JRC), Cambridge Econometrics, DG ECFIN

This potentially large supply shock has different implications in terms of economic transformation. We discuss here four other shocks to the economy that imply significant adjustment costs.

a) Investment and reallocation of capital

The transition to a net zero economy will require significant additional investments to replace or rebuild the capital stock. Cost estimates provided by

different international organisations point to additional annual investments in the order of 2 % GDP to achieve climate targets by 2030 (Table 7)

Table 7 / **Additional annual investment needs and emission reductions**

Source	Region	Sectors	Period	Investment need (% GDP)	Climate target
OECD (2017)	World	all	2016-2030	1,89	2 °C
Mc Collum et al. (2018)	World	Energy	2016-2050	2,07 0,39-4,38	1,5°
IEA (2021)	World	Energy	2021-2030	2,68	NZE by 2050
EIB (2021)	EU	All	2021-30	2,09	-55 % emissions reduction by 2030
European Commission (2020)	EU	All	2021-30	1,5-1,8 (incl. transport)	-55 % emissions reduction by 2030

Source: IMF (2021), European Commission (2020)

In its impact assessment of the 2030 revised climate targets, the European Commission (2020) expects an increase of investments (including transport) of an average of 356 billion euros per annum, in the period 2021-2030 compared to the preceding decade equating in terms of GDP to 1,5-1,8 pp (Table 2). In 2031-50, additional investment needs can exceed EUR 500 billion per annum compared to the 2011-2020 period ([59]) (EC 2020). This represents a significant boost to investment, which adds to the share of gross fixed capital formation in the EU, which amounted to around 21, 5 % on average in 2000-2019.

This also entails a shift in composition of the energy needs as all fossil fuel investments need to be phased out over time while additional investments are required in low carbon technologies, electricity networks and storage, energy efficiency and sustainable transport infrastructure. Capital investment in energy rises from 2.5 % of GDP in recent years to 4.5 % by 2030; the majority is spent on electricity generation, networks and electric end-user equipment.

The IEA (2021) has drawn up new scenarios on how the world energy market might develop up to 2050. By 2050, investment in the energy system would need to be sustained for a long period at a higher level relative to GDP than has been the case so far. Under the net zero economy scenario, which includes policies and targets pledged by governments, the IEA expects a significant expansion in the contribution of renewables to primary energy consumption and a corresponding

([59]) All figures are in 2015 prices. Reaching the 55 % target by 2030 and net zero by 2050 requires about 1 200 billion euros per annum of total energy investments in the period of 2031-2050 compared to around 680 billion euros in the period of 2011-2020 in the baseline EC(2020).

fall in the contribution of fossil fuels in developed economies. However, the need for new infrastructure is not limited to power generation. Substantial investment will also be required in energy efficiency in the residential sector as well as for climate adaptation.

Table 8 / **Average total and additional annual investment needs for the climate and energy policy (incl. transport)**

Baseline scenario 2011-2020, and 40 % and 55 % policy scenarios 2021-2030, (EUR 2015, bn)

	20 % until 2020 targets	**40 % until 2030 targets**	**55 % until 2030 targets**	***Additional investment needs***
Sector	**BSL scenario (2011-2020)**	**BSL scenario (2021-2030)**	**MIX scenario**	***BSL 2020 vs. 55 % by 2030***
Power grid	25	50	60	*35*
Power plants, incl. Boilers and new fuels	35	45	60	*25*
Industry	10	15	20	*10*
Residential	85	150	190	*105*
Tertiary	40	75	90	*50*
Transport	490	610	620	*130*
Total	**685**	**945**	**1040**	**355**

Source: European Commission (2020)

Public investments can provide a temporary stimulus of demand, although not all investments will be additional, as part of it will be used to replace the old or unused capital stock. However, they have a catalytic role to play in triggering private investment. For example, renewable energy infrastructure requires large upfront investment in public infrastructure to bring energy costs down in the long term.

The strategies of reallocating investments towards the low carbon economy may lead to slower potential growth in the short to medium term, due to adjustment costs, but will result in the long run in faster economic growth. Furthermore, investments in the green economy also reduce downside risks of adverse events associated with climate change, energy shocks, water scarcity and loss of biodiversity. They will also result in the long term in increased employment, as green investments are generally more employment intensive, and have direct benefits in terms of productivity.

An orderly transition to net zero would require significant changes to capital allocation. Capital stock will increase due to additional investments in new infrastructure and R & D. At the same time, it will decrease as fossil fuel assets will be stranded due to trajectories in new low carbon technologies (e.g. renewable energy deployment, transport electrification) and climate policies such as carbon pricing. There are, however, no precise indications on the magnitude of this

shock ([60]). According to certain estimates, the loss from stranded assets may amount to a discounted global wealth loss of USD 1-4 trillion (J.-F. Mercure et al. 2018).

Some geographic places, especially those dependent on fossil fuel assets will be more exposed than others. Let us take the example of steel production. By 2030, steel furnaces will have to be replaced to reduce CO^2 emissions. The company will have to face massive investment, which will translate in a price increase for green steel. CO^2 emissions targets will lead to higher industrial prices through the industrial value chain as other industrial companies are buying steel and use energy to run their production chains. Even with efficiency gains stemming from automation and robotics, the cost pressures outweigh the savings.

b) Innovation and technology

Innovation is key for decarbonising the economy. The deployment of renewable energy has made rapid progress in recent years. This is an important development as the electricity sector has a share of 32 % in global emissions. Solar photovoltaic prices have fallen by around 90 % since the end of 2009, while wind turbine prices have fallen by 55-60 % since 2010 (IRENA 2020). As a result, the share of renewables has grown steadily due to the fall in prices and now nears the lower bound of fossil fuel prices. In a net zero scenario by 2050, renewable energy as the dominant source of energy could become cost optimal (IEA 2021).

Nevertheless given the inherent variability in renewable electricity generation, there is an ongoing need to improve energy storage and for electricity to replace fossil fuels in a wider range of transport modes. A number of potential innovation 'game changers' have been identified which could be transformative in terms of reducing CO_2 emissions and generate wider economic benefits. In addition to energy storage and electric vehicles, technologies to capture and store CO_2 emissions from power stations and advanced forms of bioenergy are available or need to be brought at scale.

The development of new clean technologies could have significant benefits in terms of knowledge spillovers to the rest of the economy. New technologies – such as clean energy or electric cars – generate substantially more spillovers than conventional electricity or cars. Such technologies are at an earlier stage of the innovation process and therefore appear to have experienced more radical innovations. There is also evidence that innovation in clean technologies responds positively to increases in the cost of fossil fuels. However, new technological developments will be required in areas such as renewable energy generation, energy storage and electric vehicles.

While there is inadequate investment in low carbon technologies, the emerging 'cleantech' sector could provide substantial scope for innovation-driven economic growth. In the EU, clean tech investment in venture capital has doubled in 2021, thereby closing the gap with the US but bringing it to scale will be difficult and rely on EU policy to accelerate the green transition (Cleantech Europe, 2021).

([60]) The concept of ' stranded assets' was introduced by Climate Tracker Initiative to raise awareness of the risk of not adjusting investment to the emissions trajectories required to limit global warming. An example of stranded asset concerns oil and gas reserves.

Despite these opportunities, current levels of energy R & D remains very low compared to other sectors such as defence, health or space exploration ([61]). Public R & D spending on energy is also minimal compared with the deployment of renewable energy, although the latter can stimulate private innovation and bring down production costs.

c) Reallocation of labour and income distribution

The green transition will profoundly affect Europe's labour markets. For example, more ambitious climate targets alone, delivering a 55 % reduction in greenhouse gas emissions in the EU by 2030, could lead to a *net* increase of up to 884 000 jobs, especially in energy intensive industries and the renewable energy sector (Asikainen et al. 2021). For the energy sector, the IEA (2021) predicts that 14 million jobs will be created by 2030 worldwide due to new activities and investments in clean energy. If we add other investments for more efficient appliances, electric and fuel cell vehicles, and building retrofits and energy-efficient buildings, additional 16 million jobs might be created. As the share of fossil fuels decline, about 5 million jobs might be lost in energy intensive industries.

Studies building upon a standard input-output model to capture the interdependencies of the renewable energy sector in relation to other sectors show positive gross employment effects related to renewable energy sector expansion, ranging between 23 000 and 258 000 additional jobs through 2030 ([62]) (Pestel IZA, 2019).

Overall, these are significant results, considering that entire industries may be left behind. They tend to suggest that the green transition is mainly about managing the transformation across sectors and regions, as employment is redirected towards cleaner production to support Europe's shift towards the net-zero target.

These job opportunities might occur in different locations, sectors and for different skills ([63]) than the jobs that will be destroyed in fossil fuel activities. Regionally, the job impact of the green transition will be unevenly spread: a few regions will be exposed to job losses in fossil fuel-based sectors, like coal mining and manufactured fuels, due to the need to promote alternative fuels in transportation. Other regions will see new jobs in renewable energy and the circular economy.

On the other hand, job losses are located in the proximity of fossil fuel resources and many of these workers get relatively high wages. In Germany, the areas

([61]) IEA (2021), 'RD&D Budget (Edition 2020)', *IEA Energy Technology RD&D Statistics* (database), https://doi.org/10.1787/2144f925-en. According to National Science Foundation, federal R & D spending in defence (around 60 billion USD in 2018) was 30 times larger than in advanced energy and renewables.

([62]) These estimates are based on some key assumptions (e.g. projections of global energy prices and German firms' global market share in the industry).

([63]) Recent work by the IMF (2022b) examined the environmental properties of jobs across a sample of developed economies and found that the average employment-weighted green intensity of occupations ranges from about 2 to 3 percent. In other words, green jobs are concentrated in a small subset of workers (World Ecponomic Outlook 2022, chap.3).

dependent on coal will receive up to € 40 billion in financial aid ([64]) until 2038 (or 2030) for investments facilitating their structural change. The coal exit strategy will affect 20 thousand workers working directly in the lignite industry and if we include the indirect jobs in related industries, the number of jobs affected could rise to 32 thousand. In this case the over-compensation of potential 'losers' is driven by political economy considerations (i.e. the need to offset right wing populism and social discontent) as well as industrial policy (as a test laboratory for industrial transformation) (Suedukum 2021)

It is thus evident that the green transition, which does not affect only the energy system, should take account of the social and economic impacts on individuals and communities and involve people's participation. Structural change can cause shocks for communities with impacts that persist over time. This requires careful attention from policymakers to address the employment losses. It will be vital to minimise the social damage associated with this transformation, by retraining workers, relocation of new clean energy facilities in heavily affected areas and providing regional aid, notably from cohesion and just transition funds.

This process will have as a primary effect a direct increase in energy prices, which has the potential to stifle labour demand in energy-intensive sectors and reduce the purchasing power of private households. This can fuel social unrest and populistic reactions if vulnerable households are not adequately compensated.

5.2.2. International trade

There is growing concern in Europe, particularly among leading countries for the deployment of low carbon technologies that the increase of the use of renewable energy may push energy intensive industries outside in search of lower energy costs. Output and emissions would then rise in the so-called pollution havens, offsetting partly or in full the efforts to reduce global emissions.

Empirical studies suggest that the unilateral implementation of environmental regulation and carbon pricing has limited effects on industrial competitiveness. An OECD paper finds that the European Trading System (ETS) has induced carbon emission reductions in the order of -10 % between 2005 and 2012, but had no negative impact on the economic performance of regulated firms (Dechezleprêtre et al. 2018). This finding suggests that the deterioration of trade balances in energy intensive industries will be offset by higher exports in low carbon intensive sectors. International comparative advantages are determined by different policies and factors such as wages, skills and trade liberalisation. Pollution related expenditure represents only a small part compared to other costs. However, stricter environmental standards may lead to efficiency gains as firms react by introducing innovations to improve their economic performance, which

([64]) This includes top-ups for research and promotional programs, research infrastructure projects, and new federal institutions opening in the areas. Additional expenses for directly affected coalmining workers (e.g. via early retirement schemes) come on top, as well as compensatory payments for households and industry in response to rising electricity prices.

in turn generate positive spillovers for the economy (Porter, Van der Linde, 1995). Albrizio et al (2014) show that tighter environmental policies had little effect on aggregate productivity, spurring primarily short-term adjustments. Nevertheless, they have led to various effects within the economy – the most technologically advanced industries and firms have seen a small increase in productivity, while the least productive firms have seen their productivity fall.

Carbon border taxes are a typical way to address such competitiveness concerns. The EU has proposed a Carbon border Adjustment Mechanism as a levy on emissions tied to imports, which, if fully implemented will contribute to reshape global value chains ([65]). Such levy will impose duties on imported goods to account for the fact they have been produced with looser environmental standards. It aims, therefore, to achieve a more stringent level playing field so that countries cannot gain a competitive advantage by adopting looser standards. Moreover, countries wishing to tighten regulations can do so without adversely affecting their own competitive position. To some extent, this approach reduces the need for close international cooperation. However, such taxes are difficult to calibrate precisely for each imported good (they require detailed knowledge of production processes and the supply chain) and run the risk of being used as a form of protectionism.

The academic literature is in general rather critical on the imposition of a carbon border adjustment mechanism. There are mainly two arguments that are usually mentioned. The first one is the lack of empirical evidence that would justify such unilateral measure on the basis of leakage and relocation effects of carbon intensive production (Böhringer et al 2012). The second argument relate to legal and political challenges to the design of a carbon border mechanism. These are policy choices that need to strike a complex balance on the one hand between efficiency and equity as well as taking into account complexity and political risks (Brueghel 2019). In this regard, the EU has proposed a simplified design of a carbon border mechanism focusing only on carbon intensive and trade exposed sectors while maximising its benefits in the medium term (EC 2021c).

In contrast, the IMF (2021) recommends a global carbon price floor as a better alternative to carbon border adjustments ([66]). However, there are

([65]) When the tax is fully implemented in January 2026, the biggest initial impact will be on the cost of such high-carbon inputs as steel, cement, aluminium, chemicals, and electricity; EU importers and non-EU producers of these inputs will be required to pay an estimated €75 per metric ton of CO_2 emissions. This could increase the cost of materials made by more carbon-intensive producers, such as China, Russia, and India, by 15 % to 30 % overnight. And the effect will increase during subsequent years: the tax rate is projected to approach €100 per metric ton by 2030, and more products will likely fall within its scope at that point of time (EC 2021c)

([66]) The proposal is articulated as follows: 1) Large carbon emitters would need to agree on a minimum carbon price (the proposal lists the U.S., China, the EU, the U.K., Canada, and India as large emitters); 2) A differentiated price floor ($75, $50, $25) would apply to the six jurisdictions based on their development level; 3) Countries would be allowed to use non-pricing policies such as regulations to meet the price floor requirement; 4) The proposal leaves it open whether the global minimum carbon price floor would take the form of a voluntary agreement or an international treaty.

significant challenges to achieving a global carbon price floor as this would entail long, complex negotiations. Domestic carbon taxes coupled with border adjustments would be quicker and more practical in encouraging international decarbonisation.

5.3. TRANSITION RISKS AND MACRO-FINANCIAL STABILITY

In recent years, there has been a growing recognition that climate change may be relevant for financial stability (Coeuré 2018). M. Carney warned against these risks in what he called 'the tragedy of the horizon' (Carney 2015). While the impacts of climate change will be felt over a long time horizon, with massive costs and consequences on future generations, the time horizon in which economic and financial actors operate is much shorter, typically over 3-5 years. In the financial world, these risks are characterised as systemic (ESRB 2016) or 'green swans' alluding to known risks with enormous consequences for businesses, households and the financial sector (BIS 2020).

5.3.1. Climate change as a source of financial risk

Our economies face both physical risks from climate change and transition risks from the shift to a low carbon economy.

Physical risks from climate change affect economies directly**.** Such risks arise from the interaction of climate-related hazards with human and natural systems. The main sources of physical risks are: (a) increase in the frequency, severity, and interdependence of acute climate events; and (b) chronic climate events and changes associated with climatic and geosphere related variables. The risks are likely to intensify in the future, even under the Paris agreement scenario of limiting global warming to well below 2 °C, compared to pre-industrial levels. These events are however difficult to predict 'considering very complex and interconnected atmospheric systems and so not all of these future outcomes are as certain as the observed increase in temperature, melting ice, and sea level rise' (Swiss re (2020).

These physical risks entail significant economic costs. Cumulative losses ([67]) from climate-related events were at least EUR 419 billion (inflation adjusted) between 1980 and 2019 in the EU27 and some projections estimate global losses could range from 4 % to 18 % of GDP depending on the climate scenario. For Europe, this could range from 3 % to 11 % (Swiss Re 2021). In 2019, total economic losses from extreme events amounted to 1 % of GDP in the euro area and without

([67]) Data and evidence is still fragmentary as most EU member States do not have any mechanism in place to collect, assess or report economic losses from weather and climate related extreme events. The OECD has conducted in 2016 a specific survey on natural disasters and there are some developments among international organisations, in particular the World Bank to improve the evidence base on the costs of natural disasters.

action, these costs are expected to rise over time as only a third of climate-related economic losses in the euro area are insured (ECB, 2021). At the same time 'without coverage and accompanying incentives for preventive measures, the costs and protection gap risk are becoming even larger' (EC 2021).

Transition risks arise from the pace of transformation toward a low carbon economy, either from an uncoordinated process of implementation of low carbon pathways, or as a result of their implementation**.** The speed of the transition, especially in high carbon economies, could affect the timing and size of the associated costs. Delays in implementing climate policies may result in the need to have a larger future reduction in emissions, thus increasing economic costs up to $0.5tr per year for a 2 °C stabilisation target (IMF 2021). The decrease in emissions comes with a mitigation cost, and is likely to reduce short-term growth, with implications for both fiscal and monetary policy. Low-carbon investment policies could also pose financial risks to investors that do not adapt their strategies.

Such risks linked to decarbonisation include possible declines in asset prices, income and profits in sectors that rely on high carbon emissions. These risks are more salient for the energy sector, which may face the ending of fossil fuel subsidies or the decommissioning of fossil fuel power plants, but they are also relevant for transport, construction, manufacturing and other sectors (IEA 2021). Businesses that rely on emissions of greenhouse gases may suffer financial losses and stranded assets in a near future. However, decarbonisation can also create new opportunities in other sectors, such as the production of electric vehicles, although those opportunities could also induce financial risks to asset prices from a low carbon investment boom ([68]).

Table 9 / **Climate related risks and transmission channels**

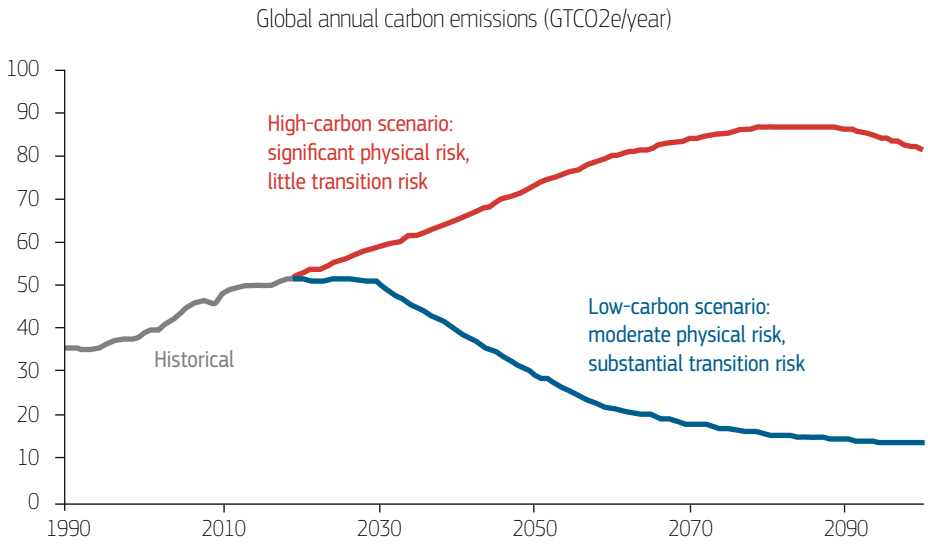
Risk type		Economic outcomes	Horizon
Physical risks	Acute climate events	Unexpected shocks to components of demand and supply	Short to medium term
	Chronic climate events	Impacts of potential productive capacity and economic growth	Medium to long term
Transition risks		Shock to demand and supply, effect on economic growth	Short to medium

Source: IMF (2021)

([68]) R. Engle, Nobel laureate in 2003 and professor of financial economics at the NY Stern university, has carried out recent research to study the impact of climate change on financial risks using modern finance and risk management tools. His research project is to identify optimal hedging portfolios against environmental /climate risks. In his paper, he shows that climate funds are performing well during the pandemic and that the transition risk – as measured by stranded assets portfolios- has been most extreme in 2020 (Engle R. 2019).

This can be conceptualised with a stylised model based on two scenarios: one with a high carbon scenario and the other with a low carbon scenario (Rudenbusch G. (2021)). In the first scenario, physical risks will remain significant while transition risks are marginal. In the second scenario, physical risks are moderate due to adaptation and mitigation measures while transition risks are substantial (Figure18).

Figure 18 / **Physical and transition risks – Global emissions**



Source: G. Rudebusch, FED (2018)

Both physical and transition risks have macroeconomic and financial implications and consequences for price stability (ECB 2021). The losses caused by extreme weather events or stranded assets can cause volatility in output and inflation. There are also long-lasting effects on structures influencing growth and inflation from physical damages, transition policies and innovation.

Estimating the severity and the materiality of climate change risks helps to prevent potential costs for the economy. Climate change can also affect fiscal sustainability: both physical and transition risks potentially trigger contingent liabilities of public resources, and limit the fiscal space. However, national circumstances play a critical role in both the design and implementation of climate policies. Overall, a better knowledge of climate risks and of related policy levers could be of great benefit to governments confronted with developing and implementing mitigation and adaptation strategies.

5.3.2. Challenges for central banks

Central banks traditionally undertake supervision, regulation and oversight of financial institutions along with the implementation of monetary policy.

However, they are confronted to several trade-offs and dilemmas in tackling climate related risks (Brunnermeier, Landau, 2020). This involves a number of strategic choices for adapting monetary policy operational frameworks to climate related risks. These relate to the strategy, risk management, data and mitigation measures (NGFS 2021).

The ability of central banks and supervisors to control climate risks and macroeconomic stability will become more difficult as global temperatures rise and structural change accelerates. In fact, there does not appear to be a consensus among central banks as to whether and how they should incorporate the effects of climate change into their monetary policy frameworks. Some central bankers view the extent to which central banks can use their monetary instruments to tackle climate change as problematic (Honohan 2019). The situation maybe more complex for the European Central Bank (ECB). To the extent that price stability is not compromised and that fighting climate change is a key priority of the EU, the question arises as to whether the ECB can use some of its available instruments to pursue a climate change objective. The secondary mandate of the ECB could serve as a foundation for such efforts: it tasks the ECB to support the 'general economic policies in the Union' ([69]).

The debate revolves around the principle of *market neutrality* that assumes that the market is efficient, and that market prices reflect all relevant and available data. This has been put in question because financial markets do not adequately factor in climate related risks ([70]). This market failure could become a potential issue for price stability in the medium term and therefore requires collective action (Schnabel, 2020, 2021).

The common line is that as far as climate related risks are concerned, 'governments have the principal responsibility for setting the policy response to climate change and have a much broader range of tools and policies on hand to prevent and mitigate it than central banks' (NGFS 2021).

Yet, central banks and financial supervisors around the world have taken steps on a path to assess and manage those risks ([71]) (ECB, 2021) ([72]). Central banks have

([69]) The EU Treaty (art 127 1) states that '... without prejudice to the objective of price stability', the Euro system shall also 'support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union'. These include 'full employment' and 'balanced economic growth'.

([70]) Evidence regarding the capacity of the market to price climate externalities is currently mixed. Some point to the existence of a positive carbon premium whereby investors demand a compensation for holding securities issued by carbon-intensive companies. However, when a premium exists, it seems to only reflect the transition policy risk. See Van der Ploeg, F. (2020). 'Macro-financial implications of climate change and the carbon transition'. ECB.

([71]) One pertinent example is the establishment of the Network for Greening the Financial System (NGFS), which brings together around a hundred of central banks, supervisory agencies and international financial institutions to develop a coordinated response to climate-related risks in the global financial system.

([72]) As part of its strategy review carried out in 2021, the ECB has taken significant steps to integrate climate change in its monetary policy framework. It has put forward a comprehensive action plan – adopted by the Governing Council on 8 July 2021-, which includes a number of activities, in particular macro-modelling, statistical data, disclosures, climate stress tests, a revised collateral framework and most notably corporate sector asset purchase in light of climate risks.

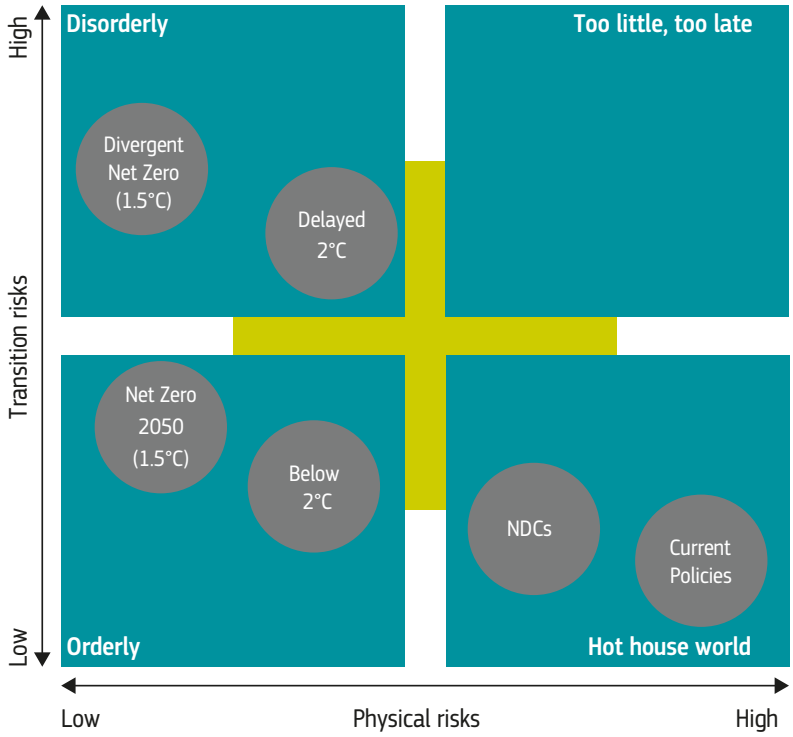
at their disposal a range of tools to support the 'greening' of the financial system. Some are uncontroversial while some others are more innovative. These range from disclosure requirements and the provision of data to the integration of climate related risks into financial supervision and prudential frameworks (climate stress tests). In parallel, there are several EU initiatives and regulatory proposals, including the ESRB action plan (2018), the EU taxonomy for sustainable finance, the disclosures regulation to ensure that the financial system is resilient to climate related risks.

Financial stability is threatened by both physical and transition risks. Around the world, many central banks have acknowledged the importance of accounting for the increasing financial risks from climate change (NGFS 2021). These risks include potential loan losses for banks resulting from the business interruptions and bankruptcies caused by storms, droughts, wildfires, and other extreme events. There are also transition risks associated with the adjustment to a low-carbon economy, such as the unexpected losses in the value of assets or companies that depend on fossil fuels. In this regard, even long-term risks can have near-term consequences as investors reprice assets for a low-carbon future. Furthermore, financial firms with limited carbon emissions may still face substantial climate-based credit risk exposure, for example, through loans to affected businesses or mortgages on coastal real estate. If such exposures were broadly correlated across regions or industries, the resulting climate-based risk could threaten the stability of the financial system as a whole. For the euro area, around 30 % of banking exposures are to firms with high or increasing physical risks. However, two thirds of exposures to those firms are secured by collateral that plays an important role in mitigating losses for banks but may result in damage or loss of value. Furthermore, the bulk of financial risk is concentrated in a few banks that have other vulnerabilities (ECB 2020).

A commonly used tool for calibrating these risks is climate scenario analysis, which explores the consequences for financial institutions from different climate related outcomes. This means that they should incorporate climate risks in their assessment of potential growth and output as well as the natural equilibrium interest rate. Even in the short run, climate change can have an impact if it leads to an increased frequency of extreme weather events. Those events, with supply shocks affecting negatively output and prices, make the role of central banks even harder.

The NGFS (2019) has elaborated several climate scenarios for central banks and financial supervisors (Figure 19). In all possible scenarios, climate change will impact on economic agents and their behaviour. An orderly transition towards a 1.5 °C-2 °C of average global temperature rise requires substantial mitigation measures to reduce physical risk, which will require public, economic and financial agents to invest and adapt.

Figure 19 / **Climate scenarios- NGFS (2022)**



By contrast, a lack of mitigation and adaptation policies would lead to a 'hot house world' scenario, which is expected to result in rapidly soaring costs stemming from soaring physical risk impacts. Alternatively, there could be 'disorderly' transition scenarios – with unanticipated, staggered action – in which a range of physical risks (limited or high) could unfold. Disorderly scenarios increase largely macroeconomic costs of mitigation actions (Bosetti V, 2021).

Under all scenarios, the bottom line is that the economic and financial system in which central banks conduct their monetary policy will very likely change to ensure its coherence with climate objectives. As Hansen (2021) put it, ''monetary policy can support these objectives and promote sound strategies for quantifying longer term impacts of exposure to climate change uncertainty'.

Over the last decade, central banks have significantly expanded their balance sheets, in particular the ECB through its massive purchase of assets in response to the financial crisis and the consequences of the COVID 19 crisis. In this context, the ECB has purchased green bonds under both the Corporate Sector Purchase Programme (CSPP) and the Public Sector Purchase Programme (PSPP). Another possibility would be haircuts to different kinds of collateral used in refinancing operations. Alternatively, central banks could purchase low carbon project bonds issued by public investment or development banks, such as the European Investment Bank (De Grauwe 2019)

In creating those incentives, central banks can encourage the development of long-term finance to sustain the transition to a low carbon economy. Thus, they can contribute to reduce policy uncertainty and help remove barriers to take advantage of low interest rates and favourable financing conditions for long term, risky projects.

5.4. SOME POLICY ISSUES

Policymakers and economists concur that an ambitious and effective climate policy needs a balanced framework. Objectives can only be reached by the simultaneous and well-proportioned deployment of investment, regulation, standards and market mechanisms. The literature provide insights on the type of policy mix using fiscal, financial, monetary and regulatory tools in a complementary way for climate mitigation notably to send price signals and deliver the required public and private investments (Krogstrup, Oman 2019).

Fiscal implications are particularly important for economic policymakers in view of contingent liabilities with potentially high (unknown) fiscal costs (Dunz N, Power S.- World Bank 2021) ([73]). However, given the range of fiscal tools deployed it is difficult to discern the net impact on public finances. The balance between fiscal revenues and taxes depends on the policy design of climate policies in individual countries. For example, carbon taxes give rise to additional revenues that can be redistributed partly or wholly to particular groups affected. However, other policy measures may imply additional government expenditure or the crowding out of other public investment or public expenditure, as well as the coverage of financial losses not covered by private insurance.

Climate investments are likely to push for more government debt to preserve the environment at the expense of sound public finances. In the EU, these investments will be financed through common debt as part of the national recovery plans to get out from the COVID crisis and make future generations better off. These are complex discussions which are currently taking place in European and international fora.

We discuss below four policy issues: carbon pricing, green investment, climate finance; distributional impacts and fairness.

5.4.1. Carbon pricing

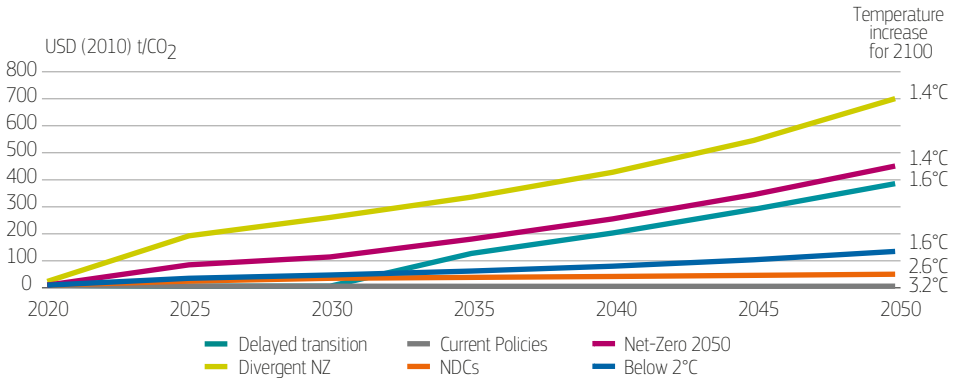
There is broad consensus that carbon pricing is an effective way to reduce carbon emissions. While it allows to set price signals to market actors, to change investment and behavioural patterns, carbon pricing can only have the desired effects in well-functioning markets. This is however far from being the case with carbon markets, in particular for road transport and buildings. Decarbonisation

([73]) The Coalition of Finance Ministers for Climate Action was launched in 2019 to raise awareness on the fiscal consequences of climate change and devise risk management approaches.

in these two sectors was lagging behind the rest of the economy and they need to embark on a more radical path. Both sectors have market 'rigidities' as their emissions do not currently respond to price signals.

Today, carbon pricing instruments cover only 21.5 % of global emissions and only 4 % are covered by a price of more than USD 40 (World Bank 2021). Most economists think the price of carbon should be above USD 75 to reach net zero emissions by 2050, reaching a median level of USD 100 (Stern, Stiglitz 2021). According to the latest NGFS scenarios (NGFS 2022), they could be even higher up to USD 600 for reaching the 1.5° target (see Figure 20).

Figure 20 / **Carbon price development by 2050**



In order to achieve the EU climate targets, the cornerstone of European policy is the establishment of a carbon price via emission trading schemes. Set up in 2005, the EU- Emissions Trading System (ETS) involves a 'cap and trade' system of tradable permits to release CO_2 applicable to large emitters. It is the largest carbon market in the world: it covers more than 11 000 heavy energy-using installations and airlines, accounting for around 40 percent of the EU's greenhouse gas emissions.

In the EU, carbon prices under the ETS have rapidly soared to reach these levels ([74]). A persistent rise in carbon prices will help accelerate the green transition as it would provide strong disincentives for new investments in fossil fuel activities. This reflects partly expectations about new EU policy commitments to deliver the green transition. The 'Fit for 55' policy package aims to strengthen the current ETS and extend its scope to other sectors (such as shipping) ([75]) and to review the Energy taxation Directive with the aim of raising the minimum tax rate for inefficient and polluting fuels, and lowering those for efficient and clean fuels (EC 2021).

([74]) In early December, ETS prices reached a peak of nearly €90 per tonne of carbon, almost three times as high as at the beginning of 2021, and a multiple of their level a few years ago.
([75]) A separate ETS system will be created for buildings and road transport.

Carbon pricing mechanisms such as cap and trade systems or carbon taxes can bring potential benefits. The most obvious one is that they allow for internalising negative environmental externalities of CO_2 emissions as reflected in the social cost of carbon. As such, they clearly offer scope for increasing revenues for individual member States and the European Union. The ETS provides the revenues for financing innovative low carbon technologies from the auctioning of 450 million allowances from 2020 to 2030 as well other unspent funds. Moreover, if the ETS revenues were to become an own resource for the EU budget, they could bring additional funding to it in the order of € 10 bn a year depending on the carbon price. ETS revenues could also fund the Social Climate Fund with € 72 bn (EC 2021).

An alternative way of shifting the costs of climate change onto polluters is through carbon taxes. While this may appear as economically efficient, raising carbon prices through taxation can be vulnerable to political or social pressures. Examples of instability in government climate policies affecting carbon pricing and subsidies, as in the case of the 'Yellow vests' in France, point to the credibility of new initiatives.

Finally, green tax revenues may be 'recycled' for other purposes- such as to support energy efficiency, especially for poor households- in order to make carbon taxes more politically acceptable. There may also be the need to provide subsidies for the deployment of renewable energy and climate adaptation measures through either taxation or levies. In most cases the cost of decarbonising power generation will fall onto energy users.

As an illustration, the extension of the current ETS system implies that some significant costs are passed on to consumers. A study by Cambridge Econometrics (2020) found that the Commission's plans would increase the cost of gas-fuelled heating by 30 %, and fossil-fuelled driving by 16 %. In countries like Poland, with relatively high emissions and more vulnerable households, this effect would be even worse.

Hence, carbon pricing alone may not provide a sufficient incentive for the necessary investments in low carbon forms of energy such as renewables. It has to be complemented with well-targeted investment schemes and combined to other measures to tackle its unequal consequences.

5.4.2. The case for green investment

Green recovery has received much attention both in academic and policy circles. Yet there is still a lack of clarity of what is green and what is not. The global estimates provided by different organisations and databases, climate trackers, point to a range between 12 and 18 % of COVID related expenditure characterised as green. The term green recovery has a strong focus on policy measures to combat climate change but also encompasses other relevant environmental issues, like biodiversity loss

The various green recovery trackers suggest that indeed the existing COVID-19 recovery programmes rely mainly on (investment) spending, while tax incentives

and regulatory measures appear to play a minor role. Only recovery measures of a structural nature are considered (Table 10, Figure 21) ([76]).

The European Recovery Programme – the so-called ' Next Generation EU – through its main investment vehicle, the Recovery and Resilience Facility, is quite large in macroeconomic terms with a maximum volume of financing of €750 billion (in 2018 prices) or 5.4 % of EU GDP in 2019. Its composition is made up of €390 billion in the form of grants and the rest in the form of loans for the period 2021–2026. Its investment budget is set to allocate at least 37 % of its spending to climate and environmental objectives ([77]). On the basis of the agreed national plans, this share accounts for around 40 % of total spending (EUR 176 bn) ranging between 37,5 % in Greece and Italy to 61 % in Luxemburg.

Table 10 / **Green spending in proportion of total recovery related measures**

	Scope	Green spending (in bn $, €)	Share % total recovery spending	Types of measures	Funding instruments
Oxford-UNEP Global recovery Observatory (November 2021)	50 leading economies	USD 760	22 %	Green transport, low carbon energy, natural capital (e.g. reforestation), green building upgrades, and green R & D	Recovery measures
OECD Green Recovery Database (2021)	43 countries- OECD+ most G-20 countries	USD 339	21 %	A set of 1380 measures with clear positive, negative or mixed environmental impacts	Grants/ loans Tax reductions, other subsidies Regulatory costs
Greeness of Stimulus Index (Vivid Economics)	G-20+ ten other countries	USD 1,39 tr	12 %	Most climate and energy measures	
European Commission (2021)	EU 27 countries	EUR 269	40 % on average Ra	37,5 % (Italy) 61 % (Luxemburg)	Grants/loans Financed through common debt issued and repayments differed to 2038 until 2050

Sources: OECD, Oxford-UNEP, European Commission

([76]) For a presentation of the conceptual and methodological issues on green recovery investments and their likely effects, see: Köppl, Schratzenstaller (2021).

([77]) A clear definition is provided by the Recovery and Resilience Facility Regulation (RRF; *European Commission*, 2021a), which states that '... a contribution to the green transition should be supported by reforms and investments in green technologies and capacities, including in biodiversity, energy efficiency, building renovation and the circular economy, while contributing to the Union's climate targets, fostering sustainable growth, creating jobs and preserving energy security'.

Simulations carried out with the Quest model show that with the NGEU policy package, under the assumption of a fast spending scenario between 2021 and 2024 ([78]), the level of real GDP in the EU-27 could be around 1.5 % higher than without NGEU investments (in 2024). The impact on GDP could be one third smaller without positive spillovers from trade. Small open economies benefit proportionately more from these spillover effects than larger ones (Pfeiffer, Varga, In'tVeld 2021).

The case for green recovery packages is often based on the hypothesis that green investment measures have a higher employment impact and multiplier effect than conventional ones. This might be the case for renewable energy investments, investments in energy efficiency, investment for improving the building stock or sustainable transport). IMF (WEO 2020) finds that a policy mix of carbon taxes and green investment stimulus could increase the level of global GDP in the next 15 years by about 0.7 pp and create around 12 million new jobs through 2027.

Past experience, however, does not provide clear-cut evidence on the employment impacts. For the US, Popp et al. (2020) found that the 2008 American Recovery and Reinvestment Act (ARRA) had a large positive effect on employment: on aggregate, each $1 million of green investment created 15 new jobs during the post-ARRA period (2013-2017). However, there is no evidence of significant short-term gains. Popp et al (2020) conclude that 'rather than boosting overall economic activity in the short-run, green ARRA investments were more successful at reshaping the economy towards green sectors by increasing the local demand for green skills'. Further estimates based on 140 countries show that the direct employment impact of public investment is on aggregate 7 million jobs worldwide for 1 % GDP of public investment. This represents a ratio for USD 1 million, 3 – 7 jobs in advanced economies, 10-17 in emerging market economies and 16-30 in developing economies. The largest jobs multipliers are in green sectors such as renewable energy and water sanitation (IMF 2020).

These results have direct implications for economic policymaking. Green stimulus measures, like those promoted by the European Recovery Plan (NGEU) may be particularly effective in shaping the transformation of the economy and directing it on a green path during the post pandemic recovery. Furthermore, these measures may have stronger environmental benefits if complemented with carbon pricing policies, such as cap and trade or carbon taxes to incentivize green investments (Agrawal et al. (2020)).

Furthermore, investments in renewables and energy efficiency that would form part of any plan to get off Russian gas will also have a cost, which the European Commission estimates at €195bn (EC 2022). Any attempt to accelerate the green transition, in particular its renewable energy targets and at the same time diversify gas supplies for the most reliant member States, will have implications for the EU budget.

([78]) The simulations assume that MS use 100 % of EU grants for additional public investment, while it is assumed that EU loans are 50 % additional.

In order to finance these additional costs, the Commission's plan proposes to reallocate unused funds from NGEU and to raise new funds, through its takings from carbon pricing revenue. An alternative avenue – albeit politically difficult and therefore least viable option, would be another common debt scheme, but for energy infrastructure.

5.4.3. Scaling up green finance

Green finance is developing at rapid pace although its instruments and legislation are subject to constant developments. Different institutional and regulatory initiatives have been launched to push the finance sector towards an active role in the transformation process (e.g. Task Force on Disclosures, NGFS, etc.) ([79]). The EU has developed a taxonomy ([80]) on sustainable finance and a broad regime of ESG (Environmental, Social, and Governance) activities to help scale up sustainable investment and implement the European green deal.

A central question for economic development is why capital flows do not flow enough from rich to poor countries. R. Lucas (1990) raised a long time ago the paradox that is also relevant for the green transition. One explanation is the inadequacy of international finance that is reflected in the misalignment of global capital flows between regions and sectors that are relevant to climate transition investments. This leads to a paradox: trillions of dollars in savings in high-income economies earn a negative real interest rate, while climate investments in developing economies are not being financed (Green Climate Fund 2021). Developing countries also stress the importance of the predictability of funding, whose flows and volumes should not have to be dependent on variable or volatile factors.

A key pillar of the Paris Agreement ([81]) is the pledge by developed countries to jointly mobilize US$100 billion per year to address the needs of developing countries. Yet, this pledge has not been met in 2020: OECD (2021) estimated that only $79.6 billion of climate finance was mobilised in 2019. By comparison, in 2020 alone, G20 and emerging economies spent over USD 345 billion subsidising fossil-fuel use according to OECD-IEA estimates (Parry et al 2020).

Boosting international climate finance is essential to coordinated and effective global climate action, especially in times when most developing countries are devastated by the COVID-19 pandemic (Stern 2020). Some estimates project that the low-carbon infrastructure investment gap in developing countries could

([79]) For a brief overview of the evolution of the green finance agenda see, e.g., *Kletzan-Slamanig – Köppl* (2021).

([80]) The so-called Taxonomy regulation provides a classification of environmentally sustainable activities. See 'Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088,

([81]) Finance's role in climate policy is emphasized in Article 2 of the Paris Agreement, which calls for 'making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development'. The Paris Agreement (Art. 7) also stipulates that the provision of scaled up resources should aim at achieving a balance between climate mitigation and adaptation.

reach $15-30 trillion by 2040 (Green Climate Fund 2020). According to data from the World Bank (2019), the world will need to make significant investment in infrastructure over the next 15 years –around US$90 trillion by 2030. For the energy sector only, an annual investment of $2.4 trillion is needed in the energy system alone until 2035 to limit temperature rise to below 1.5 °C from pre-industrial levels (IEA 2021). However, these efforts go beyond transforming energy systems: it includes spending on reforestation, coastal-defence systems and many other efforts to cut emissions and adapt to rising temperatures. Spending on adaptation efforts is also particularly low.

Financing the large upfront investments can be challenging in many aspects. After COP 26, developed countries must deliver on the commitment to mobilize $100 billion in climate finance a year in 2021 and build on that to expand international public climate finance prior to 2025 when the next target will be set. To deliver these commitments, multilateral development banks (MDBs) have a key role to play to enhance climate action in developing countries and for mobilizing and leveraging climate finance at appropriate scale. There is also scope and need for mobilizing private finance at scale through better public-private partnerships by mitigating risks and creating attractive assets for long-term institutional investors (Stern 2021). An important issue is also the use of Special Drawing Rights (SDRs) for purposes of supporting developing countries for sustainable development activities.

Aligning the financial system with climate objectives is also the primary goal of The Network of Central Banks and Supervisors for Greening the Financial System (NGFS), the Coalition of Finance Ministers on Climate Action, and COP26 Private Finance Agenda.

5.4.4. Distributional impacts – a fair transition

Distributional issues are critical to address climate change and the consequences of climate policies as decarbonisation costs are not equally distributed across society. While climate change mitigation requires global action, distributional impacts of carbon policies are country specific, i.e. the initial socioeconomic conditions in the country. These impacts are also dependent on sectors concerned, policy design and tools deployed. In other words, individual climate policy measures can have very different distributional effects.

Understanding the distributional impacts of climate policies is crucial to design economically efficient climate mitigation policies that are socially acceptable and avoid adverse impacts on the poor. Several studies have shown that carbon taxation could result in regressive distributional impacts for households (Ohlendorf et al., 2018). Zachmann et al (2018) found that 'key climate policy tools such as carbon taxes for different fuels, certain mandatory standards, subsidies and regulatory tools, can be regressive. For other climate policies, such as trade policies, public investment and agriculture policies, the effects are less clear. Fuel taxes on aviation demonstrate that climate policies can also be progressive' Känzig (2022) explores the unequal consequences of a tight carbon pricing regime

as a policy shock. His conclusion is rather unambiguous: 'a tighter carbon pricing regime leads to a significant increase in energy prices, a persistent fall in emissions and an uptick in green innovation. This comes at the cost of a temporary fall in economic activity, which is not borne equally across society: poorer households lower their consumption significantly while richer households are less affected. Not only are the poor more exposed because of their higher energy share, they also experience a larger fall in their income'.

While climate policies can have distributional effects, government intervention is justified on equity grounds. Non-action would make everybody worse off and would affect disproportionately the poor households. There is hence no trade-off between climate and equity. The question is how to design climate policies to minimise any adverse distributional effects.

Carbon taxes have the advantage that they can be recycled and used to compensate vulnerable households, for example for higher energy prices. On the other hand, regulation based policies, for example, energy efficiency standards can be more regressive if compared with energy taxes on a revenue equivalent base (Levinson 2016).

To tackle inequality and improve the political acceptability of decarbonisation, these distributive effects need to be addressed. If this were not to happen, there is a real possibility that decarbonisation policies will face a political backlash. The idea of a just transition increasingly features in policy and political discourse and appeals to the need that efforts to steer society towards a low carbon future are underpinned by issues of equity and justice. Beyond the pledge to 'leave no one behind', the EU has introduced among other measures two financial mechanisms – The Just Transition mechanism and the Social Climate Fund – intended to mitigate the impact of the transition to a net zero economy on the most affected regions, individuals and businesses.

Moreover, this transition should be compatible with the pursuit of 'climate justice' to current and future generations exposed to the social and ecological disruptions caused by increasing concentrations of GHG (Newell, Mahoney, 2013).

CONCLUSIONS

To limit global warming below 2 °C, climate change mitigation requires a deep and rapid transformation in the structure of economic activity on a massive scale. This requires far reaching changes in production structures, in industrial and infrastructure systems on which economic activity relies. In this process of structural change, technological change and innovation will play a key role in shaping new economic activities, jobs and skills while other economic activities will retire gradually making jobs and skills in fossil fuel activities redundant. The transition will require changes in relative prices of energy as well as increased investments in green infrastructure, productive capacity and R & D.

On their own, markets cannot adequately address the challenge of climate change mitigation. Market failures are at the root of climate change and prevent an appropriate market response. Government failures amplify this problem. Some market failures can prevent sufficient long-term private investment even if public investments were sufficient and relative energy prices appropriate.

There is a strong consensus among the scientific community and various international organisations that the transition costs are relatively modest compared with the longer-term impacts and damages from climate change. The transition involves some macroeconomic shocks of different nature. It implies a negative supply shock that affects durably output and relative prices as the productive potential might be affected by climate change impacts, e.g. extreme weather events. High uncertainty also lead to demand shocks that affect the level of savings and consumption. Both supply and demand shocks entail short-term adjustment costs. Macroeconomic models point from moderate GDP losses by 2030 to slightly positive effects resulting from higher investment and consumption if carbon revenues are recycled in favour of households.

The green transition will require sustained investments for a longer period and at a higher level in low carbon technologies. Most estimates converge to a level of investment representing an additional 2 % of GDP annually to meet climate targets by 2030. This shock might be significant in net terms – as part of the capital stock will be stranded over time due to retirement of fossil fuel activities. But it is a largely positive one, especially if the economic returns of these investments in terms of productivity, employment and environmental co benefits are taken into account.

Technological change and innovation led to a rapid decline of prices of renewables and an increase of their share in total energy demand. But new clean technologies still need to be developed and brought to scale. There is significant scope for innovation in coming years with large benefits in terms of knowledge spillovers for the economy. However, this requires public investments in energy R & D which are now quite low as well as appropriate financial instruments such as venture capital.

The green transition will lead to a significant reallocation of labour and capital across sectors and geographical places. As capital will be reallocated, employment will also be redirected towards ‘ clean’ industries while it will decrease in ‘brown’ industries. Positive net effects might be expected, particularly with the expansion of renewable energy infrastructure. The coal exit strategy in Germany shows how political economy considerations as well as industrial policy arguments may prevail in this case.

There are also implications in terms of international trade that affect the industrial structure and competitiveness. Some studies show that tighter environmental legislation do not affect the economic performance of firms and may lead to increased efficiency gains as firms tend to innovate with wider spillovers for the rest of the economy. In this respect, the EU carbon border adjustment mechanism

is a way of addressing these concerns by creating a 'level playing field' at the international level.

Physical and transition risks have macroeconomic and financial implications and consequences for price stability. Extreme weather events can lead to higher volatility in output and inflation. There are also long lasting effects on structures influencing growth and inflation from physical damages, transition policies and innovation. Central banks and supervisors have a role to play with several policy options including better reflecting climate risks in supervision, prudential frameworks and portfolios of large scale asset purchase programmes.

Policy makers have at their disposal a broad range of macroeconomic and financial policy instruments that should be part of the policy effort toward climate mitigation and adaptation. Fiscal policy tools have been mostly used, with the main options revolving around carbon pricing, green spending and investment, public guarantees as well as compensatory measures in the form of reduced labour taxes and subsidies.

There are still early discussions on the net fiscal impact of those measures if they are pursued complementarily. Fiscal measures also give rise to trade-offs and political economy considerations in terms of inter-temporal choices, i.e. spending and investment now at the cost of higher debt and deficit with increased benefits for growth and inter-generational welfare.

Most institutions have regarded carbon pricing as the most cost effective tool to reduce emissions and provide incentives for clean investments. However, it will not suffice alone to achieve the climate targets. Moreover, its implementation is not exempt of risks and negative consequences, especially for the most affected groups. EU proposals point to that direction by extending the scope of the European Trading System but at the same time putting in place compensatory measures (e.g. Social Climate Fund).

After a significant drop in past years, public investments are turning central as an engine of growth to overcome the severity of the shock caused by the pandemic and help ensure a swift recovery of the most affected economies. In most recovery programmes, green investments represent between 20-40 % (in the case of Next Generation EU). Albeit there is no clear-cut evidence yet, there is a strong consensus among policymakers that they can generate a higher employment impact and multipliers to the rest of the economy. However, these investments are most effective if they are coupled with other policy measures such as carbon pricing or regulation (e.g. energy efficiency standards), in which case they could contribute to further the green transition.

Green investments will have to be financed both from public and private sources. Climate finance requires a collective and coordinated action at the global level to ensure COP26 pledges for developing countries are realised on the required scale with predictability and sound policies. Financing these, large upfront investments also require public and private partnerships, the

participation of multi-lateral development banks as well as the mobilization of other international financial instruments.

Finally, the green transition will have significant distributional impacts that should be addressed to avoid any adverse social consequences. These concerns should be part of the policy design of climate policies with options including different redistributive measures, e.g. lump sums, transfers, subsidies, reduced labour taxes.

There is no alternative to a green transition to low carbon economy although it will entail hard choices as well as risks and uncertainties along the different pathways to a low carbon economy. If the transition is felt as socially unjust, it may not be accepted by large parts of the population and ultimately fail. In times of high uncertainty, governments will need to push the green transition forward while at the same time protecting the most vulnerable groups. Placed based approaches should be privileged by supporting skills, training, places and relocation whenever necessary. Policy credibility matters above all, but also political economy and ethical considerations should also prevail in 'green' macroeconomic and financial policies.

6. PUBLIC SPENDING AND GOVERNMENT PERFORMANCE IN EUROPE AND ASIA: TIGERS TODAY AND IN THE FUTURE

Ludger Schuknecht ([82])

INTRODUCTION

In this study, I look at the spending role of government and the outcomes of government activity for total spending and a number of expenditure categories. The study compares country groups from advanced and emerging countries, notably in Europe and in Asia. By applying descriptive statistical analysis, the study derives some interesting patterns of spending and performance across countries and country groups.

The analysis of public expenditure and related outcomes is important from several angles. First, public spending on the core tasks of government is an essential ingredient for economic progress, development and convergence. Second, the responsible use of public money is important for the legitimacy of and trust in government. Third, good government services not only raise prosperity but also benefit equal economic and social opportunity as it is the poor who benefit the most from good government. Fourth, public spending is a key ingredient to debt sustainability and macroeconomic stability, which, in turn, ensures an adequate balancing of the interests of today and tomorrow and the mastering of population aging and climate-related transformation. Fifth, and finally, public spending through its impact on all these factors determines the relative economic and political weight of countries and regions and their peaceful cooperation in the world.

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The literature on the role of public expenditure from an international perspective is relatively limited, in particular when it comes to the catching up process of emerging economies in Asia and Europe. For a comprehensive discussion of many expenditure-related aspects, see Schuknecht (2020). Afonso et al. (2005 and 2007) discuss the performance and efficiency of government for advanced countries and emerging economies. They find very diverse performance in Eastern Europe also compared to Asia, and strong institutions help reduce spending inefficiency. Buti and Székely (2021) report on income convergence between the former Asian 'tigers' and the EU and the divergence within EU, making reference to different degrees of spending efficiency. Miyakoshi et. Al (2014) examine the role of public expenditure in developing countries and emphasise the importance of high-quality productive spending. Jafar (2009) discusses the role of public expenditure for human development in Asia as regards health and finds that low public spending can go together with high development. Rao (1998) stresses the importance of macroeconomic stability, cost-effective spending, private sector involvement and human resource development for the success of fast-growing Asia. Mura (2014) argues that education and infrastructure spending were most important for the rapid growth in Eastern Europe post 1990.

The analysis in this study provides comparative patterns rather than a full-fledged econometric analysis. It finds a tendency towards higher (non interest) public spending over the past 20 years in many countries, notably on social spending. Asian countries tend to feature much smaller governments than EU Member States. Smaller government countries do not spend less (and sometimes even more) on productive categories than their bigger government peers while they spend far less on social protection.

Government performance on core government activities (rule of law, education, infrastructure, income distribution, debt, prosperity) differs hugely across countries. While advanced countries overall do well, a number of big government European countries have shown rising spending and weakening performance. A number of Asian and Central European countries–the 'tigers' of the past two decades– feature relatively low spending and strong and improving performance. Other emerging economies in Europe and Asia also report much progress. Further improvements could put them on the path to being the next generation of 'tigers'.

6.1. PUBLIC EXPENDITURE PATTERNS IN EUROPE AND ASIA

6.1.1. Total expenditure

Public expenditure should aim to achieve the core roles of government: good framework conditions for the economy, high-quality public goods and services, notably education and infrastructure, and a stable and prosperous economy with reasonable social protection.

The understanding of the role of government, however, has evolved significantly over the past 150 years. It is, therefore, worth starting the discussion of public expenditure with a brief historical flashback. Public spending in the late 19th century was not much more than one tenth of GDP on average in today's advanced economies (Schuknecht, 2020). Governments spent little and what they spent was largely on public administration, the military, debt service and infrastructure. Spending on other public goods such as education and social spending, which are very important by today's standards, were minimal. In the following decades, public spending increased hugely as modern administrations were built, basic social safety nets were created and public education and infrastructure expanded. Consequently, by 1960, total public spending averaged almost 30 % of GDP in today's advanced countries.

In the following decades, public spending increased significantly further. First and until about 1980, this happened in all advanced countries ([83]). Thereafter, spending increased very gradually further across countries with some interruptions and a number of countries breaking the trend. By the end of the millennium, public spending in the 38 advanced countries as defined by the IMF, public spending averaged 38.8 % of GDP (Table 1). This ratio was almost unchanged in 2019 at 38.6 % of GDP. However, when abstracting from falling interest payments on public debt, so-called primary (or non-interest) spending had increased further by roughly 2 % of GDP over the first 2 decades of the 21st century.

In emerging economies, the size of the state has been considerably smaller over recent decades ([84]). In 2019, it was about 7 % of GDP lower on average than in advanced countries ([85]). Or in other words, the average for emerging economies in 2019 was not far from the average for advanced countries in about 1960. For the past two decades, the pattern is similar to that of advanced countries: total spending changed little while non-interest spending had increased.

When looking at countries and country groups beyond this very general categorization, there are huge differences both in terms of levels and dynamics of public expenditure. Advanced countries featured public spending between about 14 % of GDP in Singapore and 55 % of GDP in France in 2019. Emerging economies' public spending ratios ranged from 15 % in Bangladesh to 47 % of GDP in Croatia.

The highest expenditure ratios were reported by South-Western and Centre-Northern European countries with an average of about 48 % of GDP. These are

([83]) This excludes the advanced economies of Asia outside Japan as for these, little historical data is available.

([84]) Emerging economies by the definition of this paper includes all Central Eastern European countries. This differs slightly from the IMF definition. Comparable and reliable historical data beyond a few decades back is not available for this country group.

([85]) Comparing the size of government on the basis of public spending, however, is not without perils. In some emerging countries with low public spending, the parastatal sector played a significant role so that public spending understates the role of government. In some advanced countries, like the Nordics, government social benefits are taxed, so that spending ratios overstate the role of government relative to others. Nevertheless, the overall patterns remain relevant.

all EU Member States. For South-Western Europe this reflects a notable increase in total spending and a substantial increase in primary spending as compared to 1999. Centre-Northern Europe featured a decline in total spending and broadly stable primary spending. Sweden and Denmark reported strong declines in public expenditure ratios.

Other advanced economies which include mainly Anglo-Saxon countries, and Asian advanced economies showed much smaller public sectors, averaging 35.1 % and 22.4 % of GDP respectively. In both groups, total spending had not changed much after 1999. Amongst the Asian advanced countries, Japan is the biggest spender, although it is still below the advanced country average. The 'classic' Asian tigers and newly advanced economies of South Korea, Hong Kong-China, Taiwan-China and Singapore reported very low public spending ratios around 20 % of GDP.

Amongst emerging economies, the former planned economies of Central Eastern and South-Eastern Europe report average expenditure ratios around 40 % of GDP. This is almost 10 % of GDP below the average of their European Union peers. None of these countries except Serbia reported an increase over the past two decades while several of them shrank the size of the state beyond what had been achieved in the 1990s. This includes the Baltics, Slovakia, Croatia and Slovenia.

Emerging economies in Asia feature similar public spending ratios as advanced Asia but much lower spending than European peers. The average of somewhat above 20 % of GDP reflects a range from 15 % to 34 % of GDP. There is no major difference between South and East–South-East Asia. The spending ratio increased most significantly in China where it more than doubled over the past two decades, largely on account of a huge public investment boom (see below). Vietnam, Bangladesh and Pakistan also saw increases over this period while spending relative to GDP declined strongly in Thailand.

The COVID-19 pandemic resulted in a major increase in public expenditure ratios across all countries and country groups in 2020. Advanced countries reported the strongest increases by 6.5 % of GDP on average in 2019-20 (Table 1). France and Italy show the highest ratios of around 60 % of GDP for 2020. The increase of 4.2 % in emerging countries was more modest due to the smaller increase in Asia's emerging economies. Spending ratios are forecast to have fallen slightly on average in 2021.

In conclusion, advanced countries outside Asia feature significantly larger public sectors than their Asian peers. European emerging economies also report bigger governments than emerging Asia. The past 20 years saw upward dynamics in public spending in many countries, notably in South-Western Europe and in some emerging economies, notably China. With the COVID-19 pandemic, public spending increased strongly everywhere and most strongly in Europe. It is too early to say how much of this increase is permanent, but there are risks that lower growth paths and certain programs may have a more durable effect.

Table 11 / **General government, total expenditure (% of GDP)**

	I 1999	II 2019	III Change 1999-2019	IV 2020	V 2021
Advanced (all simple average)	38,8	38,6	-0,2	45,3	43,8
Emerging Europe and Asia	30,7	31,6	1,0	35,8	35,6
Advanced EU SouthWest (FRA, ITA, ESP, PRT, BEL, GRC)	46,8	48,1	1,3	56,1	55,0
Belgium	50,5	52,1	1,6	60,0	57,3
France	52,6	55,4	2,7	61,8	60,7
Italy	47,2	48,6	1,4	57,3	57,7
Portugal	42,5	42,4	-0,1	49,0	48,8
Spain	41,0	42,1	1,1	52,3	50,7
Advanced EU CenterNorth (DEU, NDL, AUT, DNK, SWE, FLD)	50,1	47,6	-2,6	52,7	53,1
Austria	50,3	48,6	-1,7	57,4	54,2
Denmark	54,5	49,5	-5,0	53,8	53,6
Finland	49,9	53,3	3,4	57,0	56,8
Germany	48,2	45,0	-3,2	50,8	53,2
Netherlands	42,6	41,1	-1,5	45,4	48,2
Sweden	55,2	48,0	-7,2	51,8	52,6
Other advanced	35,1	35,1	0,0	42,7	40,2
Australia	36,3	38,9	2,6	44,8	42,8
Canada	41,8	41,0	-0,8	52,8	48,1
Ireland	32,5	24,4	-8,1	27,7	25,2
Switzerland	33,2	31,5	-1,7	36,5	35,2
United Kingdom	34,0	38,9	4,8	49,1	47,7
United States	32,8	35,8	3,0	45,4	42,0
Advanced Asia	21,6	22,4	0,8	28,9	25,9
Hong Kong, China	17,1	21,0	3,9	29,8	24,8
Japan	35,6	37,3	1,7	45,0	43,5
Republic of Korea	16,7	22,6	5,8	25,2	26,5
Singapore	15,9	14,1	-1,8	26,5	19,2
Taiwan, China	22,8	17,3	-5,5	18,3	15,4
Central Eastern Europe (POL, CZE, SLK, LIT, LTV, EST)	41,8	39,5	-2,4	45,7	45,9
Czech Republic	41,2	41,1	-0,1	47,1	47,6
Estonia	40,7	39,5	-1,2	45,6	44,2
Latvia	39,3	37,9	-1,4	42,5	47,1
Lithuania	39,5	33,8	-5,6	42,7	41,7
Poland	42,5	41,8	-0,7	48,7	45,2
Slovakia	48,0	42,7	-5,3	47,8	49,9

	I 1999	II 2019	III Change 1999-2019	IV 2020	V 2021
South Eastern Europe	40,2	40,4	0,2	46,5	46,1
Bulgaria	36,2	36,0	-0,1	38,4	40,4
Croatia	51,3	47,2	-4,2	55,4	55,2
Romania	35,1	33,5	-1,6	38,6	37,0
Serbia	31,3	42,1	10,7	48,6	47,9
Slovenia	47,0	43,3	-3,7	51,3	49,6
Emerging East and South East Asia	19,8	23,4	3,6	25,7	25,5
China	15,0	34,1	19,1	36,5	33,3
Indonesia	15,1	16,4	1,2	18,2	18,5
Malaysia	24,6	23,5	-1,1	25,4	26,0
Philippines	20,7	21,7	0,9	26,4	27,7
Thailand	26,5	21,8	-4,7	25,3	27,2
Viet Nam	16,7	23,0	6,3	22,4	20,4
Emerging South Asia	18,3	21,2	3,0	22,9	22,0
Bangladesh	10,0	15,4	5,4	15,3	16,1
India	25,4	27,1	1,6	31,1	30,4
Sri Lanka	21,2	20,6	-0,6	21,9	20,0
Pakistan	16,5	21,9	5,4	23,2	21,6

Sources: IMF WEO Oct 2021 (WEOGGX_NGDP).

6.1.2. Education expenditure

Education is considered one of the most important drivers of economic prosperity and of equality of opportunity. The public sector is to provide financial support to ensure that there is adequate investment in skills and education at the societal level so as to reap the social and economic dividends of good education systems.

The share of public spending on education is surprisingly modest, given its importance, while differences across country groups are much smaller than for total spending. The average education spending ratio stood at 4.7 % in 2019 in advanced countries compared to 3.9 % in emerging economies (Table 2). This reflects about 12 % of public spending and a moderate decline by ½ % of GDP in both country groups, compared to 1999.

There are important but not huge differences across countries and groups, with the exception of emerging South Asia. Amongst advanced countries, the Centre-Northern EU countries have the highest spending ratios at 5.5 % of GDP. Belgium, the Nordics and the US feature the highest country-specific spending ratios. Advanced Asia reports an average of 3.5 % of GDP. Korea comes close

to the advanced country average. Note, however, that the share of education in Asian total spending is much higher than in advanced non-Asian countries and reaches up to 20 %. Moreover, the more important question is how this spending translates into competencies and performance. This will be discussed for a number of spending and performance categories in the next section.

Amongst emerging economies, Central Eastern Europe reports average spending above the advanced country average. Estonia and Latvia are amongst the top spenders overall. East–South-East Asia reports somewhat lower spending of 4.3 % of GDP. The emerging economies of South-Eastern Europe show the same average expenditure ratios as their Asian advanced peers.

The only country group that features public education spending far below the average is emerging South Asia. At 2.4 % of GDP, this ratio is only at half the advanced economy average and at 60 % of the emerging country figure mentioned above. Bangladesh, Sri Lanka and Pakistan spend least on public education.

In conclusion, public spending on education absorbs about 3.5-5 % of GDP in most countries, which is about 12 % of total spending on average and up to 20 % for some countries. Differences across countries are significant but much smaller than for total spending. Some advanced countries stand out as high spenders, while emerging South Asia reports the lowest spending ratios. There are no figures for the effect of the pandemic period yet but additional spending on (digital) education was reportedly quite limited–most new spending went into the support of companies and jobs (IMF, 2020).

Table 12 / **Public spending on education (% of GDP)**

	2009	2019	Change 2009-2019
Advanced (all simple average)	5,2	4,7	-0,5
Emerging Europe and Asia	4,4	3,9	-0,4
Advanced EU SouthWest (FRA, ITA, ESP, PRT, BEL, GRC)	5,5	4,8	-0,7
Belgium	6,1	6,2	0,1
France	5,7	5,3	-0,4
Italy	4,5	3,9	-0,6
Portugal	6,5	4,4	-2,1
Spain	4,6	4,0	-0,7
Advanced EU CenterNorth (DEU, NDL, AUT, DNK, SWE, FLD)	5,9	5,5	-0,4
Austria	5,1	4,8	-0,3
Denmark	6,9	6,3	-0,6
Finland	6,5	5,6	-0,9
Germany	4,3	4,3	0,0
Netherlands	5,6	5,0	-0,6
Sweden	6,7	6,9	0,2

	2009	2019	Change 2009-2019
Other advanced	5,5	4,9	-0,6
Australia	5,4	5,5	0,1
Canada	4,9	4,8	-0,1
Ireland	4,7	3,1	-1,6
Switzerland	4,8	4,9	0,1
United Kingdom	6,2	4,9	-1,4
United States	6,7	6,0	-0,8
Advanced Asia	3,6	3,5	-0,1
Hong Kong, China	3,5	3,7	0,2
Japan	3,6	3,2	-0,4
Republic of Korea	3,9	4,5	0,5
Singapore	3,1	2,6	-0,5
Taiwan, China	4,1	3,7	-0,4
Central Eastern Europe (POL, CZE, SLK, LIT, LTV, EST)	5,8	5,1	-0,7
Czech Republic	4,6	4,9	0,3
Estonia	7,0	6,0	-0,9
Latvia	6,7	5,8	-0,9
Lithuania	6,7	4,6	-2,1
Poland	5,4	5,1	-0,4
Slovakia	4,5	4,2	-0,3
South Eastern Europe	4,7	4,3	-0,4
Bulgaria	4,1	3,9	-0,2
Croatia	4,5	4,8	0,3
Romania	3,8	3,6	-0,2
Serbia	4,5	3,6	-0,9
Slovenia	6,6	5,5	-1,1
Emerging East and South East Asia	3,9	3,5	-0,4
China	2,4	3,5	1,2
Indonesia	3,5	2,8	-0,7
Malaysia	6,0	4,2	-1,8
Philippines	2,5	3,2	0,7
Thailand	3,9	3,0	-0,9
Viet Nam	4,8	4,1	-0,8
Emerging South Asia	2,5	2,4	-0,1
Bangladesh	1,9	1,3	-0,6
India	3,3	3,5	0,2
Sri Lanka	2,1	2,1	0,1
Pakistan	2,6	2,5	-0,1

Sources: IMF GFS and WB WDI.

6.1.3. Public investment

Public investment expenditure or, more technically, general government gross fixed capital formation is another spending category that is potentially highly relevant for economic development, prosperity and opportunity. Public investment that finances high quality transport, energy and digital infrastructure, or education and health infrastructure strengthens the environment for private investment and the participation in global value chains (AIIB, 2021). Such infrastructure also boosts individual opportunity by raising productivity and expanding the scope of the labour market, especially for the less well-off.

Public investment on the whole is slightly lower than public education spending (Table 3). At 3.5 % of GDP it absorbed 9 % of total spending in advanced economies. The relevant spending was 4.3 % of GDP or about 14 % of total spending in emerging countries in 2019. This reflects a change in patterns compared to 20 years earlier when advanced countries' public investment had exceeded that of emerging economies.

The general impression that public investment has strongly declined in the advanced countries, however, is not correct. Public investment fell to 2.5 % of GDP in the South-Western EU countries, and notably in Portugal and Spain. In the other two advanced country groups outside Asia, it increased or remained constant on average. In the Asian advanced economies, public investment declined strongly over the past 20 years but from a level that was more than twice as high as the non-Asian advanced countries. As a result, public investment in this country group is still much higher than amongst their non-Asian peers ([86]).

As regards emerging economies, there has been a trend towards higher public investment in most countries. When excluding China, all four country groups reported average public investment ratios within a relatively narrow range of 3.8-4.8 % of GDP that was similar to the level prevailing in advanced countries 20 years earlier.

The fast-growing Central Eastern European countries as well as East–South-East Asian countries outside China reported above average spending, similar to the average for the advanced Asian economies. In Europe, two of the Baltics (Estonia and Latvia) reported public investment of 5 % of GDP. In emerging Asia, Malaysia, Vietnam, Thailand, Bangladesh and India featured similar or higher spending levels. China's 17 % of GDP of public investment reflects a huge increase over 20 years earlier and constitutes a distant spending record.

([86]) Note, however, that these figures are often not well comparable across countries, as the extent of private sector financing differs significantly across countries and the scope of private sector involvement in infrastructure finance increased significantly. Moreover, in many advanced countries, the bottleneck for public investment has typically not been a lack of money but the absence of efficient and unbureaucratic processes (Schuknecht, 2020b). An assessment of countries' infrastructure policies, therefore, needs to be undertaken from the outcome side rather than by looking only at inputs.

In conclusion, public investment spending in 2019 differed strongly across countries, while being broadly in the range of 2.5 % to 5 % of GDP (except China). Spending was mostly above average in the advanced Asian economies and the emerging countries of Central-Eastern Europe and East–South-East Asia. Contrary to many economists' claims, public investment spending remained broadly stable in non-Asian advanced countries over the past two decades, except in the South-West EU group.

Table 13 / **Public Investment Spending (% of GDP)**

	1999	2019	Change 1999-2019
Advanced (all simple average)	4,3	3,5	-0,9
Emerging Europe and Asia	4,5	4,9	0,3
Advanced EU SouthWest (FRA, ITA, ESP, PRT, BEL, GRC)	3,4	2,5	-0,9
Belgium	2,3	2,6	0,3
France	4,0	3,6	-0,4
Italy	2,9	2,3	-0,6
Portugal	4,5	1,8	-2,6
Spain	3,5	2,0	-1,5
Advanced EU CenterNorth (DEU, NDL, AUT, DNK, SWE, FLD)	3,5	3,5	0,0
Austria	2,8	3,0	0,2
Denmark	2,9	3,2	0,3
Finland	4,4	4,2	-0,2
Germany	2,4	2,4	0,0
Netherlands	3,8	3,4	-0,4
Sweden	4,6	4,5	-0,1
Other advanced	2,9	3,2	0,3
Australia	2,2	3,9	1,7
Canada	3,1	3,9	0,8
Ireland	3,0	2,4	-0,6
Switzerland	3,4	3,0	-0,4
United Kingdom	1,8	2,7	0,9
United States	4,0	3,5	-0,5
Advanced Asia	7,9	4,7	-3,2
Hong Kong, China	6,6	5,8	-0,8
Japan	9,9	5,0	-4,9
Republic of Korea	6,0	4,8	-1,2
Singapore	7,3	4,7	-2,6
Taiwan, China	9,8	3,4	-6,4
Central Eastern Europe (POL, CZE, SLK, LIT, LTV, EST)	2,6	4,2	1,6
Czech Republic	3,2	4,4	1,2

	1999	2019	Change 1999-2019
Estonia	3,3	5,0	1,7
Latvia	1,4	5,0	3,6
Lithuania	2,0	3,1	1,1
Poland	2,5	4,3	1,8
Slovakia	3,3	3,6	0,3
South Eastern Europe	3,2	3,8	0,6
Bulgaria	3,4	3,4	0,0
Croatia	6,9	4,5	-2,4
Romania	1,4	3,5	2,1
Serbia	0,4	3,9	3,5
Slovenia	4,0	3,8	-0,1
Emerging East and South East Asia	8,0	6,9	-1,5
China	21,3	17,3	-6,4
Indonesia	3,0	3,4	0,4
Malaysia	9,5	6,2	-3,2
Philippines	3,0	3,7	0,8
Thailand	8,3	5,0	-3,3
Viet Nam	3,1	5,8	2,7
Emerging South Asia	3,4	4,2	0,8
Bangladesh	4,4	6,3	1,9
India	5,4	5,1	-0,3
Sri Lanka	1,4	3,8	2,3
Pakistan	2,6	1,7	-0,8

General government gross fixed capital formation as % of GDP from IMF ICSD database.

6.1.4. Social expenditure

Social protection spending is a relative 'new-comer' as regards state involvement. Only at the end of the 19th century did the first countries introduce social insurance. By the late 20th century and the early 21st century, social security had started to dominate public spending in many advanced countries, but it was still not widely accessible in many poor countries.

There are good arguments why basic social safety nets feature prominently in the discussion on the role of the state and development goals: safety nets not only enhance personal welfare by reducing health and longevity risks, they also increase people's ability for economic risk taking. For high social spending, however, these positive growth effects might be dominated by adverse effects from higher taxes, disincentives to work, and rent seeking.

Social expenditure is the most important spending category in almost all advanced countries outside Asia and it has grown continuously over the past six decades. The OECD reports social spending almost tripling as a share of GDP from 9 % in 1960 to almost one quarter of GDP in the late 2010s (OECD, 2021; Schuknecht, 2020). However, there is a huge country variance and differing social expenditure ratios explain much of the variance in total public spending across advanced countries.

Surprisingly, the coverage of social expenditure data is relatively patchy outside advanced countries. OECD countries provide such data in a relatively consistent manner since the 1960s but this is not the case for emerging economies. IMF data, which is used throughout this paper, only covers such spending for many countries since the 2000s. Still, there are some interesting patterns.

Social protection spending is highest in the European advanced countries at 20 % of GDP in 2019. This figure had remained broadly stable over the 20 years in Northern-Central Europe while it had increased by almost 4 % of GDP in the South-Western EU countries. Other advanced countries (outside Asia) reported little more than half that ratio at 10.7 % of GDP on average.

Social protection spending by general government in advanced Asia was even lower at 6.1 % on average. Japan was an exception, at 16 % of GDP, reflecting the country's aging population and increasingly generous social protection. Singapore was at the other end of the spectrum where pension spending has been fully funded and outside the scope of general government.

As regards emerging economies, social spending ratios were quite similar in Central Eastern and South-Eastern Europe, at around 14 % of GDP in 2019. However, this was much lower than for the advanced European countries and it was broadly unchanged from 20 years earlier (despite significant population aging in the meantime). Emerging East–South-East Asia and South Asia featured very low social protection spending at 1-8 % of GDP. This reflects the patchiness of social security in some of these countries and a greater role of private and family-based social insurance.

In conclusion, advanced countries in Europe showed very generous social welfare systems before COVID. These systems are largely responsible for the countries' high total public spending ratios. In a number of countries, such spending has increased significantly further in recent decades. Emerging Eastern Europe reported significantly lower social protection spending. Non-EU advanced countries and notably advanced Asia feature even smaller welfare state spending. Much of emerging East–South-East Asia and South Asia are still in the process of developing their systems.

Table 14 / **Social protection spending (% of GDP)**

	1999	2009	2019	Change 1999-2019
Advanced (all simple average)	14,62	15,0	14,3	-0,4
Emerging Europe and Asia	14,22	9,1	8,7	-5,5
Advanced EU SouthWest (FRA, ITA, ESP, PRT, BEL, GRC)	16,08	19,2	19,8	3,7
Belgium	16,93	19,2	19,5	2,6
France	21,15	23,7	23,9	2,7
Italy	17,20	19,7	21,2	4,0
Portugal	12,15	17,2	17,0	4,9
Spain	12,98	16,1	17,4	4,4
Advanced EU Center North (DEU, NDL, AUT, DNK, SWE, FLD)	20,67	21,1	20,0	-0,7
Austria	21,08	21,2	20,1	-1,0
Denmark	22,85	24,3	21,6	-1,2
Finland	21,13	22,5	24,0	2,9
Germany	21,32	20,7	19,7	-1,6
Netherlands	15,37	16,4	15,4	0,1
Sweden	22,25	21,4	19,1	-3,2
Other advanced	10,91	13,0	10,7	-0,3
Australia	9,45	11,2	9,5	0,0
Canada		11,2	11,2	
Ireland	11,78	18,1	8,9	-2,9
Switzerland	13,43	12,1	12,4	-1,1
United Kingdom	13,39	16,7	14,8	1,4
United States	6,52	8,6	7,5	1,0
Advanced Asia	2,10	5,9	6,1	-0,1
Hong Kong, China		2,7	4,0	
Japan		15,9	16,2	
Republic of Korea		5,5	6,3	
Singapore	0,28	2,1	0,9	0,6
Taiwan, China	3,92	3,1	3,1	-0,8
Central Eastern Europe (POL, CZE, SLK, LIT, LTV, EST)	14,30	15,1	13,6	-0,7
Czech Republic	11,97	13,4	12,6	0,6
Estonia	11,76	15,3	13,2	1,5
Latvia	15,19	14,0	12,1	-3,1
Lithuania	13,47	16,6	12,4	-1,1
Poland	18,43	16,1	16,8	-1,6
Slovakia	14,99	15,1	14,3	-0,7

	1999	2009	2019	Change 1999-2019
South Eastern Europe	14,10	15,4	14,1	-0,4
Bulgaria	12,00	12,9	11,5	-0,5
Croatia	15,46	15,4	14,6	-0,8
Romania	11,38	13,1	11,8	0,5
Serbia		17,1	16,1	
Slovenia	17,54	18,4	16,6	-0,9
Emerging East and South East Asia		2,9	3,9	
China		2,1	8,1	
Indonesia		1,2	1,3	
Malaysia		3,5	4,2	
Philippines		2,4	2,6	
Thailand		3,4	3,1	
Viet Nam		4,7	4,3	
Emerging South Asia		1,9	1,8	
Bangladesh		1,4	0,7	
India		1,5	1,4	
Sri Lanka		3,2	3,2	
Pakistan		1,3	1,9	

Sources: IMF GFS, ILO World Social Protection database, ADB SPI database, and local statistics office.

6.2. PUBLIC SPENDING AND PUBLIC SECTOR PERFORMANCE IN EUROPE AND ASIA

After the description of public expenditure patterns across country groups, it is worth discussing what citizens get for their taxes and whether higher spending delivers better outcomes. This study will not venture deeply into the topic and rather focus on some correlation patterns between spending and performance across countries and categories. We will limit ourselves to a few that are linked to the core role of government in providing essential public goods and services. Of course, there are number of caveats for comparing spending and spending outcomes across countries (Schuknecht, 2020), so that the results are only illustrative and have to be seen 'with a grain of salt'.

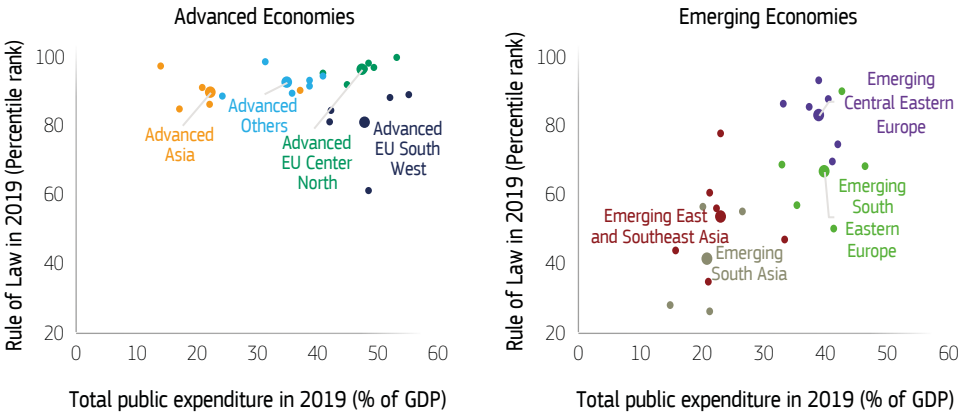
6.2.1. Total spending and framework conditions for the economy

One of the most important outcomes of government activity is the framework conditions in which the private sector operates and creates wealth. There are a number of measures that can proxy such framework conditions or rules of the

game. A prominent one is the World Bank 'rule of law' indicator, as the 'rule of law' determines the security of property rights and the reliability, clarity and enforceability of contracts. Another indicator is the World Bank's 'Government Effectiveness' indicator. Given that the two are highly correlated, I only report the results for the correlation between government spending–the size of government–and the 'rule of law'.

The results across country groups are quite interesting: there is virtually no correlation between size of government and the rule of law. Amongst advanced countries, the advanced Asian, the Centre-North EU and the other advanced countries all have very high indicator values with little variation within the groups (Figure 21a). This speaks for quite favourable framework conditions towards a flourishing economy.

Figure 21 / **Total public expenditure and rule of law in 2019**



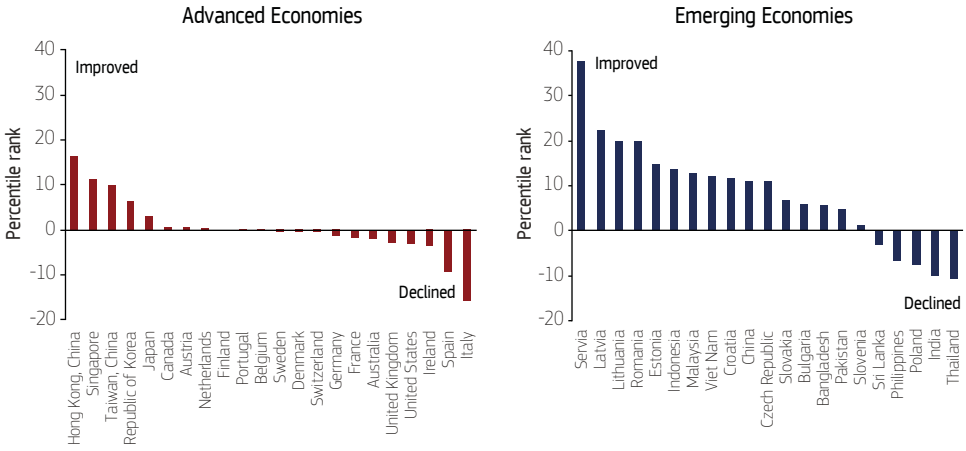
At the same time, the size of government differs hugely across groups. Advanced Asia clearly has the smallest government sectors, as already described in the previous sections (near 22 % of GDP). Even Japan, the largest government country in Asia, 'only' reports spending similar to that of the Anglo-Saxon countries and Switzerland (35 %) and far below the European advanced country average. The Centre-North EU and the South-West report similar total public spending, while the 'rule of law' scores tend to be markedly higher.

The pattern amongst emerging economies is quite different (Figure 21b). Here, we observe a moderately positive correlation between the size of government and the 'rule of law'. Emerging South Asia reports the smallest government sectors and the lowest 'rule of law' values. Emerging East–South-East Asia features small government and very diverse values for this indicator with Malaysia in the top scoring group. In emerging South-Eastern Europe, government spending is much higher and rule of law somewhat better than in East–South-East Asia and

Slovenia is top scoring. Emerging Central Eastern Europe features similar levels of public spending with significantly higher rule of law values. While these findings say nothing about causality, they nevertheless show that countries with more developed public sectors also feature a more favourable economic environment. Nevertheless, the variance is huge.

Finally, it is interesting to look at the change in public sector performance over the past two decades (Figure 22). Here, the remarkable progress of the Asian advanced countries as regards the rule of law is noteworthy. At the same time, South-West EU countries and some other advanced countries report a modest to significant decline in this indicator.

Figure 22 / **Change in rule of law, 1999–2019**



Again, the picture is very different for emerging economies. Especially some of the European and East–South-East Asian countries have made significant progress and the Baltic countries stand out. By contrast a few countries report a backsliding in the rule of law.

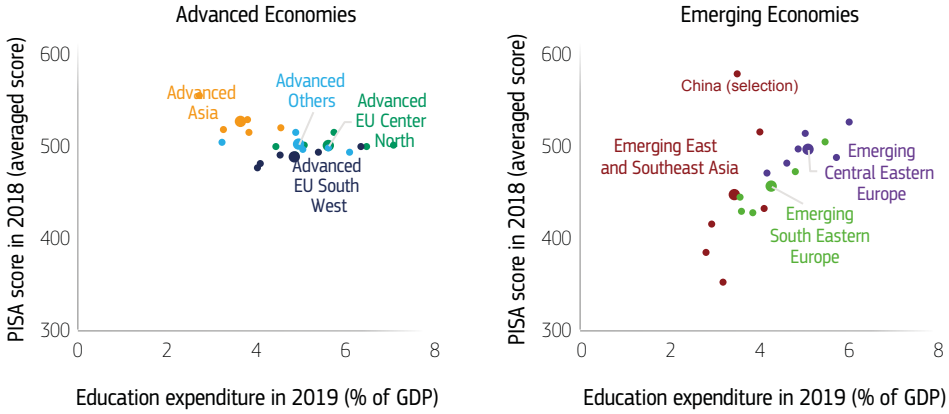
In conclusion, the size of government in advanced countries is not correlated with the economic framework conditions as measures by the rule of law (or government effectiveness) while there is a moderately positive correlation in emerging economies amidst significant variation. Asian advanced countries and most emerging economies have made significant progress in the past 20 years while some non-Asian advanced countries and a few emerging economies have regressed.

6.2.2. Public spending on education and education performance

It is not easy to measure the impact of public spending on education and skills across countries. There are many dimensions to education–primary, secondary, tertiary, professional–and there is a differing role of the private sector across countries. Nevertheless, it is worthwhile looking at public expenditure ratios and OECD PISA score across countries as proxies for public inputs into the education sector and the level of human capital across countries ([87]).

PISA measures the reading, maths and science competencies for 15-year-olds across a growing countries (see the relevant OECD publications, e.g., OECD (2020)). In advanced countries, the correlation between education spending and education outcomes is, if anything, somewhat negative (Figure 23a). The best-performing Asian advanced economies feature the lowest public spending ratios. The other three country groups report somewhat higher spending and somewhat lower PISA scores on average and significant spending and performance divergence across countries. Only a few countries can keep up with advanced Asia.

Figure 23 / **Education expenditure and PISA score in 2019**



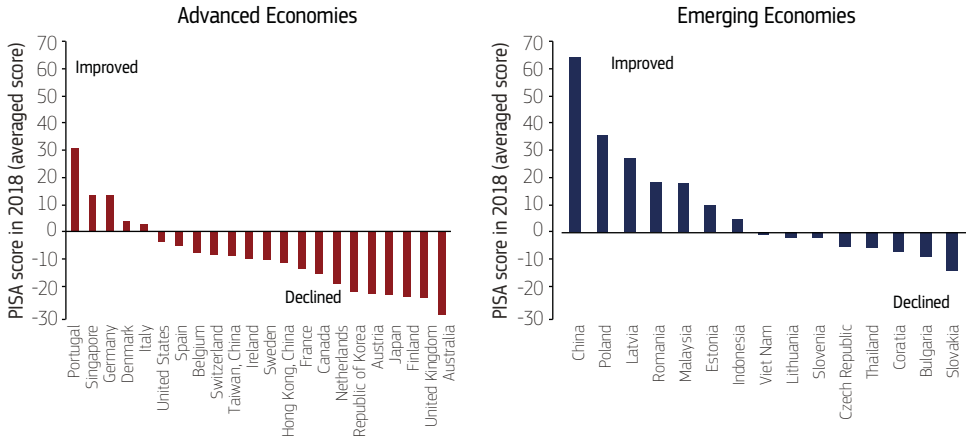
Amongst emerging economies, the picture is quite different (Figure 23b). First, there is not data for South-Asian countries as they did not participate in PISA in the past. Second, emerging East–South-East Asia features the lowest average expenditure ratios (similar to that of their advanced Asian 'colleagues') and the greatest performance divergence. With Vietnam and mainland China it comprises two countries that even outperform most advanced countries. Third, emerging Central Eastern Europe reports the highest average spending, very much in line

([87]) In some very few countries, private education expenditure is quite important. An important difference in spending patterns across countries is on tertiary education which does not affect the chosen measure of education performance. On the whole, however, comparing public education expenditure and education performance as reflected in PISA scores is a reasonable proxy for assessing the effectiveness and efficiency of government.

with the advanced country peers, and PISA scores that are in line with the non-Asian advanced countries. Emerging South-Eastern Europe is in between the two groups both in terms of the size of spending and education performance.

It is also worth looking at the change in education performance across countries in the past (almost) 20 years (Figure 24). From 2003 to 2018, PISA scores in the advanced countries mostly declined, and in some countries even quite significantly so. Only Portugal reports a strong increase from formerly low levels to near the average. Amongst emerging economies, the picture is more positive (even though the sample size is somewhat reduced). A number of countries from the three relevant groups improved their scores, notably China, Poland and Latvia. Only few countries fell slightly back.

Figure 24 / **Change in PISA score, 2003-2018**



In conclusion, advanced Asia and some emerging Asian economies perform very well in the education domain while reporting low public education spending. The other advanced country groups and emerging Central Eastern Europe also perform reasonably well on average with much higher spending. There are a few less strong performers in Europe and notably in emerging East–South-East Asia and South-Eastern Europe.

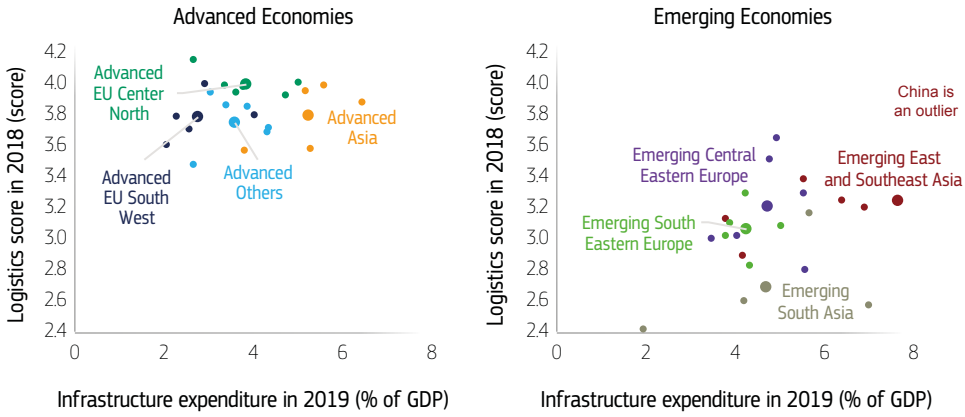
6.2.3. Public investment and infrastructure quality

Infrastructure is another important building-block for promoting economic prospects and social opportunities within countries. However, the measurement of infrastructure quality is difficult, not all public investment goes into infrastructure in the strict sense of connecting people and facilitating trade, and the role of the private sector in the provision of infrastructure (notably telecom or energy but also other areas) differs hugely across countries (Schwartz, et.al, 2020; Schuknecht, 2020). Still, from a big picture perspective, it is worthwhile

conducting the same correlation exercise as before. I use the World Bank logistics infrastructure quality index as it includes the main elements relevant for connectivity and trade.

Advanced countries have had many decades to build their road, energy, telecom and other infrastructure. It is, therefore, not surprising that all advanced countries show much higher indicators than most emerging economies (Figure 25). The Centre-North EU group posts the highest average indicator, and Germany (contrary to many casual claims about poor quality) reports the highest score of all. The three other groups feature slightly lower averages.

Figure 25 / **Infrastructure investment and logistics performance**



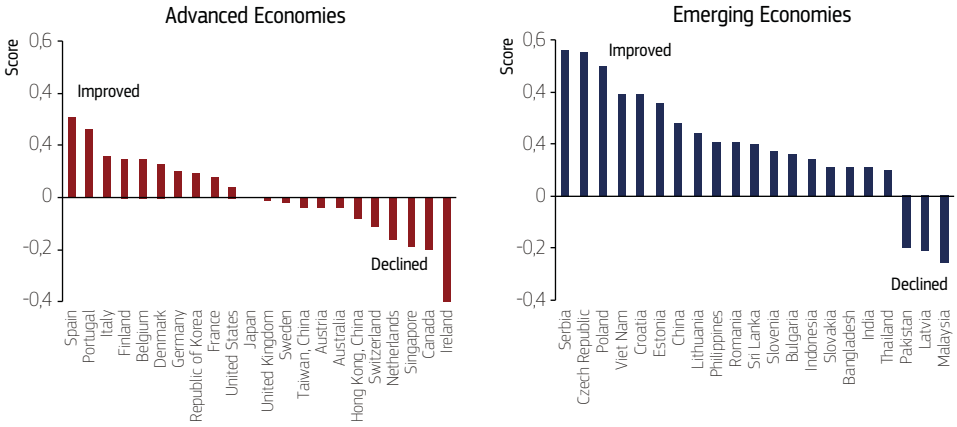
More interesting, however, is the fact that advanced Asia has caught up with the infrastructure quality of the 'West' in a very short time frame, and the high average public investment ratios are probably an important reason for that. Low spending in the South-West EU group and a few countries from other groups may reflect a strong role of the private sector (Germany). However, it may also be a sign of low-quality spending (e.g. on white elephants) and the prioritisation of consumptive spending that risk undermining infrastructure quality in the future.

As regards emerging economies the picture is quite mixed. Public investment spending is high amongst a number of European and Asian economies but infrastructure quality is often still low and much catching up seems necessary. Poland and the Czech Republic feature the best indicator values (on par with other advanced countries) with moderate public expenditure. With massive investment (17 % of GDP in 2018 and off the Chart), China has catapulted itself in very little time to a similar quality level as other top performing emerging economies and some of the advanced countries.

These findings are confirmed when looking at the change in infrastructure quality (Figure 26). Unfortunately, data scarcity only allows a comparison between 2008 and 2018. Amongst advanced countries, improvements and declines

in infrastructure quality over the decades are almost balanced. This further contradicts the claim that all or most advanced countries have experienced a deterioration in quality that warrants major new public investment programs. Spain and Portugal have seen the strongest improvement over this decade, contrary to the claims of the damaging effect of austerity. The picture is perhaps a bit more complex than many critics claim.

Figure 26 / **Change in logistics performance score, 2008-2018**



When looking at emerging economies, the facts are quite remarkable. Several countries in Europe and Asia report major improvements in infrastructure quality over the previous decade, including Serbia, Czech Republic, Poland, Vietnam, Croatia, Estonia and China. Only three countries experienced a decline. Given that the overall difference between advanced countries (ca 3.8) and emerging economies in Europe and East South-East Asia (ca 3.2) is only 0.6, it may take many countries not more than one or two decades to catch up, given increases of up to 0.6 in the previous decade.

In conclusion, most advanced countries report very high infrastructure quality scores and advanced Asia has fully caught up with the 'West'. While there is no evidence of a widespread degradation over the past decade, some countries feature a falling quality index. Emerging economies report lower quality scores on average but a few countries have already caught up with advanced countries. The speed of improvements suggests that more will do so in the next 20 years or so.

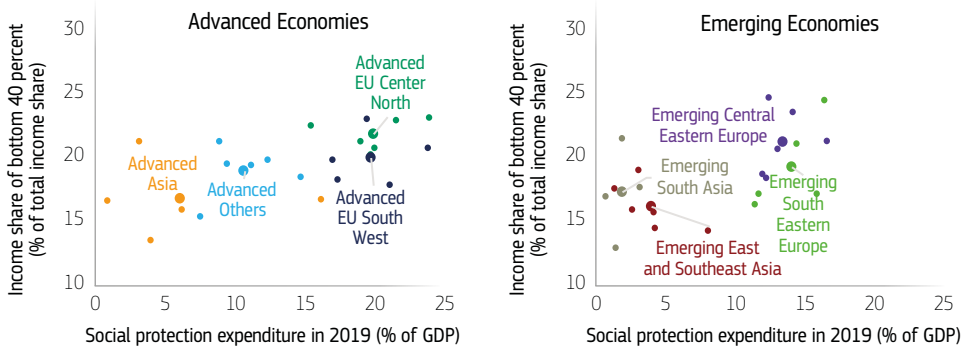
6.2.4. Social protection expenditure and income inequality

Income distribution features prominently in today's policy debate but the role of government in equalising incomes and the impact this has on growth and opportunity is highly contested. Some studies argue that the insurance effect of more equality boosts growth more than the distortionary effect of taxes and disincentives reduces it. Others claim the opposite. Moreover, it is not just public spending (and taxation) that determines the wedge between market and post-tax/

transfer income. Well-functioning labour markets and strong education systems may be equally if not more important.

This study shows the post-tax/transfer income share of the bottom 40 % of households and its correlation with social protection expenditure (Figure 27). The correlation between social protection spending and income equality is very moderately positive amidst much variation in the advanced countries. Income distribution is most equal in the Centre-North EU country group where social protection spending is also very high. But the South-West EU groups spends just as much and includes a number of countries where inequality is rather large.

Figure 27 / **Social protection expenditure and income inequality in 2019**



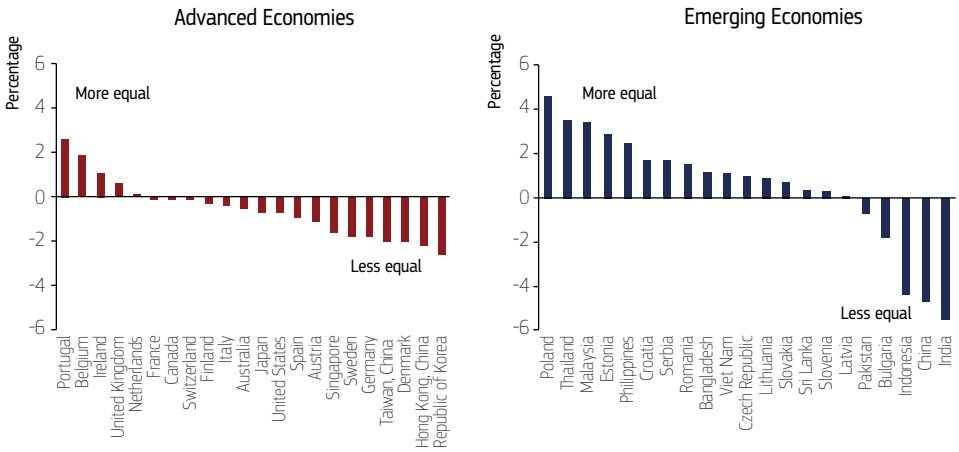
The Asian and other advanced economies spend much less on social protection but a few of them feature income equality almost at a par with the most equal big government countries. This includes China-Taiwan and Ireland. The Netherlands reports high equality with average social protection spending of 'only' 15 % of GDP, compared to 20 % or more in other high-equality countries. Undeniably, some of the Asian advanced economies and the US feature both low social protection spending and a small income share of the lower two income quintiles.

Emerging economies report much lower social spending but they do not always feature more inequality (Figure 27). The correlation between public spending and equality seems to be somewhat stronger than in advanced countries, though there is (again) huge variation across countries. The income share of the bottom 40 % of households in much of emerging Asia is similar to that of advanced Asia but never lower than that of the most unequal advanced countries. Emerging South-East Europe reports figures similar to those for South-West EU and other advanced countries while Central-Eastern emerging Europe is at a par with the advanced Centre-North EU ([88]).

([88]) Buti and Székely (2021) argue that different European country groups may be on different production possibility frontiers, where South-Western Europe achieves more equality with higher social spending within the country group but much less equality for the same social spending ratio compared to other groups.

When looking at the change over the past 20 years, there are also clear differences in the patterns across advanced and emerging economies. In most advanced economies, the income share of the bottom 40 % of households has declined (Figure 28). Nevertheless, Portugal, Belgium, Ireland and the United Kingdom report more equality than two decades earlier. For Portugal and Ireland, these figures contradict casual claims of austerity induced inequality after the European financial crisis.

Figure 28 / **Change in income distribution, 1999-2019**



Amongst emerging economies, most countries reported a significant or moderate improvement in income equality. Notably Poland, Thailand, Malaysia, Estonia and the Philippines stand out. Indonesia, India and China reported the opposite trend. These developments are consistent with the claim that low skill/low-income households in the advanced countries have suffered from global competition while their peers in emerging economies benefitted.

In conclusion, income inequality differs hugely in advanced and emerging economies. While social spending in advanced countries tends to be higher, the average income share of the poorest 40 % of households is not very dissimilar in advanced and emerging economies. The correlation with public protection spending is modest in advanced countries while it is more significant in emerging economies. Europe generally report higher social spending and more equality. A number of countries feature relatively efficient welfare states where low social protection spending coincides with a high degree of income equality.

6.2.5. Total expenditure and public debt

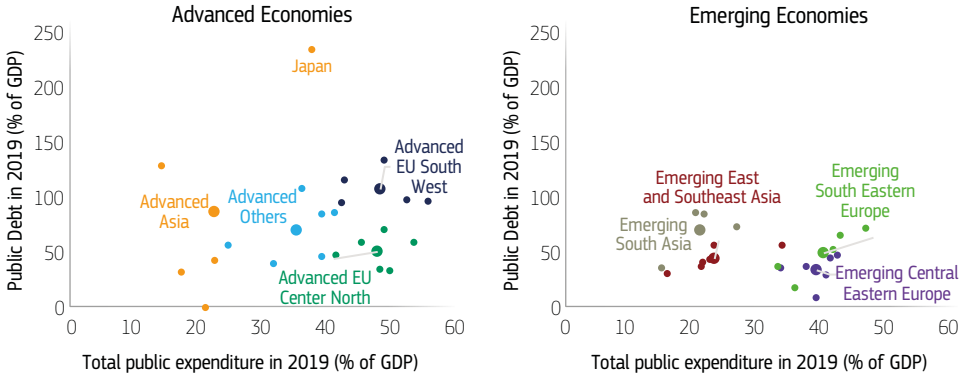
Public expenditure is also related to macroeconomic stability. High public spending may be difficult to finance economically or politically so that it may lead to persistent deficits and higher debt. This may, especially in emerging economies, undermine macroeconomic stability and stoke fiscal and financial crisis. The

global financial crisis has shown that high spending and debt can provoke fiscal crisis in advanced countries as well, especially when it comes together with falling economic competitiveness and financial sector problems. Given ultra-low interest rates, however, the consensus of the 1990s–that reasonably low debt is desirable as it provides buffers for future crises or higher interest rates–has dissipated. Still, as assessments may change again in the future, it is important to check whether high spending is correlated with higher debt and, thus, potential sustainability problems looking ahead.

In advanced countries, the public debt situation is quite diverse but there is no clear correlation between public debt and total expenditure ratios (Figure 29). Only when taking out Japan as an outlier, there is perhaps a modest correlation between size of government and public debt. However, the stronger one seems to be between the size of the country and public-indebtedness: most high-debt countries today are large economies.

As regards, geographic groupings, two groups stand out. The Centre-North EU countries all feature relatively modest debt and the lowest group average while they feature relatively high spending. The South-West EU, by contrast, reports the highest average as all its members are highly indebted while the spending ratio is on average close to their EU peers (and much above the other two groups). In advanced Asia, three economies have very low debt while a pre-funded pension system drove up debt in Singapore and huge fiscal imbalances for decades left Japan with the highest public debt in the world (>250 % of GDP).

Figure 29 / **Total public expenditure and public debt in 2019**

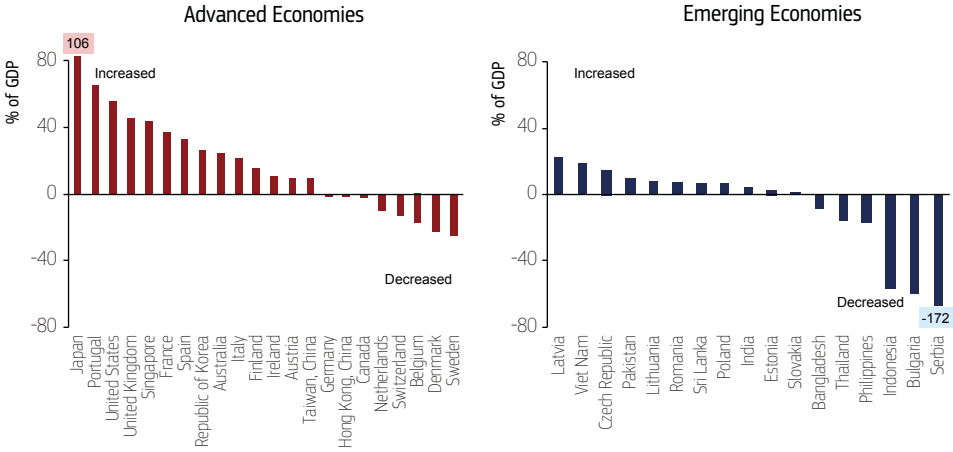


As regards emerging countries, total spending ratios differ strongly as argued above while debt ratios differ less across countries and across groups than for advanced countries. In particular, there is not a single country with debt above 100 % of GDP. Emerging Central and Eastern Europe feature the lowest debt with the highest spending ratio. But this is not much below emerging East and South-East Asia which has the smallest governments.

When looking at changes in indebtedness over the 1999-2019 period, public debt went up almost everywhere (Figure 30) and it increased significantly further in 2020/21. However, it increased fastest in the largest advanced countries. In fact, in the G7 it increased from about 85 % of GDP in 2007 to 140 % in 2020. Debt increased modestly or not at all in the Asian advanced countries. Only a few smaller advanced countries in Europe reduced their public debt ratio before COVID struck.

The public debt increase in the emerging countries was much less dramatic and on average even rather minimal. Only with the COVID pandemic, did public debt in emerging economies increase as well, though less strongly than in the advanced ones.

Figure 30 / **Change in public debt, 1999-2019**



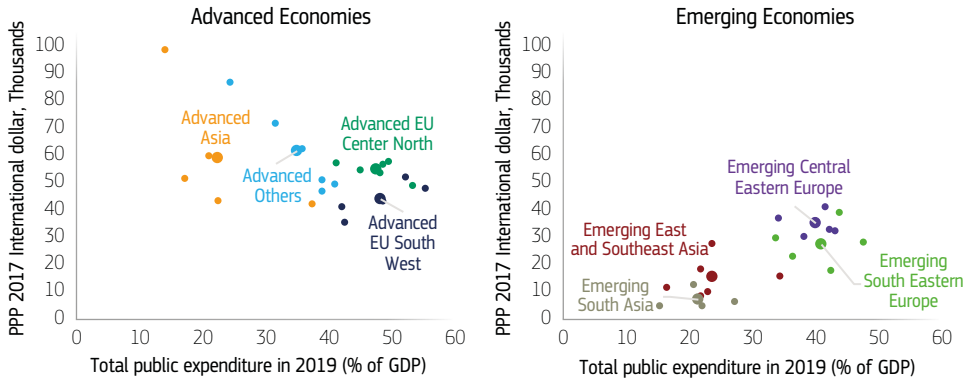
In conclusion, advanced and emerging economies posted record public debt levels in 2019 and this increased further with the pandemic (IMF, 2020; Schuknecht, 2022). However, debt-ratios do not correlate much with expenditure ratios in the respective advanced and emerging country groups. It seems rather, that large countries are particularly highly indebted while smaller economies know of their vulnerability and behave more prudently. Perhaps, after the banks' 'too big to fail' of the early 2000s, we now see governments behaving as if they are too big to fail too. Only, who should save them?

6.2.6. Public spending and per capita GDP PPP

Public spending is supposed to provide public goods and services and ensure well-functioning administrations so that economies thrive. At the same time public spending needs to be financed and taxes tend to be distortionary so that growth tends to be hurt. Over time, this should translate into higher or lower levels of per-capita GDP, and the relation with spending ratios is likely to say something about trade-offs.

What do the numbers say about the correlation between purchasing power adjusted per-capita GDP and total public spending? While the relationship is quite clearly negative for advanced economies it seems to be more positive for emerging countries (Figure 31). The richest advanced countries, the Asian and non-EU advanced country groups feature average per capita GDP PPP of about 60 000 US$. This is about 10 % above the average for the Centre-North EU and one quarter above the South-West EU. Singapore is the richest country at about 100 000 US$ per person, the poorest one being below 40 000. The richest countries all feature public expenditure ratios below 40 % of GDP, while the countries below the average display the whole public spending spectrum.

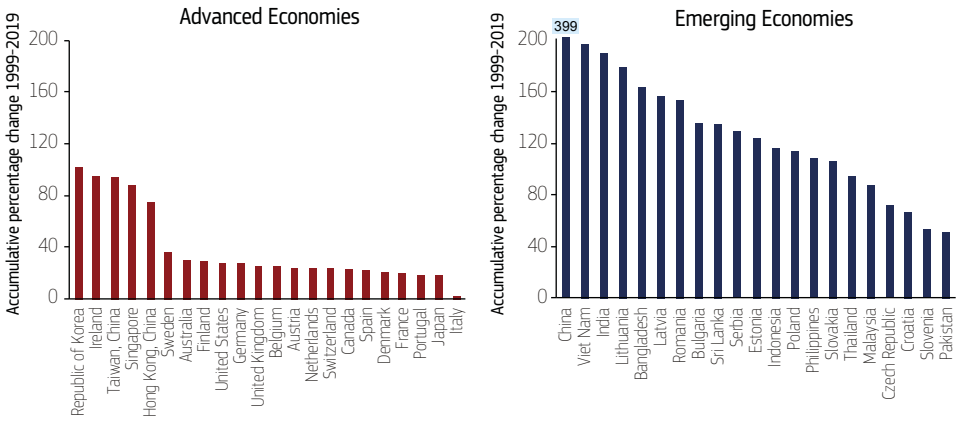
Figure 31 / **Total public expenditure and GDP per capita in 2019**



Amongst the emerging economies, East–South-East Asia and South Asia are still relatively poor and the size of the public sector is quite small. European emerging economies of both groups, by contrast feature much large public sectors and higher incomes.

A look at the changes in per-capita GDP over the past two decades nuances the overall picture somewhat (Figure 32). In fact the distance in prosperity in the advanced countries has increased significantly between big and small government countries (Schuknecht, 2020). This is also illustrated in Figure 32 where four of the top five countries in relative growth performance are from Asia: Korea; Hong Kong, China; Taiwan, China and Singapore. Or in other words, advanced Asia has rapidly caught up with advanced Europe (Buti and Székely, 2021). From Europe, only Ireland is in the top group with per capita income increases of 75-100 %. All these countries feature much below average sizes of the public sector. Sweden is the only 'big-government' country with above average per capita GDP growth over the past 20 years.

Figure 32 / **Change in GDP per capita, 1999-2019**



Emerging economies generally reported much faster economic growth and most countries cumulative growth rates over the two decades exceeded that of the advanced country top group. This is income convergence 'at work'. Asian economies came out on top: per-capita GDP PPP in China almost quadrupled, it almost doubled in Vietnam and India. A number of European and Asian economies also posted strong growth between 180 % and 50 % over the period.

In conclusion, there appears to be a clear negative correlation between the size of government and per capita GDP in advanced countries. Moreover, advanced country prosperity seems to have diverged between the countries with large versus small public sectors over the past two decades. For emerging economies, Asian countries appear to have, on average and when looking at the median, grown somewhat faster than their European emerging economy peers.

6.3. EMERGING ECONOMIES OF SOUTH-EASTERN EUROPE AND ASIA: WHO WILL BE THE NEXT 'TIGERS'?

After World War II, today's advanced countries of Europe, North America and Oceania emerged from destruction. Japan was the first Asian 'tiger' to follow suit and it had caught up with the 'West' in the 1980s. A number of additional Asian 'tiger' economies started their ascent in the 1960s, 1970s and 1980s which continued until today when some of them even surpassed their Western peers: Singapore, Hong Kong, China, Taiwan, China, South Korea. With the end of communism, Central Eastern Europe became the next group 'tigers' with rapidly catching up economies since the 1990s.

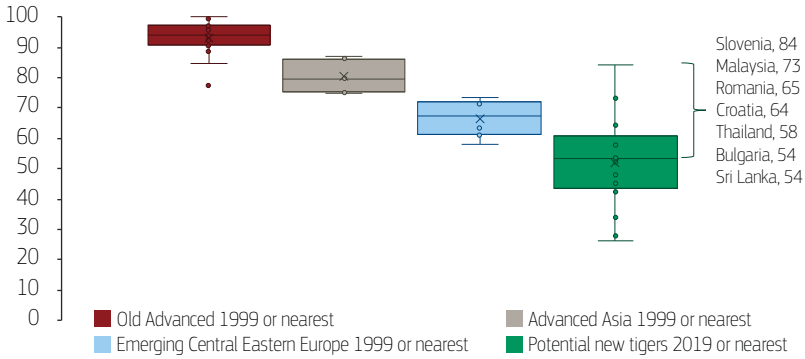
In this section, we ask: where did the fast-growing countries of the past two decades stand 20 years ago? Who are going to be the next 'tigers' when looking at

where the emerging economies of South-Eastern Europe and Asia stand today? Three criteria that we examined in this study seem particularly relevant: the rule of law and favourable framework conditions for the private sector, a good human capital and skill base for the economy and sound infrastructure that connects people and countries internally and externally. As regards these three criteria, the earlier tigers seem to have been strong performers during their ascent.

6.3.1. Economic framework conditions and future 'tigers'

Where did the catching up advanced economies of Asia and the emerging economies of Central Eastern Europe stand 20 years ago from the perspective of rule of law and framework conditions? Which countries of the emerging country group in South-Eastern Europe, East–South-East Asia and South Asia are well-positioned today to catch up with their Asian or European peers? Figure 33 illustrates the distribution of scores across and within country groups 20 years ago for the 'old' advanced countries, advanced Asia and emerging Central and Eastern Europe.

Figure 33 / **Rule of law, percentile ranks**



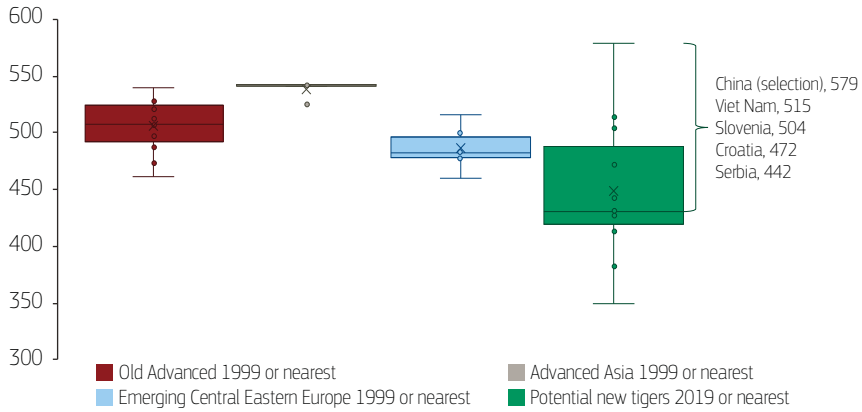
Then and today, the 'old' advanced countries (burgundy) featured high 'rule of law' scores. At that time advanced Asia (grey) reported slightly lower but already very sound values. As reported above, advanced Asia has fully caught up has fully caught up. Central Eastern Europe (blue) also started at a relatively high level in the late 1990s after very transformative years during the 1990s. All in all, the rule of law conditions for rapid growth in today's advanced Asian economies and Central Eastern European countries were well in place at that time. They are likely to boost prosperity in the future as well.

When looking at the remaining emerging economies, four countries stand out: Slovenia, Malaysia, Croatia and Romania. Their 'rule of law' scores that are broadly in the range of Central Eastern Europe at the time of their take off. Thailand, Vietnam and Sri Lanka feature above average indicators but they remain well below those prevailing in the Central Eastern European 'tigers' of the past two decades. Some other countries have also improved, as seen above, but they still feature relatively low scores.

6.3.2. Human capital and future 'tigers'

Turning to human capital as measured by PISA scores, 'old' advanced countries posted high education scores in the early 2000s, but already then, the scores for the Asian advanced countries were higher (while their per capita GDP was still much lower) (Figure 34). Central Eastern emerging economies also featured strong human capital scores, almost on par with the 'old' advanced countries. Hence, again Asian and Central Eastern European economies were well placed for fast growth in the following 20 years from a human capital perspective and they are in a good position to stay on this course in the future.

Figure 34 / **PISA score, simple average of math, science and reading**

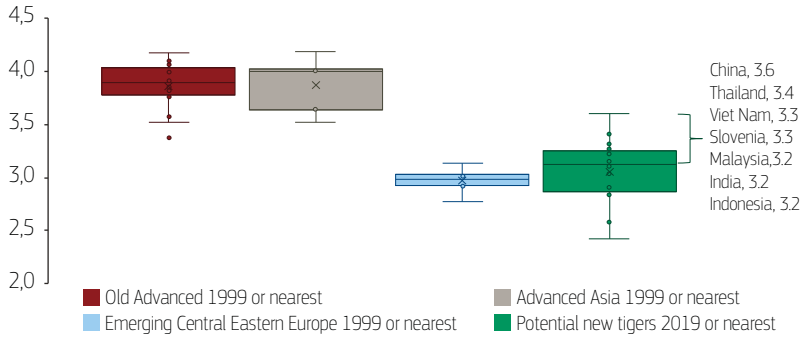


When looking at PISA scores for the emerging economies in South-Eastern Europe and Asia, the situation is very diverse. For some countries notably in South Asia, there is no information. For the remaining countries, there are some clear success stories, where today's scores are very promising for the future. This includes China (selected provinces), Slovenia, Vietnam and Croatia. These countries seem well placed from a human capital perspective to continue on a fast growth path.

6.3.3. Infrastructure performance and future 'tigers'

Finally, we look at infrastructure indicators across countries and country groups. As already discussed above, there are a number of caveats around this data including their relatively late availability (early 2000s). Already then 'old' advanced countries, and the Asian advanced countries had top infrastructure quality scores (Figure 35). This was an area where Central and Eastern Europe was furthest behind. During the high-growth and investment phase of the past 20 years, this country group could catch up significantly within relatively reasonable expenditure bounds and is, thus, also well-placed for the future.

Figure 35 / **Logistics performance index, score**



The potential 'tiger' countries of South-East Europe and Asia are not badly positioned if they continue investing in high quality infrastructure. Most countries today feature a higher infrastructure score than the average of the Central Eastern European countries in the late 1990s. China, Thailand, Vietnam, Slovenia, India, Indonesia and Malaysia are well above that average. Hence, there are quite a few countries that are well advanced on this criterion.

6.3.4. Synthesis on the prospects of future 'tigers'

Putting the findings on these three indicators together and with the caveat that these are not all the relevant factors that determine whether a country is a future 'tiger', there are some interesting results. First, the 'tigers' of today's advanced Asia and Central Eastern Europe prioritised the 'rule of law', education and infrastructure from early on and with determination. This took precedent over the establishment of the welfare state which in the case of Central Eastern Europe was even curtailed. Twenty years ago, these country groups were well-advanced or advancing rapidly regards government performance in these areas. Both groups are, hence, in a good position to continue on their course of success.

As regards today's South-Eastern European and Asian emerging economies, the picture is more mixed. Many countries are doing well and progressing on infrastructure, a number of East Asian and European countries also show strong education systems. However, on rule of law and framework conditions the picture is patchier. Slovenia and Vietnam feature promising indicators in all three categories, a number of other countries show strong results or potential in at least two. But the starting point and experience of the Asian and European 'tigers' of past decades shows that there is some way to go for most countries, and new success stories might be slower to emerge than in the past.

It is also worth recalling that doing well on these three criteria does not require high levels of public spending. A strong public administration that implements the rule of law does not have to be very large. Singapore gets by with a few percent

of GDP, Switzerland's public consumption is only about 12 % of GDP compared to 20 % in many other advanced countries. Education spending of 3-4 % of GDP has financed some of the best education systems. Infrastructure spending of 4 % of GDP, implemented efficiently and sustained over a significant period of time is probably sufficient in the emerging economy context, especially if it can be combined with significant private finance.

Hence, there is no reason to argue that today's governments are structurally underfinanced when expenditure exceeds 20 % or 30 % of GDP. It is a matter of prioritisation. None of the countries discussed should, therefore, be impeded from becoming a new 'tiger' due to an unduly small government. At the same time, some countries in Europe already feature relatively large governments that require high taxes so that an efficient use of public resources seems particularly important.

CONCLUSION

In this study we examined the size of public expenditure and government performance across several groups of advanced and emerging economies in Europe and Asia. Several findings stand out:

1) European advanced countries have the largest public sectors. The difference to other country groups mainly relates to the size of the welfare state. Productive spending on education or infrastructure, by contrast, differ much less across advanced country groups.

2) Central Eastern European emerging countries also have larger public sectors than their emerging economy peers. Emerging economies of South-Eastern Europe and notably Asia feature smaller public sectors.

3) As regards government performance, there are huge differences across countries and country groups. Advanced Asia has further consolidated its lead position on several indicators while maintaining low spending. Some European advanced economies' performance indicators have declined amidst further increases in total spending ratios.

4) There is a more positive correlation between spending and performance amongst the emerging economies. Performance has been converging significantly towards that of advanced country peers over the past two decades.

5) When looking at the starting position of the Asian and Central Eastern European 'tigers' in the past 20 years, these countries already featured strong indicators on rule of law, human capital and infrastructure at the turn of the millennium. Hence, their success in retrospect does not come at a surprise and they are in a good position for the future.

6) A number of the emerging economies of Asia and South-Eastern Europe also show strong performance in these domains but the overall situation is mixed.

Slovenia and Vietnam are in a good position on all three accounts while a number of other countries performs well on at least two of them.

7) In all emerging countries, spending is high enough to finance the necessary productive spending, in some South East European countries it may already be rather high.

What are the implications for the future? Public expenditure in many advanced countries and especially in Europe is very high and perhaps too high to remain competitive with Asian and European peers (see also Schuknecht, 2022). Public expenditure in many countries could 'buy' citizens much better public goods and services. This suggests that a regime shift is necessary to move towards a more productive use of public spending (Schuknecht, 2020a; Buti and Székely, 2021). Expenditure on infrastructure and education are particularly important for future growth prospects. However, institutional settings matter more than public spending to achieve high quality education systems and infrastructure networks (Schwartz, et.al, 2020; Woessmann, 2016). Expenditure savings, prioritisation towards more productive spending and better spending 'governance' are needed so as to strengthen economic dynamism ([89]).

For 'tiger' economies in Europe and Asia, the findings suggest keeping governments lean and productive and strengthen performance in key areas so as to underpin growth and sustainability. This will allow emerging countries to further catch up with advanced economies. With the continued ascent of emerging economies, their relative weight in the global economy and in geopolitics will increase. This should be of a reason for satisfaction rather than concern.

While the COVID-19 pandemic dust is still settling, two developments stand out. Overall public spending increased hugely, notably in advanced countries. It is not clear yet whether spending levels and patterns will revert to pre-COVID times. That depends on how much of the growth decline and spending increase is permanent. But given high spending ratios in many advanced countries before the pandemic, these increases and rapidly rising public debt have decreased the scope of dealing with future challenges such as population aging, climate change or financial instability.

Moreover, the casual evidence in this paper does not suggest that more spending is linked with better government performance. At a time when many observers call for a stronger role of the public sector and higher spending, this study does not find evidence in support of such claims; on the contrary: 'tiger' governments tend to be productive and 'lean'.

([89]) Moreover, and beyond the scope of this paper, revenue collection is important. The adverse effect of financing public spending via taxes could be reduced significantly, if tax systems were efficient and if revenue was actually collected. The European Commission (2021) reports that some countries collect, e.g., 20 % or even one third less in VAT than statutory rates would suggest. There are also strong arguments that fiscal discipline provides incentives for higher quality spending due to the need for prioritisation (Schuknecht, 2020a). Delegation of fiscal 'quality control' to supranational levels could also be a way to getter 'better spending' (Buti and Székely, 2021).

7. INNOVATION AND COHESION POLICIES IN THE CONTEXT OF GLOBAL COMPETITION: TOWARDS A EUROPEAN 'VENTURE COMMONS' ([90])

Eric Brousseau, Jean-Michel Dalle

INTRODUCTION: IS ANYTHING WRONG WITH THE CURRENT EU INNOVATION POLICY?

In professional conferences, the idea that Europe should promote the development of a number of "deeptech valleys" — the figure of 100 being often quoted in policy slogans — to catch up with its two main technological competitors — the US and China — has recently been raised (e.g. Sifted, 2022). Many policymakers, whether at the EU level or at the infra-national levels, seem convinced that a wide number of 'innovation clusters' mimicking the Silicon Valley ecosystem should be developed. A great deal of middle size cities promote their own incubation system and call for support to their local start-ups by the Union or the National authorities. At the EU level, many of these requests are welcomed, and backed by member-states; which does not mean, however, that they are appropriately satisfied.

This current approach to support innovation seems to be related to the idea that one of the essential roles of the Union is to guarantee equal opportunity to all (countries, regions, cities). Given the logic of the treaties establishing the EU, it is indeed essential and relevant to guarantee to all citizens equal opportunities as far as it concerns education, social benefits, access to major infrastructures, etc. However, whether this approach is relevant to support innovation should be open to debate. Indeed, innovation is a "best shot" public good (Hirshleifer, 1983). Only the most efficient innovators and innovation ecosystems are necessary

([90]) This paper benefitted from the excellent help and inputs of Dilva Maupou (Agoranov) and from very useful comments by Istvan Szekely (European Commission). They are both warmly thanked. Usual caveats apply and the opinion expressed in this paper are those of the authors only.

to guarantee an optimal level of innovation, and equal access means then favoring the spread of innovation to all potential users (including subsidizing adoption). Innovation policies should therefore concentrate on supporting the most promising innovators. However, this might favor a permanent and growing geographic (and social) divergence, since spillovers of innovation (further opportunity to innovate, better jobs and remuneration, higher amenities in matter of education or culture, etc.) result into strong positive economies of agglomeration. This explains why EU and national public policies aimed at supporting a system of distributed clusters of innovation are so popular among public decision makers. Moreover, this echoes the legitimate will of each local community to highlight its innovative capabilities (reinforced by natural endowment, heritage, and traditions). This approach seems however to be driven by a misunderstanding of how innovative ecosystems work and what they are.

More precisely, while there is a general agreement around the idea that innovation capabilities do not depends upon specific individuals or organizations per-se, but from the fact that entrepreneurs and firms are embedded in an ecosystem made of stakeholders pertaining to different "species" — research labs, expertise tanks, governmental agencies, innovators, investors, etc. —, the exact nature of these innovation (or entrepreneurial) ecosystems is still debated. In a nutshell, at one end of the spectrum, lies the idea that the clustering of the set of capabilities/ stakeholders listed above should allow innovation. Whether a place-based set of entrepreneurs, firms and universities succeeds in becoming an innovation cluster is before all a question of management and governance. Either an historical heritage of entrepreneurship resulting in accumulated experience and appropriate behavioral patterns, or an adequate policy favoring alignment of interests and the development of infrastructures aimed at sharing knowledge and risks, and often the combination of the two, explain why a specific ecosystem succeed in being innovative or not. At the other end of the spectrum lies the idea that some (or a combination of) key ingredients — world class academic institutions, venture capitalists, incubators, etc. — are necessary to turn an eco-system into an innovative one. Both approaches might also correspond to different types of innovation: incremental vs. break-through or disruptive. This tension and debate has recently received a renewed and increased attention, in a post-Covid era, since the aim of a twin, green and digital, transition is seen by many as implying a more pronounced shift towards disruptive and break-through innovations (Buti and Szekely, 2021).

In this paper we will focus on the second type of innovation ecosystem; those who are able to generate a critical mass of start-up firms, and to turn some of them into unicorns. This does not mean that innovation is only driven by unicorns, since some successful start-ups can be acquired by large corporations. The capability to generate unicorns is however a signal of the ability of an innovative ecosystem to turn entrepreneurial projects into successful industrial ventures. This will therefore lead us to discuss entrepreneurial ecosystems (EES), a notion that has become common to describe the geographical concentration, and interdependence, of the many actors allowing the creation and development of innovative startups (Autio et al., 2014). The term was initially coined by business and public decisionmakers seeking to improve the conditions under which entrepreneurship and innovation

can thrive. Entrepreneurial ecosystems have rapidly become central in local, national, and international innovation policies (Gilbert, et al. 2004; Minniti, 2008), as innovative startups were drawing ever-increasing investments from venture capitalists and benefited from an intensified attention because of their potential to create jobs and economic growth (Birch, 1987; Thurik and Wennekers, 1999; Wong, et al., 2005). Following the leading example of San Francisco and the Silicon Valley, Austin, Boston, Los Angeles or New York in the US, Berlin, London, or Paris in Europe (Slush, 2017), among numerous others, have started competing against one another as entrepreneurial ecosystems, to support entrepreneurs and attract investors. In this context, the notion of entrepreneurial ecosystem has started to be actively investigated by economics and management sciences, both theoretically and empirically (e.g., Audretsch et al., 2018). We believe it is important to build on these on-going advances to explore more in depth the drivers of the competition among entrepreneurial ecosystems in order to contribute to the design of innovation policies and strategies.

We start by getting back to two alternative visions of innovation and innovation policies in the aim of highlighting that the vectors of innovation are different whether one consider incremental or break-through and disruptive innovation (section 7.1). The later crucially depends upon the development of entrepreneurial ecosystems, whose key characteristics are then explored (section 7.2). In section 7.3., we then highlight that a "power law" characterizes the distribution of EES at the global level; meaning that a few EES concentrate most successful innovation ventures. We link that to the crucial role of venture capitalism within EES, suspecting the existence of strong economies of scale and scope in the funding of entrepreneurial ventures. In a fourth section we derive policy recommendations for the EU, since what seems lacking in the European innovation eco-system is a networking of investments capabilities spread across poorly inter-connected place-based systems of innovation.

7.1. INNOVATION VS./AND COHESION

At first sight, two views of innovation policies seem to conflict. First, are policies oriented toward the promotion of "best-in-class" inventors or entrepreneurs. They are in line with a macroeconomic approach of endogenous growth — as illustrated by Phelps (2006) or Aghion (2016) — highlighting how radical innovations allowing the emergence of general-purpose technologies (GPTs), stimulate spillovers across the whole productive system and, *in fine*, substantial productivity gains in the long run. The focus is then on unlocking potential barriers to innovations (e.g., regulations), leveraging incentives for entrepreneurs and investors (e.g., lowering taxes), and supporting the development of clusters aimed at generating knowledge and facilitating transfers with the industry (i.e., world class research universities combined with an innovative entrepreneurial system). Second, in line with a microeconomic approach of innovation processes, insisting on the role of localization effects and highlighting that the reality of innovation is not reduced to high-tech and cutting-edge research, is the Smart

Specialization Strategy (3S) developed by Foray et al. (2009, 2011), which became a central reference for the European Commission policy from the 2010s. In a nutshell it consists in analyzing the local endowment of each 'Region' (recognized as such within EU member states) so as to identify the potential bottom-up processes of innovation that could improve the competitiveness of the (regional) productive system, and then to support through specific (regional) industrial policies — combining a planning and an "entrepreneurial discovery" logics ([91]) — a transformation/agile specialization of the industry. ([92]) The focus is then on decentralized governance allowing local authorities, in close cooperation with the local entrepreneurship ecosystem, to target support to specific branches and technologies; this support being a mix of subsidies, public service provision (e.g. targeted professional training), and active development of relational networks aimed at favoring the emergence, adhesion and implementation of a shared vision of the adequate regional differentiation relying on an appropriate distribution of roles among stakeholders in function of their preexisting capacities, and of the possible co-evolutions of the later.

Being grounded on different approaches of innovation — a top-down one driven by scientific progress vs. a bottom-up one based on marginal and cumulative improvements —, the policies translate into contrasted strategies: a structural policy based on competitive selection, vs. a targeted industrial policy based on strategic political choices. On the one hand, these two policies can be considered as alternatives since they rely on different approaches — free market (once innovation occurred) vs. governmental interventionism — with contrasted levels — national vs. regional — and distinctive channels of public intervention — provision of generic vs. specific inputs and capabilities (in the sense of Hausmann and Rodrik, 2006) —, triggering different distributive consequences in the short run; social and territorial cohesion not being priorities in the first case. Moreover, they rely on contrasted economic logics and dynamics. Generic innovations are more capital intensive because of the requested volume of R&D and industrial investments necessary to guarantee successful innovation efforts, and the quick scaling up at the global level to appropriate the benefits of innovation, before being imitated or bypassed by other global players. Incremental innovation requests percolation by cooperation and imitation to allow a collective appropriation of the innovation and its benefits. The strategic arena is also different: global vs. inter-regional.

([91]) This combination is supposed to allow benefitting from coordination among the stakeholders of a regional ecosystems (thus minimizing market failures), while avoiding traditional governmental/bureaucratic failures resulting in wrong choices of specialization, biased selection of winners, and market distortions. Discovery is based on a principle of deliberation among the stakeholders of the regional ecosystem to identify, select and support adequately the targeted specialization.

([92]) As pointed out by Foray et al. (2011), and in line with the development orientation of Haussmann and Rodrick [2003], "For many regions and countries it may be the case that the most important « innovations » are not technical but instead consist in the revelation of the particular business orientation that currently should be pursued in directed inventive and innovative activities". (p.7), Smart Specialization is less oriented toward radical/paradigmatic innovation than toward regional development.

On the other hand, these two policies might be considered as complementary since the first clearly targets generic and break-through or disruptive innovations, fed by frontier research and aimed at developing new GPT and related business models, while the second considers incremental transformation anchored in each regional industrial heritage, specific capabilities, and accumulated experience.

Both approaches built on the accumulated academic and practitioners' knowledge on innovation processes, but do not pertain to the same policy logic. In fact, the "endogenous growth" one is clearly aimed at boosting total factor productivity in the long run. It takes for granted that that the world economy is now involved in a knowledge-based growth regime, in which innovation is driven by science, and competition is inherently global. Players are in a global head-on competition, and national governments have to provide (institutional) infrastructures to support their research and entrepreneurial communities to maximize their ability to innovate, absorb innovations made elsewhere, articulate the necessary resources to appropriate the benefits of innovation (i.e. industrial and marketing capabilities), and built on all these components to develop successful businesses, hopefully resulting in the long run into collective benefits (jobs, internal demand, fiscal and exportation revenues, not forgetting innovation spillovers). Moreover, the propagation of generic technologies triggers the development of new applications in a great deal of sectors as well as the formation of new capabilities which result in pervasive productivity gains (Bresnahan, 2010).

By contrast, the 3S approach has been clearly developed as a regional development policy aimed at leveraging the local capabilities to innovate observed in the context of historic "industrial districts" (Marshall, 1919; Becattini et al. 2009) to favor a better integration of regions in the transnational division of labor (Foray, 2018a, 2019). ([93]) The political aim is to favor economic and political convergence by triggering industrial and commercial differentiation across regions allowing each of them to leverage its comparative advantages. It relies on the idea that (European) regions having very contrasted capabilities, levels of wealth, institutional and cultural endowment (Boschma and Gianelle, 2014; Frenken et al., 2007), uniform development policies would inevitably fail and result into reinforced inequalities across regions, and polarization among those which would be included in the core of the global economy and those who would stay at the periphery. Each region is therefore invited to identify some key domains in which new combinations between capacities and opportunities would be explored.

We are keen to embrace the "complementarity" approach of the two policies. However, it leads to establish a distinction between what pertains to an "innovation" policy and what is a component of a "cohesion" policy. According to us, the support to start-up firms should clearly be a driver/central piece of an "innovation" policy. Indeed, as pointed by the 3S literature, regional innovation dynamics are based on pre-existing economics stakeholders, which innovation

([93]) That said 3S reccognizes the fact that there are three types of innovation processes — Modernization (of an existing productive system), Transition/Diversification (toward new markets), and radical (re)foundation — that lead to different modes of insertion in the global economy.

capabilities might be boosted by an adequate public support. To the opposite, start-ups are key links between the new knowledge developed by scientific organizations, networks of highly skilled professional experts (i.e., epistemic communities), and large corporations operating R&D capabilities. Their aim is clearly to recombine existing knowledge, often at the frontier of research (or at least of professional practices), to articulate it with the one of industrial and commercial experts, and to turn it into consistent projects to be proposed to investors as well as to industrial or commercial partners to disrupt a market, a business, or a techno-economic paradigm. The uncertainty is high, not only because a wide set of technological, organizational, and industrial challenges have to be overcome to result into a marketable product or competitive process, but also because success is depending upon reception/adoption by the demand side (which articulate the users and the public authorities, which might consider the collective interest, and sometime the vested interest), as well as of the reactions and competitive innovations by incumbents and other new entrants.

While these two policies might be complementary, they have different targets and should rely on distinct tools and levers, since they address contrasted logic of innovations associated to distinct systems of innovations.

The smart specialization theory relies on case studies as the one of the eye-glasses industry in Morez in the French region of Jura, where an entrepreneur in the early 19th century was able to shift from the production of hobnails to the production of thin metal frames for spectacles, triggering imitation and complementary innovation by competitors, as well as support policies by local authorities. In the early 21st century innovation conditions are different from the one of the first industrial revolution. First, in this fourth phase of the industrial revolution, innovation tends to be more science-based, which make the access to scientific knowledge crucial, and the innovative process less bottom-up (i.e., by production engineers involved in workshops and factories). Second, and in line with the previous point, the raising capital intensity of innovation result into a more head-on competition among innovators who have a strong incentive to write off their fixed R&D cost on the widest market they can, which is facilitated in the context of a globalized economy. Third, the combination of globalization and development triggered a proliferation of innovative eco-systems resulting in more distributed capabilities to imitate first innovators and scale-up (see Figure 36). Lead-time advantage tends therefore to shorten and capacities to accelerate "maturation" processes are essential. As a result, entrepreneurial-based competitive advantage should rely more on capabilities to leap-frog (i.e., generate disruptive innovation) on a repetitive, if not permanent, basis. The receipts from the past might be of insufficient help, at least when it comes to policy aimed at favoring radical innovation.

7.2. ENTREPRENEURIAL ECOSYSTEMS (EES) AND THE ROLE OF "VENTURE COMMONS"

It is now widely recognized that innovation draws from ecosystems made of complementary players building and sharing a common pool of resources. These resources include "entrepreneurial knowledge"— which combines knowledge about science, technology, and engineering with knowledge of market growth potential and possible competitors — as well as the whole set of inputs and services required for launching a new activity.

An important dimension of these ecosystem is that they are placed-based, ([94]) since part of the circulating knowledge is tacit (non-codified). It is certainly the case of a large part of the technical and managerial know-how that is necessary to launch and scale-up a new project. This is also linked to the fact that individual characteristics matter a lot in small teams, which is one of the essential features of start-up firms. Not only the characteristics of the lead-persons matter, but also those of the members of the core group are essential since they must be complementary and need to trust each other. Thus, the forming of teams, their recompositing and their enlargement occur in an environment where people need to meet in-person and in different contexts. Moreover, exchanges of information and knowledge develop beyond the frontiers of each start-up, that is, at the ecosystem level, and again, proximity plays an important role in allowing them. Beyond information and knowledge , members of innovation ecosystems share a whole set of resources: the externalities provided by academic and research institutions, by the concentrations of talents, and by the flow of inputs — from public money to services provision — that comes with the attractiveness of a fast-growing agglomeration. As it will developed below the wide set of requested capabilities to fund the launching and development of new projects is also a strong driver of agglomeration effects. It has been widely documented that venture capitalists and bankers play an essential role of counseling and go-between among entrepreneurs... who they need therefore to know in person.

In other words, access to other people and their ideas and experiments, as well as the information they generate or circulate is essential. What Potts (2022) qualifies as "innovation commons" are requested because of the uncertainty about the nature of new ideas and the entrepreneurial opportunities they represent, because cooperation among different skills is needed, because re-distribution of project-monitoring rights might be necessary to foster the development of

([94]) The 3S literature does not develop a specific analysis of "local"/place-based innovation systems. The unit of analysis is clearly the "region", and the goal is to design "policies" aimed at promoting development at this level, whatever the initial endowment of the socio-economic system. It is therefore a methodology grounded in innovation studies aimed at providing public decision makers with principles to design a policy adapted to the specific capabilities available in the considered region thanks to the combination of strategic choice/planning logic and a decentralization of initiatives/entrepreneurial discovery logic. Clearly break-through/disruptive innovation and frontier research are not viewed as the only sources of productivity, growth, and development. To the opposite, each region is invited to particularize itself by identifying some combinations between opportunities and capacities, to establish and strengthen a competitive advantage. See, in particular, Foray (2018a, 2019)

projects (including to allow the development of complementary projects necessary to ensure the adoption and diffusion of a given technology). All these elements request multi-directional and multi-dimensional interactions among individuals, and are boosted in the context of dense and relevant social networks, ([95]) allowing information sharing and screening, revelation of latent externalities, as well as network and coalition forming. It might contribute to reduce the risks and costs of failures, either for inappropriate design of the technology, or of the business model, or of the organizational arrangement, or even for unexpected coalitions competing and fighting incumbents' innovation.

According to Potts (2022) and many others who refer to the notion of "commons", two key dimensions seem to be intertwined: the existence of a "common pool" of resources and principles of co-operative governance (see Box 1). However, even if some resources can be managed "co-operatively", common pools are not necessarily governed cooperatively. Indeed, alternative regimes of governance can be relied upon to manage the pool of resources. The reference to commons is frequently made to qualify a regime of governance by which a "democratic" system allows all the "commoners" to cooperatively manage a common pool. However, as highlighted by many historical examples, key elements of the common pool could be privatized, or 'nationalized', transforming the co-operative governance regime, into, respectively, either a quasi-corporate governance one (with tradeable shares and coalitions among shareholders), or a public policy one (in which political coalitions make decision about the government owned assets). Moreover, historical analysis of commons show that co-operative governance regimes may fail, and often do as time goes (de Moor, 2023). Therefore, it is important to qualify the nature of the resources involved in the common pool to analyze their economic properties, before analyzing in a second step the principles of governance to align actions and incentives of the stakeholders involved in the development and management of the pooled resources.

As pointed above, entrepreneurial ecosystems, rely before all on place-based social networks aimed at sharing/circulating, then pooling, a wide set of information, knowledge and skills embodied in individuals. These "information circulation" capabilities facilitate identification of opportunities and projects screening. In addition, they provide a mechanism to collectively develop entrepreneurial capabilities, and a related market for skills (labor market but also consulting services). Second, ecosystems provide shared access to physical resources (e.g., labs, workshops, logistic platforms, industrial capabilities, etc.), that are essential to develop, test and upscale concepts. Third, entrepreneurial ecosystems provide access to funding capabilities, which are needed to finance the detour of production; i.e., the time gap between revenue collection (industrial exploitation) and expenditures (R&D and industrialization). On that matter, two major challenges need to be addressed: first, the ability to mobilize large volumes of capital — the more radical the innovation, the higher the critical

([95]) Typically, a network exhibiting a low diameter and a scale-free structure — which results into a power law distribution of connections among nodes/individuals, resulting into a hierarchy of connectiveness across individuals — allows some central/star individuals to connect a wide set of individuals and to increase the "conductivity" of the whole network. For more on network see Jackson (2008)

mass of investment requested to bring the outcome to the market —, and second the speed at which a given project could be funded; the ability of reaching the market before competitors being a key competitive advantage, since it allows to influence the dominant design of the technology (Anderson and Tushman, 1990). Entrepreneurial ecosystems allow entrepreneurs to access funding capabilities, and investors to pool risks. We propose to identify as "venture commons" this combination of information circulation capabilities, physical capital, and funding capacities that are pooled in an entrepreneurial ecosystem.

Entrepreneurial ecosystems are in practice mechanisms allowing different stakeholders to be involved in a "co-opetitive" process (Brandenburger and Nalebuff, 1996) of information sharing, ideas selection, skills articulation, collective deliberation, and capabilities coordination allowing to explore alternative concepts, develop and test prototypes, launch innovation, and scale up those which seems promising. In such ecosystems, the few successes are largely the result of accumulated experience, which include the one derived from the many failures. The ecosystem is key, both to allow recombination and to support socialization of losses and benefits. Socialization of losses allows reallocation of capabilities instead of losing them and is key in guaranteeing a willingness to take (significant) risks. ([96]) Socialization of benefits is one of the drivers of the attractiveness of an ecosystem for talents, on the one hand, for investors, on the other. In such a "co-opetitive" system, governance is key. It consists mainly in selecting the projects to be developed further and reallocating the means among projects and among stakeholders.

When it comes to governance, and in line with the economic literature on common pools (e.g., Ostrom, 1990; de Moor, 2023), proximity plays an essential role in allowing the contributors to the common pool to align their interests. This is true both because a minimal level of trust is needed, and because competition by those who are external to the commons is a strong factor of cohesion and discipline.

The contribution of Ostrom also highlights a very important dimension for the governance of commons: polycentric governance; that is a complex form of governance with multiple centers of decision making, each of which operating with some degree of autonomy. This is precisely what is characteristic of entrepreneurial ecosystems. In many 'innovation policy' discussions, two main types of players are often considered: on the one hand the entrepreneurs (mainly understood as technology or marketing specialists) and, on the other hands, the policy makers (mainly understood as 'neutral' third parts among the stakeholders, driven by the will to promote the collective interest, and therefore able to play the role of facilitators). The specificity of investors/venture capitalists tends then to be under-estimated, and the public authorities are often considered as those which should solve the "market failures" resulting from the externalities characterizing an innovation ecosystem (i.e., the need to share information, to develop common

([96]) 9 out of 10 startups no longer exist ten years after they were launched. 20% of startups fall apart after a year. 30% of startups close within two years. 50% of startups shut their doors within five years. 70% of startups dissolve within 10 years. Source: https://firstsiteguide.com/startup-stats/

resources, to coordinate investments, and to select some players/solutions against competitors in the same eco-system to avoid means dilapidation). ([97]) It has been widely documented, however that the venture capital industry plays a major role in the coordination of entrepreneurial ecosystems, that requires a detailed understanding of the externalities and of the innovative complementarities.

Venture capitalists and investment bankers organize hearings of entrepreneurs, seat in the boards of the firms they support, are involved in the training and selection of CEOs, provide them with consulting service, etc. They have the right incentives to select and support entrepreneurs and allowing them to rapidly reach a critical mass, once they have demonstrated the sustainability and perspectives or their model. Of course, they might be individually/organizationally biased, but they form de-facto a distributed community of independent decision makers, limiting the risk of systemic errors. Moreover, an entrepreneurial ecosystem also gathers all types of public decision makers (pertaining also to partly independent bodies: local governments, national ministries, European agencies) and private ones (industrial firms, NGOs, entrepreneurs, etc.), who have also a say in the distributed system of selection and reallocation.

BOX 1. THE GOVERNANCE OF COMMONS, THE ORGANIZATION OF INNOVATION ECOSYSTEM, AND INNOVATION POLICY

The "Commons model" has been recognized as an institutional arrangement likely to support innovation (e.g., von Hippel, 2005; Benkler, 2006, Ostrom and Hess, 2007 Frischmann et al., 2014; Potts, 2019). By cooperatively pooling ideas, data, and experiments about news uses of technology and de facto sharing the costs of development, Schumpeterian entrepreneurs can discover new opportunities under conditions of extreme uncertainty. It is the model behind the so-called "open-source" technologies (e.g., Allen 1983, Harhoff et al 2003, Bessen and Nuvolari 2016).

([97]) In the context of the break-through, disruptive innovation, the figure of the investor is central, while in context of the less capital-intensive incremental innovation process and 3S policy monitoring is in the hands of the industrial firms and the policy makers. The later are responsible for favoring coordination of strategies, providing specific public goods, boosting knowledge sharing, and managing redistribution. Indeed, imitative entry by the firms involved in the ecosystem constitutes a key ingredient of smart specialization, in order that agglomeration externalities can be realized, economies of scale can be reached, and, also, because, by pushing market prices towards marginal costs, competition allows translating innovation into a collective competitive advantage on the interregional market, triggering collective benefits. Imitation within the ecosystem, calls however for a redistribution from those who are the beneficiaries of the increased competitivity/productivity (typically by exporting from regions) in favor of those innovators that suffer from an imperfect appropriation of the benefits of their innovation. Hence the fiscal role of (local) public authorities in this model.

For some authors, like Potts (2022), the open-source model is adaptable to all kind of technologies, not only digital ones, and should also inspire public policies. Thus, innovators should create communities mimicking the software developers' ones, and exchange resources through contracts inspired by the open-source licenses (e.g., copyleft), while public authorities should develop digital platforms aiming at favoring the matching between the various stakeholders of innovation ecosystems and allowing these players to benefit from low-cost self-governance solutions fully embedded in the technology (i.e., blockchains and Web 3).

That said, open-source software communities perform because contributors are subsidized by their public or private employers (which expect returns on their investments in terms of externalities provided by a vast reservoir of skills; cf. Lerner and Tirole, 2005), and because the need for interoperability discipline players (common standards). Moreover, software is a specific "technology", since the writing of code immediately turns into usable outcome (or input). There are no constraints of industrialization, logistic management, and access to complementary inputs, and therefore, no need for funding anything beyond the design of the concept. It is therefore not for sure that the organizational arrangement characterizing ppen-source innovation could be relied upon for any type of innovation.

When it comes to policy intervention, Potts (2022) opposes two policy models : the "free innovation" one — which emphasizes the discovery and welfare-enhancing qualities of a bottom-up, civil-society-led, global innovation framework powered by information platforms — and the "traditional" one — mostly based on state subsidies to the supply side either by providing generic infrastructure or by hear marked grants to entrepreneurs, which suppose bureaucratic/political selection of the targets. ([98]) These two "policies" rely therefore on different tools; respectively information exchange and funding provision and address two different sets of "markets failures": information externalities among the different stakeholders of an innovation ecosystem vs. capital market failures due to the uncertainties characterizing the innovation process that make difficult to reach the critical mass for funding the requested R&D and industrial investments. It is not for sure, however, that this second class of market failures would be resolved by information platforms.

([98]) From that perspective, both the "endogenous growth" innovation policy and the 3S inspired policy pertain to the same category of traditional policy since they rely on political/bureaucratic capabilities to detect and decide which innovation process should be supported. The 3S policy is simply more decentralized; relying on the efforts of local entrepreneurs to discover new opportunities, and of local authorities to evaluate potential and identify the actors to be supported). It is certainly not led by users and by (more) democratic processes of decision.

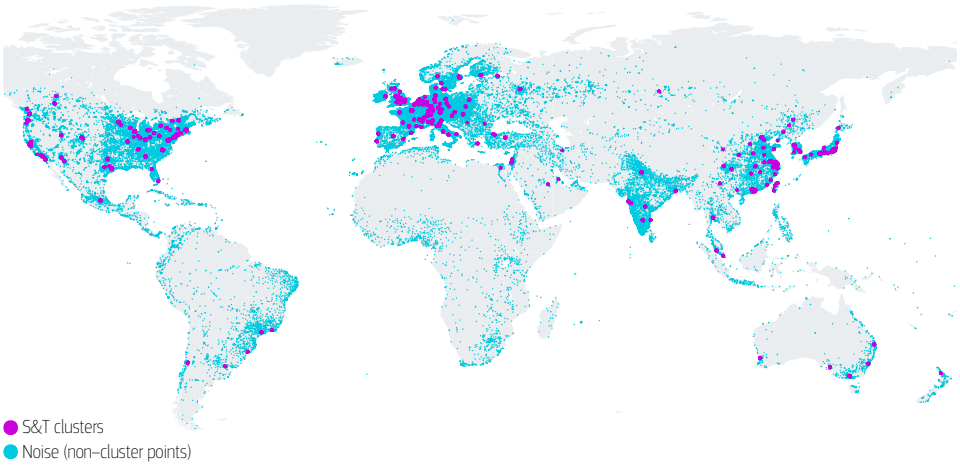
These developments about the nature of ventures commons allow to highlight some of their economic properties. In particular, they are characterized by economies of scale (and scope) as the interpersonal networks aimed at sharing of information and knowledge, fixed cost of physical resources, and capabilities

to attract and re-allocate capital result into decreasing entrepreneurial cost as the number of projects/stakeholders increases. Moreover, these economies are boosted as an appropriate regime of polycentric governance — i.e. with a diversity of decision makers, and the presence of skilled venture capitalists — allows to maximize screening effectiveness, learning capabilities, and socialization of risks.

7.3. THE IRON (POWER) LAW OF INNOVATION ECOSYSTEMS

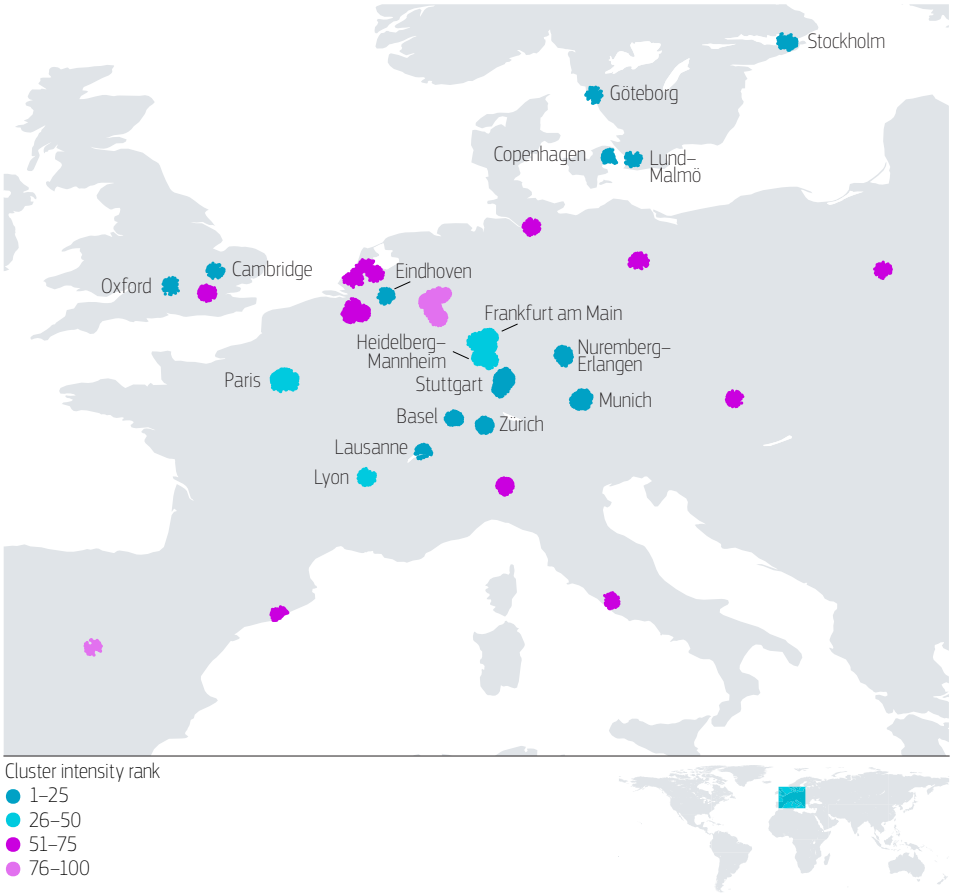
Recognizing that agglomeration effect matter for innovation, the Global Innovation Index published by the World Intellectual Property Organization (WIPO, 2022) highlights the world's largest top 100 science and technology (S&T) clusters (see Figure 36) – that is, the geographical areas around the world with the highest density of inventors and scientific authors. Europe (including the UK) accounts for 24 of those 100, while only one cluster (Paris) rank within the top ten. Among the top 10, Tokyo–Yokohama (Japan) is the top-performing cluster, followed by Shenzhen–Hong Kong–Guangzhou (China and Hong Kong, China), Beijing (China), Seoul (Republic of Korea) and San Jose–San Francisco (United States). The US and China have both 21 cluster in the top 100 and many of their clusters are much larger than the European ones. That said, when measured in terms of intensity (size of the ST clusters/size of the local population), Europe ranks very well: 11 EU clusters in the top 25 and 2 for the UK (see Figure 37). This first approach of innovation ecosystems highlights the inequalities among clusters as well as the de-facto global competition among places to attract talents and investments which are necessary to become a competitive player.

Figure 36 / **TOP 100 Science and Technology clusters (measured by the number of patents and scientific publications)**



Source: WIPO Statistics Database, April 2022.
Note: Noise refers to all inventor/author locations not classified in a cluster.

Figure 37 / **EU S&T Science and Technology clusters by intensity (measured by the number of patents and scientific publications/inhabitant)**



Source: WIPO Statistics Database, April 2022.

Although the existence of inequalities between entrepreneurial ecosystems is well-known, the magnitude of these inequalities is not always properly taken into account when designing innovation and cohesion policies. Entrepreneurial ecosystems indeed are characterized by the emergence of strong, power-law like inequalities, fueled by strong economies of agglomeration at the city level with positive spillovers organized in concentric circle. Moreover, as in the case of the spatial distribution of cities, the geographic organizations of Entrepreneurial Ecosystems (EES) seems to follow a spatial so-called fractal structure (smaller EES are sub-sets of larger/more central EES as the imbrication of smaller city economies into the economy of larger cities; cf. Mori et al, 2022 and box 2 and Figure 38).

In this respect, in the previous section we highlighted that the "venture commons" characterizing entrepreneurial ecosystems are sources of economies of scale, which are plausibly at the origin of the central place property (CPP) and the

hierarchy property (HP) characterizing entrepreneurial ecosystems. In a globalized economy, there are several reasons why these power-law inequalities increase. The global structure of the economy — thanks to a common info-structure and a wide scale logistic and commercial infrastructure, as well as institutions favoring global trade (from intergovernmental trade agreements to industry associations; see Brousseau and Glachant, 2023) — allows entrepreneurs to scale up their activity at a very high pace (e.g., US and Chinese big tech, but also pharmaceutical innovation, services, etc.). And, while adoption is becoming potentially global, imitation, and further innovation/development by multiple competitors tend to be rapid, raising the intensity of the competition in innovation. To tackle this speed challenge, innovators should benefit from an ecosystem allowing them to improve their innovation at the appropriate pace (accelerate the management of the learning process, both within organizations and by interactions with the users, and other stakeholders) and to fund their development: hence the cruciality of the acceleration and consolidations phases after the seed stage, and the importance of the entrepreneurial ecosystem benefiting to a a startup.

BOX 2. THE ECONOMICS OF AGGLOMERATION

In a recent paper, Mori et al (2022), explore the origin of power law in city size. The so-called Common Power Law (CPL) highlights not only a difference in size across cities but also in diversity (which larger cities experience more) (Mori et al, 2020). It results into a Hierarchy Property (HP) by which larger cities perform more diverse activities than smaller ones. Moreover, the city system exhibits a fractal structure by which larger cities are spaced apart to serve as centers for surrounding smaller cities, generating a similar pattern across different spatial scales (Batty and Longley, 1994).

Mori et al. demonstrate that this phenomenon might have its root in endogenous economic forces that govern agglomeration and dispersion of different industries, in line with the central place property (CPP) identified by Christaller [1933]. It asserts that diverse city sizes accrue from diverse scale economies across industries. Larger cities concentrate activities characterized by higher economies of scale resulting in a hierarchy across cities (Hsu, 2012). At each layer, every city is associated with its hinterland where it supplies its goods to smaller cities in the lower layers, where those goods are not self-supplied. The size of cities is limited by the cost of distributing/accessing the goods and the services away from the city. As a result, the city system exhibits a hierarchical ladder in which the set of industries found in a smaller city is a subset of that found in a larger city (hence, the hierarchy property, HP).

The origin of the phenomena is linked to the interaction between supply and demand. Consumers prefer locations with better access to a wider range

of goods. A large concentration of firms promotes a large concentration of consumers, which in turns provides an incentive for firms in different industries to spatially coordinate. Then, for a given population distribution, some cities are not profitable for investors in industry i, because they are too close to i-industry's competitors in nearby cities, explaining also strategic choices of localization by investors and the geographical dispersion of investments in each industry given the specific economies of scale and distribution characterizing it.

The model ignores exogenous differences across locations due to geographical advantages, available natural resources, and other historical factors that may explain the precise location and characteristic of each large city ecosystem. However, the interplay between preference for diversity, cost of access to industry output and economies of scale seems to explain the power law characterizing city ecosystems.

The recognition of entrepreneurial ecosystems as a central dimension of the dynamic of innovation has been accompanied by an increased availability of datasets of startups and investors, opening avenues for measurements (e.g., Leendertse et al., 2021) and empirical investigations. We attempt to rely on these data to clarify the magnitude of the inequalities among EES. Although innovation is intrinsically difficult to measure (the limitations of patents and publications as proxies for industrial achievement and conceptual advances are well known; R&D expenditures are inputs not outputs; etc.), and most significant dimensions of EES are subject of discussions among specialists, the situation where policymakers need to take decisions with respect to innovation on the basis of very limited, imprecise and incomplete, often anecdotal information (focused on some success stories), is not satisfactory. Used with caution, empirically grounded metrics and tools can help analysts and decisionmakers tackle analytical and strategic challenges, notably by contributing to raise their collective awareness about the relevance of venture funding as a key driver of the growth and development of entrepreneurial ecosystems.

In this vein, not only is the volume of fund raised an indicator of the ability of an ecosystem to generate several new ventures, and to turn some of them into success (i.e., unicorns), but fundraising speed is also a crucial element to guarantee the competitive development of innovative startups (since it is the determining factor of the pace at which a startup can hire talents, perform its R&D, and develop its operations and sales), and the ability of an ecosystem to reach the critical mass of innovative businesses (triggering strong economies of scope among them). The ability to raise funds is of course influenced by characteristics of any given startup, notably by the experience of its founders, by its competitors, etc. But, independently of these individual criteria, the speed at which startups raise funds is a key characteristic of its ecosystem, taken into account by entrepreneurs and founders when assessing the dynamism and vibrancy of any ecosystem, and a key

element that policymakers should take into account when considering innovation policies.

Using data from Crunchbase (Dalle and den Besten, 2017), and following Gastaud et al. (2019) ([99]), in making use of the TreeMaps FoamTree package that allows to display hierarchical data as nested polygons tiling the plane, each cell having a surface proportional to a specific dimension of the data, as is general in tessellations and TreeMap representations, Figure 38 presents a visual comparison of the larger international entrepreneurial ecosystems in terms of startup funding, as of December 2022. Each cell of the map corresponds to a startup, its surface representing the amount of funding received by the startup and its color the speed (in dollars/month) at which these funds were raised, darker colors being associated with higher fundraising speeds.

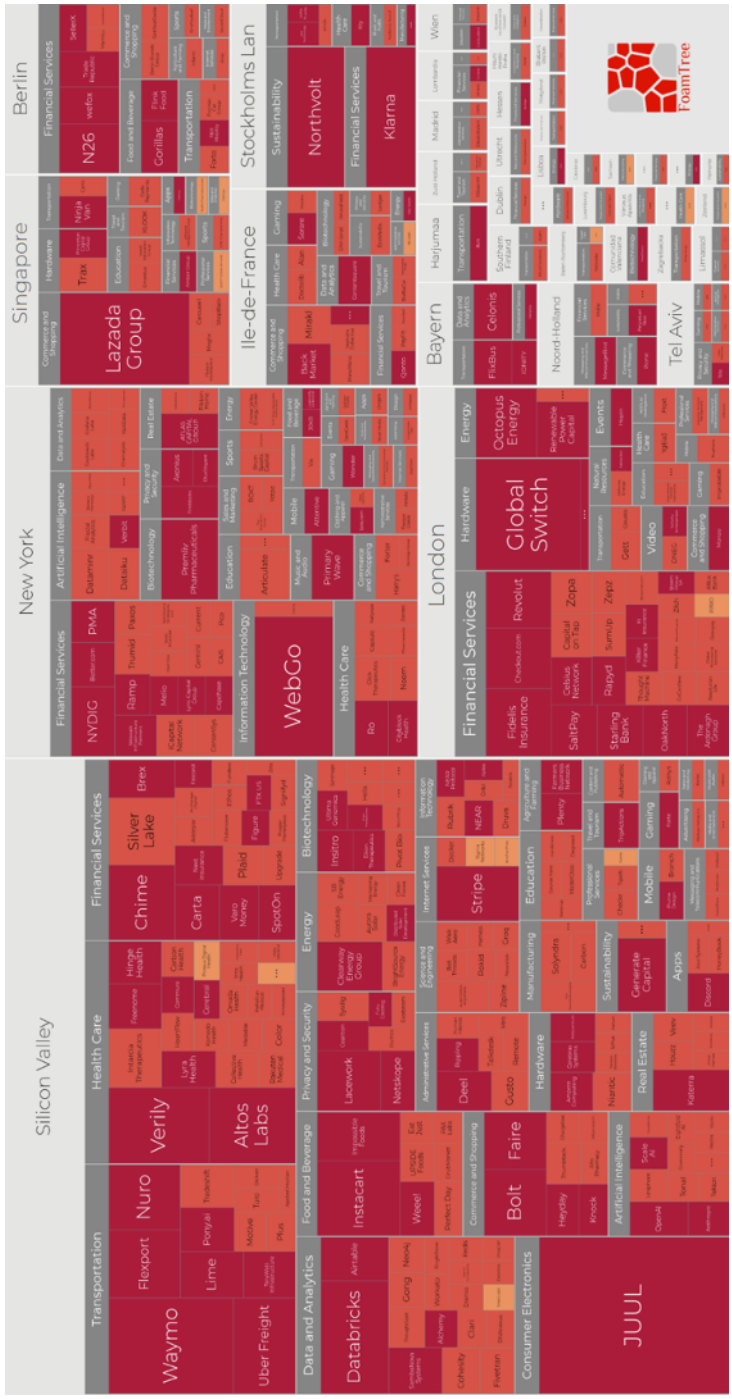
Figure 38 (top) corresponds to a set of international ecosystems, in order to compare the largest European ones with several others in the US (Silicon Valley, New York) and elsewhere (London, Singapore, Tel Aviv), while Figure 38 (bottom) focuses on EU27 entrepreneurial ecosystems. Both figures clearly suggest a sharp prevalence of a limited number of ecosystems with respect to others: in the world (Figure 38, top), the Silicon Valley and New York, followed by London, largely outperform Singapore, Berlin, Paris or Stockholm in terms of startup funding; while in the EU27 (Figure 38, bottom), Berlin and Paris, followed by Stockholm, clearly outperform others in this same respect ([100]).

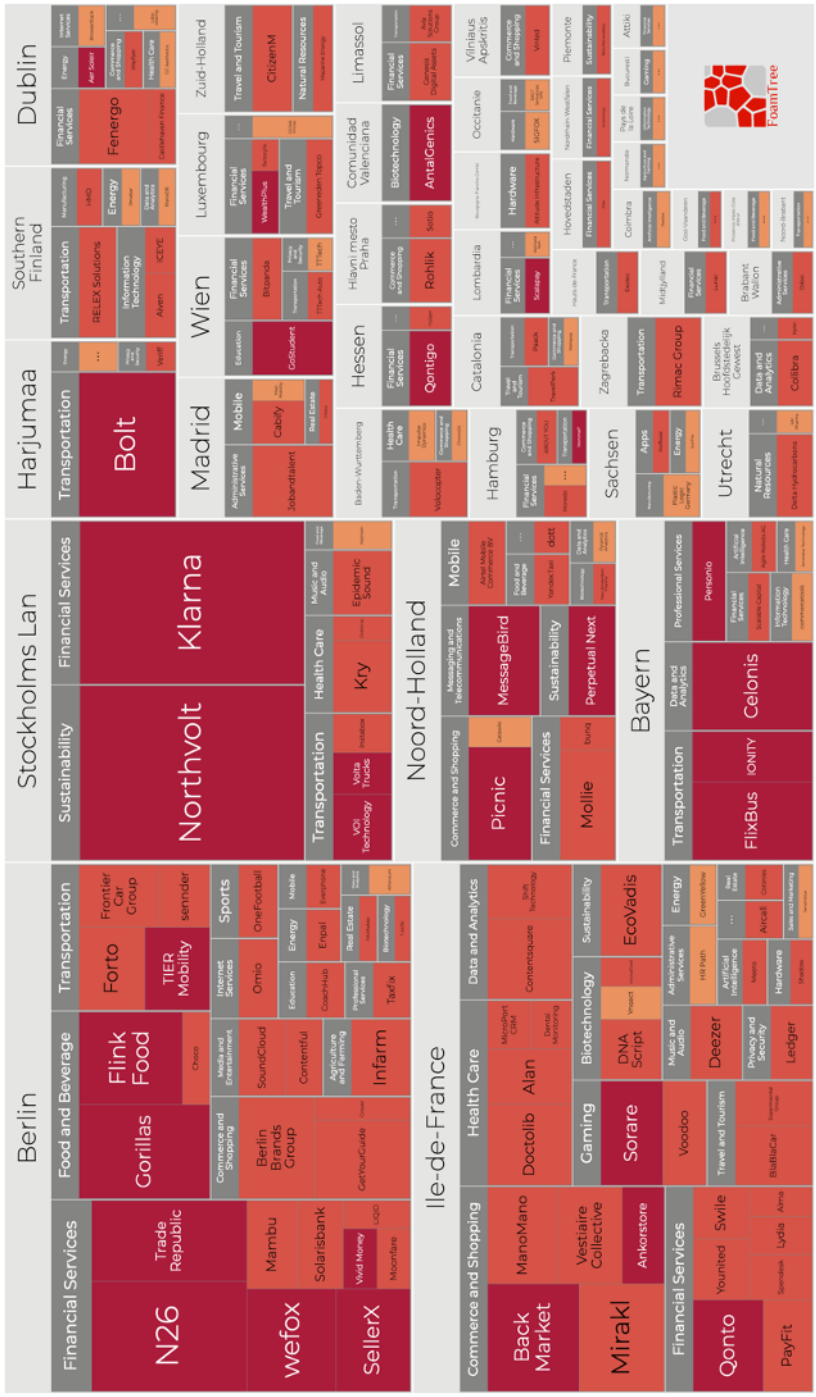
When focusing on the 200 largest startups (in terms of funds raised), Silicon Valley startups represent more than 153 B$, with an average funding speed of 110 M$ per year, compared to $72B and 53.5 M$/year for New York, while Berlin represents $24B with a fundraising speed of 22.5M $/year and Madrid $4.5B with an average speed of 3.3 M$/year. To put it differently, Silicon Valley startups have raised 6.4 times more funding than startups in Berlin and 34 times more than startups in Madrid, and they raise funds 5 times more rapidly than startups in Berlin and 33 times more rapidly than startups in Madrid.

([99]) Gastaud, et al. [2019] present empirical evidence suggesting that entrepreneurial ecosystems increase in sectoral diversity as they grow larger and therefore tend to be more robust i.e., both resilient to the economic climate and less subject to specific industry trends. They explain this through the successive rounds of allocation of funding to startups in a given entrepreneurial system which mix exploration of new opportunities in other industries and exploitation of financially successful ventures in existing ones.

([100]) The leading role of Berlin as a startup ecosystem is markedly different from its ranking as a cluster (see Figure 37 above), which could be related to the importance in the Berlin ecosystem of successful B2C startups and on the leading role that players such as Rocket Internet could have had in this context. It also strengthens the argument according to which the success achieved by an agglomeration in developing a S&T cluster is not necessarily correlated to its success in generating a vibrant entrepreneurial ecosystem, and that deeper analyses are needed to understand better the interplay between both. It highlights also the role of institutions and notably universities with respect to their contribution to human capital accumulation (Tebaldi and Elmsie, 2013; Buti and Szekely, 2021).

Figure 38 / **Several large international entrepreneurial ecosystems (1a, top) and EU27 entrepreneurial ecosystems (1b, bottom)**



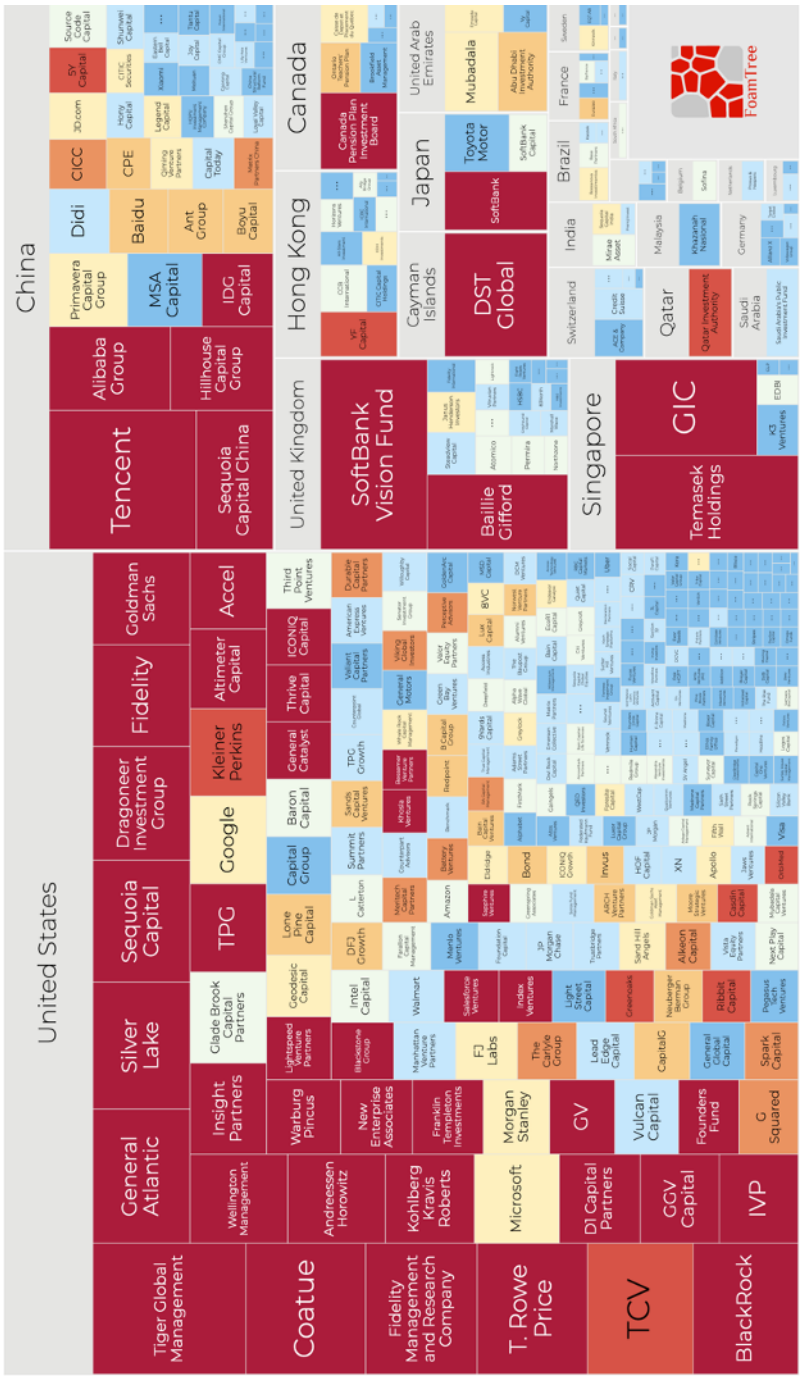


Surface of tiles represents the amount of funding received by a startup; colour represents its fundraising speed in dollars per month, darker colours being associated with higher speeds. Sources: Agoranov & Crunchbase, startups created between 1995 and 2022.

Figure 39 presents the global startup funding landscape, in terms of funding players, still as of December 2022. The size of the tiles represents the total funding of the startups funded by a given investor, while their color represents the number of investments made by a given investor, darker colors being associated with more numerous investments. EU27 investors are almost invisible on this map that highlights the power of US-based investors, followed by China, the UK and Singapore.

Here again, and probably in an even more pronounced way, the magnitude of the inequalities between entrepreneurial ecosystems is clearly visible. While investments by US investors have on average grown by 8.9 billion $ per year over the period from 1995 to 2022, this figure is only of about 550 million $ per year for a country like France, i.e., around 16 times less rapidly, while it is only 84M$ in Spain i.e., 6.5 times less than in France and 105 times less than in the Silicon Valley.

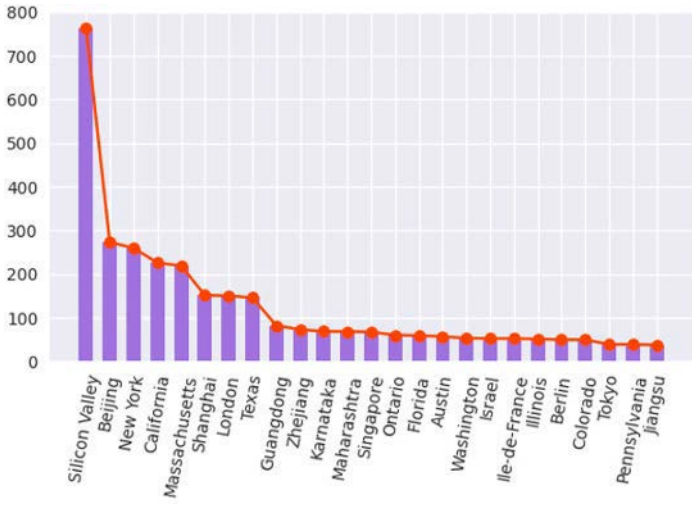
Figure 39 / **Startup investors, by countries**



Size of tiles represents the total funding of the startups funded by a given investor, colour represents the number of investments, darker colours being associated with more numerous investments.
Sources: Agoranov & Crunchbase, startups created between 1995 and 2022.

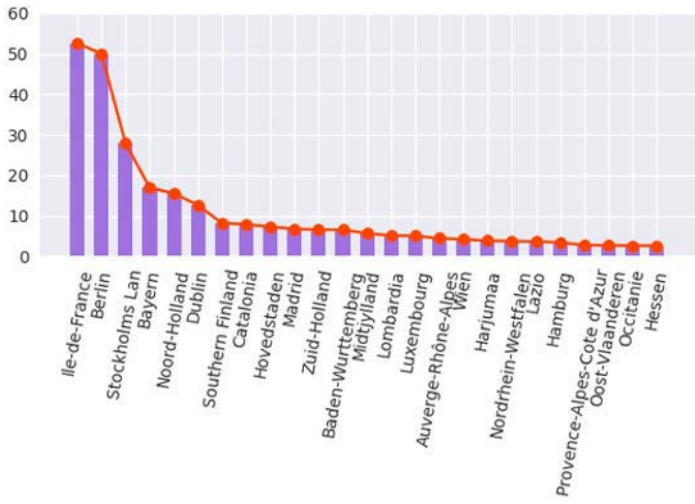
Another way to present this data is proposed in Figure 40 ir 41, which highlight the ranking of the 25 most prominent entrepreneurial ecosystems, respectively, at the global level (Figure 40) and in the EU (Figure 41). Both distributions clearly highlight the power law characterizing them. Moreover, the two EU champions are ranked 19th and 21st at the global level clearly pointing out the challenges faced by European innovation ecosystems.

Figure 40 / **The 25 top Global Entrepreneurial Ecosystems**



The height of bars represents the total funding (in billion USD) of the startups created since the year 2000 (updated in March 2023) Sources: Agoranov & Crunchbase, startups created between 1995 and 2022

Figure 41 / **The 25 top EU-Entrepreneurial Ecosystems**



The height of bars represents the total funding (in billion USD) of the startups created since the year 2000 (updated in March 2023) Sources: Agoranov & Crunchbase, startups created between 1995 and 2022

Whatever their limitations, these maps and the associated figures are presented here to emphasize the importance of accounting for the wide differences that exist between entrepreneurial ecosystems, in terms notably of investment capabilities. Again, although these differences are largely acknowledged, we have the feeling that their magnitude have n not been properly addressed by current policies. Contrary to what is sometimes suggested, the magnitude of these differences does not mean that any policy would be structurally doomed to failures. Simply, this magnitude points out what is feasible, and what is not. Whatever the theoretical relevance of various approaches to innovation or cohesion in the EU, we fear that the potentiality of any policy will be severely challenged, if not hindered, as long as the international imbalance of funding power will not be taken into account, as a key element, to any innovation strategy.

Once these agglomeration effects, and the critical role of venture capital (especially at the development/scaling up stage), are acknowledged, comes the question of the factors leading a significant entrepreneurial ecosystem to emerge here rather than there. As illustrated by London or New-York, the presence of a significant financial place, with the related ecosystems of investors, may certainly help. But it is not a necessary condition if we think to the Silicon Valley. A network of academic institutions, well connected to the industry and to 'strategic' segments of public procurement (think of energy or defense), seem to be alternative decisive factors of localization of entrepreneurial ecosystems. Then, once those pre-conditions are met, an ecosystem might become successful because the conjunctions of public and private initiatives allows organically developed institutions — to echo the one that prevail in Internet Governance (Brousseau, 2023) — to endogenously develop, ensuring an appropriate polycentric governance sustaining the development of an efficient and dynamic set of pooled resources supporting the entrepreneurial dynamic. These institutional frameworks resulting from a bottom-up process are then difficult to replicate because of the economies of scale characterizing them, and because their development takes time. This results into strong place-based competitive advantages of already developed venture commons.

7.4. RECONCILING INNOVATION AND COHESION POLICIES

Innovation policy traditionally works by creating property rights in ideas and by tax-funded support for inputs to innovation, including skilled labor, primary research, tax credits for R&D, and through industrial policies, including government procurement to directly and indirectly support new technologies (Bloom et al 2019). Still, one important point highlighted by Foray (2018b) is that while "neutral" innovation policies aimed at providing generic resources facilitating innovation and entrepreneurship (e.g. Intellectual property framework, tax cut, research institutions) can be designed at a generic/national level, "non-neutral" policies (preferential interventions in favor of a type of actor or of a technological or industrial domain) should be managed at a more decentralized level, both because of the information requirements and risk (or wrong choices) they entail.

Along this line, and applying it to entrepreneurial ecosystems, VCs and other ecosystem players appear as key coordinators of entrepreneurial action. Moreover, they might well be more skilled and better incentivized than public decision makers who might be in practice less able to understand innovative complementarities and less concerned by the long-term actual economic performance of the ecosystem they deal with. Indeed, in line with the public choice approach, investors (both banks and VCs) and ecosystem players (i.e. entrepreneurs and corporations) should be considered as decision makers balancing the potential boundaries of biases of governments and bureaucracies... which obviously does not mean that the later should not play a role. As written above, they are legitimate in contributing to fixing market failures, but their action is reinforced when complemented by those of intermediaries who also contribute to the design and implementation of actions dealing with these failures. To put it differently, traditional approaches based on subsidies to initiate local innovation clusters are doomed to failure because they ignore the magnitude of the inequalities between ecosystems: they underestimate the role and importance of venture commons, to which a wide variety of players contribute. Public money, if it can allow entrepreneurs to emerge and initiate a virtuous loop, does not allow to replace the collective learning in screening, counseling, and matching capabilities of investors and other ecosystem players.

Paradoxically, the magnitude of the inequalities between entrepreneurial ecosystems, with a quasi-fractal structure, creates an important potential which would be exploited by appropriately linking entrepreneurial ecosystems in the EU. Indeed, less developed ecosystems can considerably benefit from establishing strong connections with more advanced ones, while the advanced ones would benefit a lot from working together, to further improve their screening, counseling and matching capabilities. In terms of venture commons, it means that less advanced ecosystems would benefit from being able to "tap" from the deeper venture commons of more advanced ecosystems, while the more advanced ones would also benefit from being able to "pool" their respective venture commons. It might seem obvious but it implies that *not* too much support should be given to the endogenous development of the less advanced ecosystems: that, on the very contrary, it should be clear that the main path towards becoming a deeptech valley starts by articulating the strengths of a given ecosystem in relation to some larger neighbors, and in the EU notably to the more advanced ecosystems in Berlin, Paris, Stockholm, The Netherlands, etc.

In this respect, more than just allowing peers, as is currently the case, to exchange their experience horizontally, proper recognition should be given to "*asymmetric*" links, according to which more advanced players can coach willing peers from other ecosystems, notably by designing joint programs. These joint programs could typically help the best startups from less advanced ecosystems benefit from soft landing schemes in these more advanced ecosystems, where they would have access to skills, knowledge and funding, i.e., access to deeper innovation commons, while reassuring local authorities against fears or relocation. And in parallel, "*leading*" collaborations between advanced ecosystems should also be supported at the proper level i.e., not among others, but with an explicit and conscious recognition that fostering further the advancement of the most advanced should be, in the current international context, not just a side-effect but a true landmark of innovation policies, perfectly compatible

with cohesion policies. Up to now, the level of collaboration, in the EU, between the most advanced ecosystems, typically through some of their key ecosystem players and investors, not only through local authorities and public bodies, is limited, especially compared to the potential that actual, full-flight collaborations would represent.

Beyond the development, exploitation and pooling of entrepreneurial resources and venture commons by the support that could be provided to both asymmetric and leading collaborations, the issue of an European governance of the European venture commons should also be directly addressed. In this respect, it is quite puzzling that only limited efforts have yet been devoted to support the emergence of several large European venture capital funds able to compete with international players. Even if VC financing in the EU has been significantly supported by public funds of funds, these funds have remained small compared with many of their international competitors and have mostly addressed early-stage investment, whereas international competition is mostly active at the growth stage, whenever startups scale-up. In this context, only very recently, under the French Presidency of the Union, during in the Spring of 2022, was an initiative announced, involving several countries, including Germany and France, that would contribute to create a large 3B+ fund, to be managed by the European Investment Fund, with an expected launch in late 2023. It is difficult to understand why it took so long to give such an impetus, considering the magnitude at which international funding players were able to operate in plain sight for years, and especially for the last decade with the proliferation of so-called "mega-rounds" of funding (several hundred million euros) following the emergence of Softbank's 1 billion "Vision Fund".

There might be various explanations for such a lack of action. A possible meta-explanation is that the role of venture commons was not properly understood, or that their importance was underestimated specially for the EU, whereas the structure of the European Union, made of numerous ecosystems in 27 different countries, clearly calls for such a structural approach. The Silicon Valley and other leading ecosystems have designed, through time and collective action, a remarkable machinery to fuel innovation and new ventures in a way that rests a lot, among other things, on their venture commons; i.e., the shared, collective ability of their investors and ecosystem players to screen, counsel and match. The EU is fragmented in terms of entrepreneurial ecosystems and their venture capabilities. In addition to fostering cooperation and interactions between the most advanced European ecosystems, and in allowing less advanced ecosystems to benefit from the coaching of more advanced ones, the emergence of a true European venture capital industry is not simply a goal in itself, to remain competitive globally: it would certainly contribute to developing venture commons and therefore a better screening, counseling and matching capabilities to select and articulate innovations, talents, and investments.

Finally, the potential outcomes in terms of cohesion of such policies should not be neglected. Even if break-through, disruptive innovation and high-tech industries are expected to generate socially positive outcomes associated in the long run, in the short term, policies favoring 'bests in class' entrepreneurial ecosystems will be discriminating, even if smart soft-landing programs — such as described above, where startups do not relocate, could help mitigate these effects —. High-tech entrepreneurial policies

will remain beneficial to a limited part of the economy only; hence the necessity of national/EU public interventions in order to manage redistribution both across regions and across the various layers of the social scale, and of course the necessity to continue to stimulate regional dynamism through 3S-inspired policies.

Figure 42 / **United States and Canada**

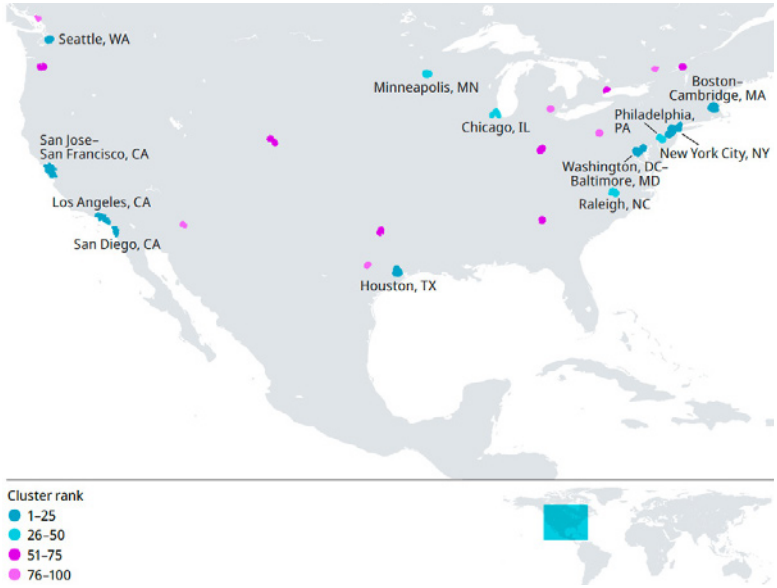
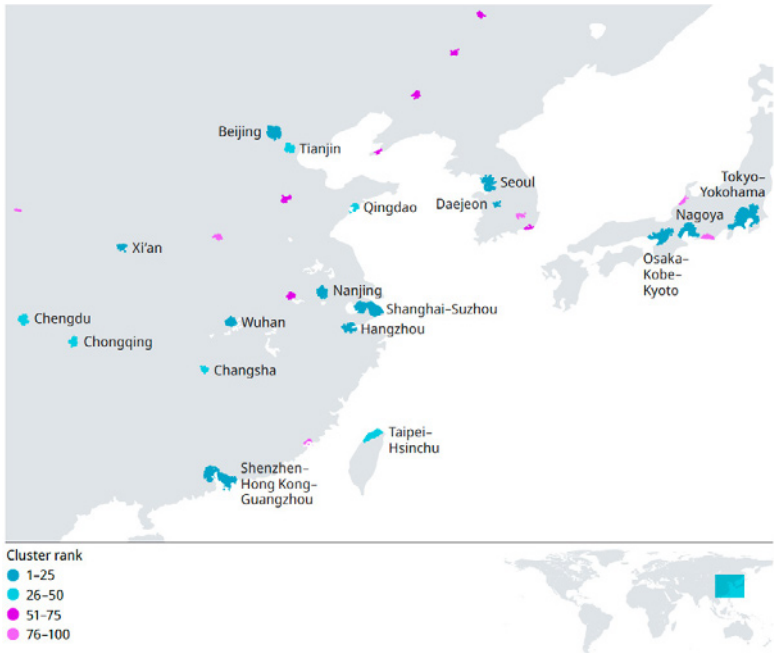


Figure 43 / **East Asia**



8. POST COVID-19 CORPORATE VULNERABILITIES, RISKS FOR THE RECOVERY OR OPPORTUNITIES FOR CHANGES?

Péter Harasztosi, Laurent Maurin, Rozália Pál, Debora Revoltella and Wouter van der Wielen ([101])

INTRODUCTION

During the COVID-19 crisis, real GDP fell more than during the two most recent crises Europe endured, the Great Financial Crisis (GFC) and Sovereign Debt Crisis (SDC). However, the COVID-19 crisis unfolded very differently. First, corporate profits did not decline that much (EIB, 2021). Second, bank lending spreads did not increase across countries (Altavilla et al, 2020), nor across borrower size (Andersson et al., 2021) ([102]). Third, investment fell less compared to the investment in the GFC and the rise in unemployment was contained, thereby limiting the risks of scarring (Portès, 2020). Major disruptions in the European corporate ecosystem were avoided and corporate bankruptcy rates even declined during the crisis. Fourth, the recovery was V-shaped, very strong and quick. Indeed, EU real GDP reached back its pre-COVID-19 level by the end of 2021.

It is widely acknowledged that the strength of the policy support deployed, by both monetary, financial and fiscal authorities (Djankov and Zhang, 2021) explain this positive outcome. The channels through which these policies have propagated are relatively well known. They have been analysed at length in the literature

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([102]) Andersson et al. (2021) show that adverse bank lending supply shocks such as those occurring during the GFC/SDC, lower loan volumes and raise spreads as the tightened loan supply has been more adverse for small corporations with limited market access.

even before the COVID-19 crisis, be it in the context of the GFC, SDC or the transition towards Basel III strengthened capital requirement ([103]).

In this chapter,, we focus on another layer of policy support. We aim at analysing the nature and impact of the support deployed by the sovereigns and the EU at the firm level. During the COVID-19 pandemic, national governments implemented a broad set of measures to support the resilience of firms including public loans, state-backed loan guarantees, debt moratoria, job retention schemes (i.e. short-time work, furlough and wage subsidy schemes), tax and social security deferrals and relief, and (targeted) subsidies and grants. In Europe, the measures primarily aimed at supporting the resilience of firms, e.g. by maintaining access to finance (via credit guarantees) and temporarily reducing costs (via job retention schemes and tax deferrals).

Firm-level policy support has not benefited from so much attention, so far at least, mostly due to the lack of a homogenous dataset yet available, matching policy support and firm characteristics. In this chapter, we use a very rich dataset to analyse the nature of this support in detail. Our empirical analysis is based on firm data drawn from the EIB Investment Survey (EIBIS). We focus on the policy support related questions in the 2021 vintage of EIBIS to illustrate the effectiveness of the support implemented in shielding corporates and fostering investment post-COVID-19.

Our analysis is related to the debate on the possible side effects of the policy support. As the policy allotment was mostly unconditional, some concerns have been raised about the misallocation of public funds towards the maintenance of corporates that would otherwise have exited, even in the absence of crisis. If this is the case, misallocation of production factors would be more pronounced after the crisis and would weigh on the long-term prospects (Archarya et al., 2020).

We analyse the factors that can enable firms to recover stronger from the crisis, transforming and raising their investment plans. We estimate linear probability models to explain the likelihood of getting policy support. We then analyse the impact of the policy support on investment, controlling for the changes in demand at the sector level and the changes in the balance sheet structure. We show that the policy support has been allotted mostly owing to the sales losses during the crisis, going to the firms most affected. We do not find evidence that the support was tilted towards firms already weak before the crisis. We also find that the firms that benefitted from the policy support tend to be more optimistic regarding their investment plans, especially those related to digital technologies. In some cases, it is strengthened by the recapitalisation that the policy support has triggered.

([103]) See e.g., Kanngieser et al. (2019) on the macroeconomic impact of banks' capital adjustment, Ferrando et al. (2019) on the Outright Monetary Transactions (OMT) programme, Betz and De Santis (2021) on the Corporate Sector Purchase Programme (CSPP) and Andreeva and García-Posada (2020) on Targeted Longer-Term Refinancing Operations (TLTROs).

The rest of the chapter is organised as follows. Section 8.1 reviews the main findings of the literature on policy support. Section 8.2 analyses the determinants of the allotment of the policy support. Section 8.3 analyses its impact on firms' investment plans. The final section provides concluding remarks.

8.1. AN OVERVIEW OF THE IMPACT OF THE POLICY SUPPORT MEASURES

Firm-level policy support has been multifaceted. Whereas the policy mix differed across countries and sectors, income and profit tax deferrals, loan guarantees and job retention schemes are among the most widely used measures. According to EIBIS 2021, the wide-ranging impact of the pandemic led to a broad coverage resulting in one in two businesses being subject to a measure. Joint use of multiple schemes was more limited, yet non-negligible, e.g. 30 % of German firms made use of more than one support measure ([104]).

While the support measures implemented in Europe are relatively similar, comparing them across countries is complicated by a variety of factors. First, the policy mix and parameters, related to the eligibility criteria, the support size or horizon, differ substantially. Second, the volumes of financial support initially set out in the programmes, the envelopes initially budgeted, differ from the amounts disbursed. Third, the COVID-19 policy support measures coincide with other accommodating policies affecting the corporate sector, e.g. the EU's Next Generation EU (NGEU), the ECB's pandemic emergency purchase programme (PEPP), and national support programmes for households as well as automatic stabilisers.

The analysis of the COVID-19 support measures can build on a vast pre-existing literature of microeconomic impact assessments. The impact of loan guarantee schemes at the firm level has been well documented for normal times. Loan guarantees offered by the US Small Business Administration, for example, have been found to create 3 to 3.5 jobs per USD 1 million of loans (Brown and Earle, 2017). Similarly, EU evidence attributes loan guarantees with a significant positive impact on firms' size, revenues, employment, investment and survival (Asdrubali and Signore, 2015; Bertoni et al., 2018) and innovation (Bertoni et al., 2019; Brault and Signore, 2019). Martín-García and Morán Santor (2021) moreover find a significant impact of credit guarantees by the regional mutual guarantee institution on firm growth in the Spanish Region of Madrid. Country studies for Italy and the Czech Republic, on the other hand, do not find a significant impact (Dvouletý et al., 2019; D'Ignazio & Menon, 2020). Likewise, past subsidised loan programmes for SMEs have been found to have positive effects on job creation, investment and productivity in Bulgaria (Erhardt, 2017) and Hungary (Horvath & Lang, 2021, Endresz et al., 2015). Finally, firm-level evidence shows that job retention schemes prevent layoffs and safeguard firms´ survival, see e.g.

([104]) Cross-country details are included in Section 8.2.1.

Hoffman and Schneck (2011), Cahuc et al. (2018), Lydon et al. (2019), Kopp and Siegenthaler (2019) and Guipponi and Landais (2020).

Although constrained by data availability limitations, early firm-level evidence is positive on the impact of national COVID-19 policy support measures. A selection of model-based simulation exercises and matches to pre-pandemic balance sheets have helped to inform policymakers from early on in the pandemic, such as Gourinchas et al. (2020, 2021), Lopez-Garcia (2020), Maurin and Pal (2020), Barnes et al. (2021), Blanco et al. (2021), Demmou et al. (2021a,b), Díez et al. (2021), Ebeke et al. (2021), and Rommedahl Julin et al. (2022). These studies have highlighted the potential of support measures to reduce liquidity shortfalls, bankruptcies, as well as output and employment losses relative to a no-policy scenario. Nevertheless, the true realised impact can only be gauged as detailed firm records become available.

More than one and a half years into the pandemic ex-post firm-level evidence is emerging ([105]). Hadjibeyli et al. (2021), for example, perform a microsimulation exercise using French firm-level data up to December 2020. The simulations show a 12 percentage points (pp.). lower increase in illiquidity and a 5.3 pp. lower increase in insolvencies when accounting for short-time work, direct subsidies and tax reliefs relative to a scenario without such policies ([106]). Building on a similar, yet smaller database for 2020, Bureau et al. (2021) simulate a reduction from 60 % to 47 % in the share of firms facing a negative cash flow shock as a result of the French support measures (not including loan guarantees). France Stratégie (2021a) extend the simulations to data up to March 2021, showing that the support measures (including loan guarantees) reduced the simulated share of firms facing a drop of the gross operating surplus of more than 25 value-added points by 13 pp. Alternatively, Drabancz et al. (2021) employ firm records up to December 2020 to provide causal evidence for Hungary's subsidised loan programmes, showing a 4 % higher headcount in firms with five or more employees that received support. Lalinsky and Pal (2021) use firm-level data from Slovakia for March-June 2020 to investigate government wage subsidies. They find significant drops in firms' probability of illiquidity (3.5 %) and insolvency (3.5 %) when granted support. Both studies moreover find stronger effects for smaller firms. In turn, this chapter uses firm-level data for the EU, to gauge the impact of policy support on corporates' investment outlook.

The positive short-run impact of the policy support measures did not preclude concerns about medium-term productivity. First, the halt in firm exit raised

([105]) In parallel to the evidence on European support measures, a vast literature assessing the US' loan guarantees under the Paycheck Protection Program (PPP) has emerged. Autor et al. (2020), Hubbard and Strain (2020), Granja et al. (2020), Doniger and Kay (2021) and Faulkender et al. (2021) all finding mild to strong evidence for the PPP boosting employment during the pandemic. Lopez and Speigel (2021) moreover find a marked positive effect of the program on small businesses' growth. Kapinos (2021a,b), nonetheless, draws a more heterogeneous picture of the program's impact.

([106]) The strong findings for liquidity are in line with corporate survey results showing that government fiscal support measures were effective in easing the liquidity needs of firms (De Santis et al., 2021).

concerns for corporate zombification (Laeven et al., 2020), which may reduce aggregate productivity. While the pandemic-related loan guarantees have the benefit of spreading the exposure, guarantees pose medium-term risks for the sovereigns underscribing them if they are concentrated among the most vulnerable firms and the hardest-hit sectors. For example, recent firm-level evidence from Italy finds that financially fragile firms – in particular smaller, less liquid, more leveraged firms are more likely to have received public guaranteed loans during COVID-19 (Core and De Marco, 2021). Interestingly, firm-level evidence for five other EU countries (Croatia, Finland, the Netherlands, Slovakia and Slovenia) suggests that this does not hold for employment subsidies and direct subsidies and that there was no immediate increase in 'zombies' (Bighelli et al., 2021, 2022) ([107]). Finally, while the results of our EU-wide analysis show that firms with low liquidity are found to be more likely to get policy support, they also confirm that the lion´s share of firms benefitting from support were in good pre-COVID financial health, thereby limiting the risk of zombification.

Second, as economies picked up again, the focus shifted to the possible impact on the process of creative destruction and intra-sectoral distortions via (mis) allocation. Freeman et al. (2021), for example, show that Dutch firms with low pre-COVID-19 productivity were more likely to get policy support than high productivity firms, therefore (at least temporarily) distorting the usual dynamics. Similarly, our EU-wide analysis finds that firms with low pre-COVID-19 productivity were significantly more likely than their peers to get policy support. Bighelli et al., (2021) and Cros et al. (2021), on the other hand, find little or no disruption in business dynamics following the Covid policy support. More definite conclusions will only become possible as support is phased out and have to be weighed against avoiding a liquidity dry-out at the outset of the crisis. Notwithstanding, the recovery of firm entry in many countries suggests that, despite the decline in bankruptcies, the crisis and emergency measures may not have completely halted creative destruction (OECD, 2021).

In addition to the firm-level impact, public guarantee schemes are likely to have spurred bank lending. Casanova et al. (2021) present suggestive evidence that the aggregate bank lending to the private non-financial sector grew faster in countries with larger public guarantee schemes. Bank lending moreover was dependent on bank size and the condition of banks' IT systems (Core and De Marco, 2021), with larger and/or better IT equipped banks disbursing guaranteed loans faster. The importance of pre-existing lending relationships, as established for pre-crisis lending (Degryse and Ongena, 2005), was also confirmed for the lending operations during the COVID-19 pandemic.

In sum, national COVID-19 policy support measures have played an important role in stabilizing the economy and bank lending during the COVID-19 pandemic. Preliminary firm-level evidence shows a decisive role for the support

([107]) Moreover, an initial assessment of bank lending in Austria suggests that increased lending has contributed to the stabilization by providing liquidity for the economy at no additional risks (Kaniovski et al., 2021).

measures in limiting insolvencies and safeguarding employment. The public support schemes that were introduced in response to the COVID-19 pandemic – in particular state-backed loan guarantees –, however, also constitute sizeable contingent liabilities for governments, therefore raising concerns about the potential medium-term risks for sovereigns. Already, the decline in output combined with increased expenditures caused a strong increase in government debt. The COVID-19 crisis erased fiscal consolidation efforts of previous years and in 2021, debt levels in the EU were above those in 2014. Moreover, GDP declined more in Member States with high debt levels, driven mainly by higher exposure to more affected sectors, like the hotel and restaurant services and transportation sectors.

In the two next sections, we rely on the 6th vintage of the European Investment Bank Investment Survey, the EIBIS2021. The annual survey contains information on more than 12000 non-financial firms in the EU ([108]). EIBIS is an EU-wide survey that gathers qualitative and quantitative information on investment activities by non-financial corporates, both SMEs (5-250 employees) and larger corporates (250+ employees), their financing requirements and the difficulties they face. Using stratified sampling, EIBIS aims to be representative across all 27 Member States of the EU, the UK and the US, within countries, four firm size classes (micro, small, medium, and large) and four sector groupings (manufacturing, services, construction, and infrastructure). All interviewed firms are drawn from the BvD ORBIS database, which allows the survey answers to be linked to firms' financials and other administrative information, but firm information remains anonymous. Detailed methodology on the survey is available from IPSOS ([109]). EIBIS has been shown to be a reliable data source with no systematic sampling bias (Brutscher et al., 2020). The 6th vintage contains several questions related to policy support. We match the answer of the firms with various pre-COVID-19 balance sheets and P&L characteristics to analyse the allotment of the policy support in Section 8.2. The survey also contains information about investment plans, their volume as well as their nature, therefore, enabling the analysis of the policy support in Section 8.3.

8.2. ALLOTMENT OF THE POLICY SUPPORT

In this section, we focus on the nature of the policy support deployed across European economies and investigate its targeted nature using the information collected during the 6th vintage of the EIBIS. The policy support received by the company can be of any origin (national or international institutions, or combined). The EIBIS question is referring to any financial support in response to COVID-19 since the start of the pandemic. This can include finance from a bank or other finance provider, or government-backed finance ([110]).

([108]) EIBIS also surveys close to 1000 firms in the US and UK. Those are not used in this analysis.
([109]) https://www.eib.org/attachments/eibis-methodology-report-2019-en.pdf.
([110]) A full overview of the types of support covered in our analysis is provided in Section 8.2.1.

It is important to note upfront that EIBIS2021 survey information does not enable to distinguish whether the absence of policy support reflects a voluntary choice or non–eligibility ([111]). Indeed, the recourse to policy support needs both and it is likely that the choice not to apply is indicative of certain firm characteristics or strategies. For example, France Stratégie (2021b) shows that the intensity of recourse decreases with business size, that the recourse to several measures is not systematic, and the non-use appears to be largely voluntary. Besides the eligibility to participate in the programmes, technical factors also matter for their deployment. The operational design of the programmes and the setup of the administrative processes have been used to explain the low take-up rate at the beginning of the crisis. Two key bank characteristics facilitated loan disbursement: size and information technology. Core and de Marco (2021) show that these factors were important because of the high volume of online applications and low-interest margins on guaranteed lending. Pre-existing relationships mattered for the allocation of guaranteed credit, as banks lent more in their core markets and where they have a larger local market share. In the following, we focus on the effective policy support.

8.2.1. Nature and intensity of the policy support deployed in EU economies

In the EIBIS, the reporting company might have benefited from one, more or none of the following four types of support: (1) New subsidised or guaranteed credits (e.g. loan, overdraft or credit card from a bank or other finance provider) that will need to be paid back in the future but may have preferential or reduced interest rates and/or an extended repayment plan; (2) Deferral of payments which still leave a liability to be paid by the company in the future (e.g. deferral of tax payments, deferral of rent or mortgage for commercial property, suspension of interest payments); (3) Subsidies or any other type of financial support that the company will not have to pay back in the future, a type of support that comprises job retention policies; and (4) Any other type of financial support.

Figure 44 reports the share of companies that have benefitted from policy support across the EU. 44 % of EU corporates did not get support, a ratio varying from 22 % in Luxembourg to 61 % in Estonia. This ratio is somewhat lower in Southern economies.

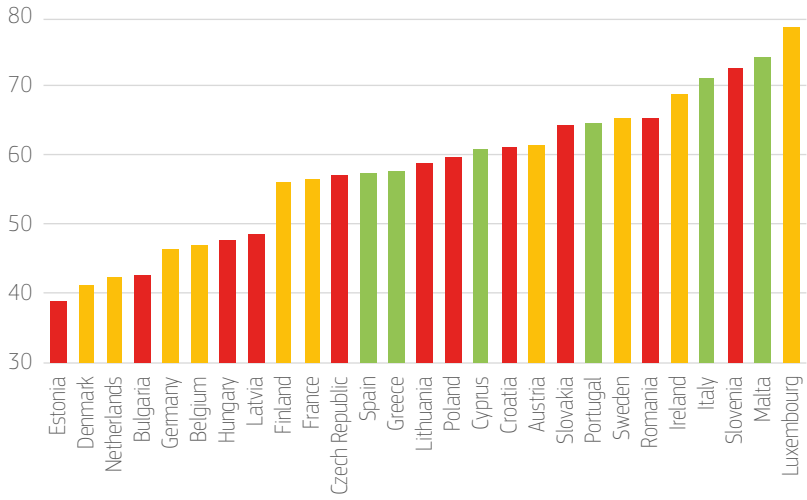
Overall, in Europe, 56 % of firms received support via at least one specific policy. The majority of the firms received only one type of support. Around a third of companies that received support benefitted from two types of policies. This represents 12 % of firms at the EU level. 4 % of firms received all three types of support. Among types of policy support, subsidised financial support (type 3) is the most common, used by 36 % of the firms. The ratio was even higher in the

([111]) Such information is available in the 2021 EIBIS 'Add-on module', albeit for a more limited number of companies, around 1 000. The Add-On Module targeted non-financial SMEs operating in manufacturing and services to gain additional insights on the impact of COVID-19, climate change and digitalisation on companies investment needs across the EU.

Northern and Western economies and in the Central and Eastern economies. A similar share of firms, 16-17 %, benefitted from the deferral of payments or credit support to be paid back ([112]).

Turning to the different layers of policy support, Figure 45 plots the share of corporations benefitting from two types of support by country. In the left panel, the intensity of new subsidised or guaranteed credits (type 1) is correlated to that of subsidies or any other type of financial support (type 3). The negative relationship suggests that these two types of policies have been substitutes to one another: countries where firms benefit more from subsidies or any other type of financial support are countries where firms benefit less from new subsidised or guaranteed credits. The negative correlation amounts to -31 %. However, it is important to notice that the negative correlation is strongly driven by a set of countries, such as Spain, Greece, Portugal, Italy and France, where the subsidised and guaranteed loans were more intensively used. These are also those EU countries that were particularly hit by the crisis, mainly due to higher exposure to the tourism and travel sectors. When eliminating from the series these particular countries, the correlation between type 1 and type 2 policy support turns positive 14 %.

Figure 44 / **Occurrence of the policy support across Europe** ***(% of recipient firms)***

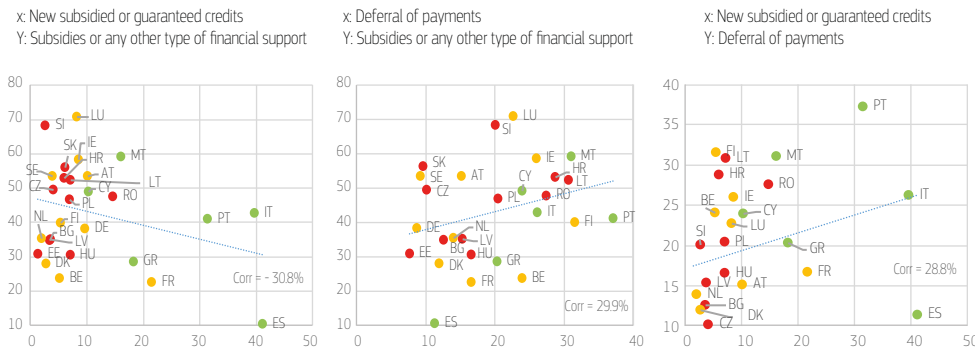


NB: % of firms having benefitted from at least one type of support. The colour reflects the region in which the economy is located: Red indicates Central and Eastern economies; Green indicates Southern economies and Orange indicates Northern and Western economies.

Source: Calculations based on the EIBIS 2021.

([112]) Type 4, 'any other type of support', is reported by a small share of companies and is very heterogeneous across countries. Therefore, it is not considered in isolation in this paper.

Figure 45 / **Relation between types of policy support**



NB: See note Figure 44 for an explanation of the colours.

Source: Calculations based on the EIBIS 2021.

In the figure on the right, deferral of payments (type 2) is correlated with subsidies or any other type of financial support not to be paid back (type 3). With a correlation of 30 %, the allotment of both policies is positively linked; countries where firms benefit more from one policy also tend to benefit more from the other. This suggests that most of the measures that fall under the category subsidies or any other type of financial support (type 3) are likely to be labour support policies. The allotment of this support has been associated with the deferral of social contributions or tax payments.

One can notice a specific pattern in terms of composition of the policy support in Greece, Italy, Portugal and Spain, countries indicated in green in Figure 45. On the left- and right-hand panels, these countries are positioned on the right of the x-axis. This indicates a relatively higher proportion of firms benefitting from subsidized or guaranteed credits. Hence, in these countries, which have suffered acute fiscal strains during the sovereign debt crisis, the composition of the policy support seems to be tilted towards least costly instruments. In turn, this could be related to the smaller fiscal space available in these countries compared to EU peers.

8.2.2. The support went to the firms most affected by the crisis

Figure 46 considers sector asymmetries using two different breakdowns. First, in the left panel, we look at the share of firms with policy support against the share of firms with severe sales loss, more than 25 % for 12 broad sectors ([113]). The sales loss variable is constructed based on the survey question that distinguish three different categories of sales loss compared to the beginning of 2020: 'a. Less than 25 %; b. 26 % to 50 %; c. More than 50 %;'. Regarding the question on policy support, it covers the same

([113]) While the EIBIS sampling is not designed to be representative of these twelve sectors, each sector is populated by 350 firms at least. In fact, the four sectors decomposition featured in the EIBIS provides only an aggregated view on the impact of the crisis.

time period, with the following question: since the start of the pandemic, until the date of interview that has been carried out between April and July 2021.

The panel confirms that services comprise some of the sectors most hit, such as hotel and restaurant, and some not or positively affected, such as IT and telecommunications. The positive correlation with the prevalence of policy support suggests that, across sectors, the support was much linked to the change in activity: the stronger the decline in turnover in the sector, the higher the intensity of the policy support. With an R-square of 76 %, there is a strong relationship. When types of policy supports are investigated separately, financial subsidies (type 3) show the strongest relationship with losses. This again relates to the composition of this policy component temporary unemployment directly linked to activity ([114]).

Looking at the right-hand panel of Figure 46, we use the breakdown of four sectors together with a breakdown by firm size categories. Firms in the manufacturing and services sector are positioned in the right, implying that they have been more affected. In the same sector, smaller firms were more affected and therefore more likely to get supported. For each of the four sectors considered separately, the proportion of allotment to smaller companies is higher than for larger companies. This seems to reflect the fact, as discussed above, that the smaller firms have reported higher sales losses (Gourinchas et al., 2021). Smaller firms are positioned to the right of their larger counterparts. During the COVID-19 crisis, small firms were more likely to have suffered large sales losses (above 25 %) compared to large firms, respectively 29.1 % vs 9.1 % in the manufacturing sector, 34.5 % vs 28.9 % in the services sector, 17.6 % vs 1.2 % in the construction sector and 25.9 % vs 16.1 % in the infrastructure sector. The difference across sizes is larger in the construction and manufacturing sectors.

Figure 46 / **Determinant of the allotment of policy support *(% of firms)***

NB: Any type of policy support is considered simultaneously. Firm sizes: (S)-micro and small firms (with between 5 and 50 employees), (M) – medium sized firms (with between 51 and 250 employees), (L) – large firms (with more than 250 employees).

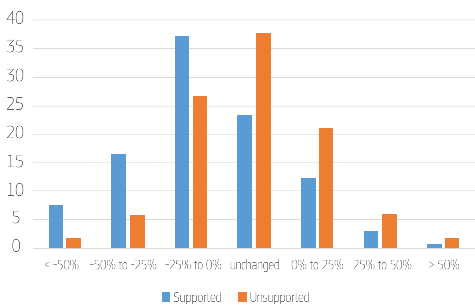
Source: Calculations based on EIBIS 2021.

([114]) For a more in-depth overview of policy type and design, see the country-level details at Policy Responses to COVID19 (imf.org).

Overall, the support went mainly to firms reporting larger sales drops. Figure 47 reports the distribution of the change in sales for firms that received the support and those that did not [115]. The two distributions are different. Firms that received support have a distribution tilted to the left. For the support, the mode of the distribution corresponds to a decline between 0 and 25 % while the unsupported have a mode around 0. Hence, supported companies have reported higher declines in sales.

In Figure 48, we report the share of companies that received each type of support, separately for the three policies. Again, the larger the sales loss, the higher the intensity of the support has been. The difference is especially strong for the allotment of subsidies and financial support as in this case, the difference between zero and major sales loss reaches 30 %. This is consistent with the nature of this policy support, mostly comprising labour support policies, and therefore even more tied to demand. Conversely, subsidised or guaranteed credits tend to be less targeted. This could suggest that corporates took the opportunity of cheap credit availability to insure themselves against possible liquidity shortfalls.

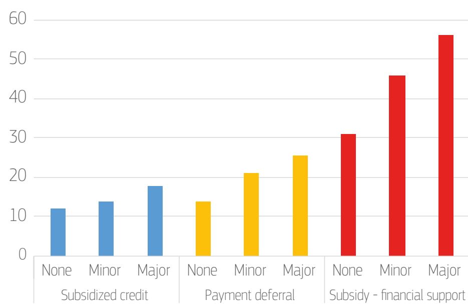
Figure 47 / **Distribution of change in sales and policy allotment *(% of respondents)***



NB: The y-axis indicates the share of firms reporting a change in sales indicated on the x-axis.

Source: Calculations based on EIBIS 2021.

Figure 48 / **Policy allotment conditioned on sales losses**



NB: The y-axis indicates the proportion of firms having benefitted from the support. Minor (Major) change corresponds to less (more) than 25 %. Source: Calculations based on the EIBIS 2021.

Source: Calculations based on EIBIS 2021.

To better estimate the dependence of the policy allotment on the change in sales during the COVID-19 crisis, we propose the following linear probability model:

$$q_i^k = \alpha Sales_i + \Gamma\theta_i + \varepsilon_i \qquad \text{EQ. 1}$$

where *q* is the answer to the question on the policy support in the EIBIS. It is a dummy variable indicating whether the firm received the policy support. Since several types of policy support are considered, the dummy is indexed by *k*, the type of support that can be of three types. The variable *Sales* is categorical variable indicating the change in sales as reported in the survey. We use this variable either as an indicator for negative change or break down the sales loss indicator into brackets. θ_i denotes a vector of dummy variables controlling for country, sector size and firm

(115) Given the specificities of the successive lockdowns implemented, the COVID-19 shock impacted the sectors very unevenly. Sale activity declined very strongly in contact-intensive sectors such as hotel and restaurants, cultural and recreational activities or transportation. Conversely, IT and communication or chemicals and pharmaceutical recorded increases in activity. As the policy support was much linked to sales losses, its intensity differed across sector. See EIB (2022) for more details.

age. Consistently with the right-hand panel of Figure 46, the four EIBIS sectors are considered in the regression, since those are by construction covered representatively. Again, consistently with Figure 46, the three size groups, micro and small, medium and large are considered. The results are presented in Table 15 and Figure 49.

Table 15 / **Factors explaining the likelihood of getting policy support**

	(1)	(2)	(3)	(4)	(5)
	Any policy support		Subsidized or guaranteed credit	Payment deferral	Subsidies or any other type of financial support
Sales loss dummy	**0.216*** **				
	[0.009]				
Sales loss categories					
• less than 25%		**0.165*** **	**0.018** **	**0.068*** **	**0.152*** **
		[0.011]	[0.007]	[0.009]	[0.011]
• between 25 to 50%		**0.272*** **	**0.055*** **	**0.095*** **	**0.255*** **
		[0.013]	[0.010]	[0.011]	[0.013]
• more than 50%		**0.302*** **	**0.073*** **	**0.183*** **	**0.280*** **
		[0.018]	[0.015]	[0.018]	[0.019]
Observations	10,929	10,929	10,929	10,929	10,929
R-squared	0.136	0.142	0.150	0.085	0.173
Firm controls	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes	yes

NB: Linear Probability Model estimated with firm size dummies (small, medium and large), sectors (as in Figure 46) and firm age dummies: less than 2 years; 2 years to less than 5 years; 5 years to less than 10 years; 10 years to less than 20 years; 20 years or more. Constant not reported. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample).

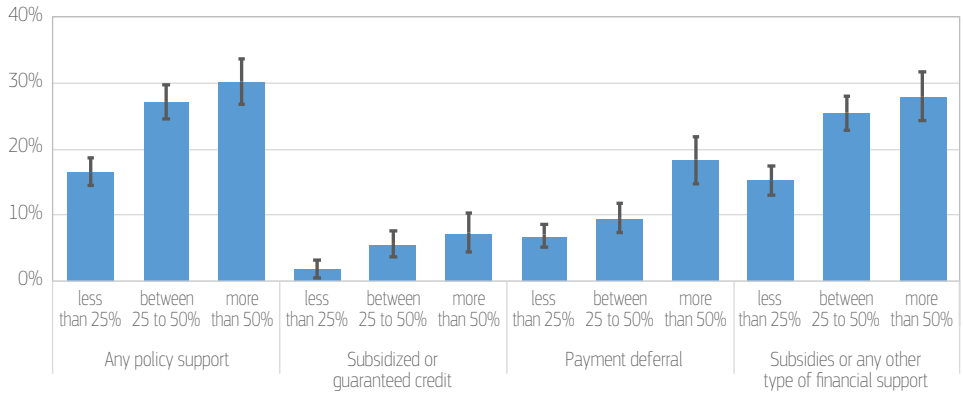
Source: Authors' estimations based on EIBIS21.

In Table 15, the first two columns relate to any type of policy support while columns 3 to 5 analyse separately each policy layer. In the first estimation, the likelihood of getting policy support of any type is explained by the dummy reporting of whether firms have recorded sales losses or not. The coefficient is positive and highly significant. It shows that recording a decline in sales increases the probability to be supported by 21 pp. The equations reported in columns 2 to 5 consider a finer breakdown of sales losses, by brackets of 25 %. The excluded category is 'unchanged' or 'increase of sales'. The conclusions drawn from Figure 47 and Figure 48 are confirmed. The impact of sales loss is always significant, for any type of support, considered together or separately. Furthermore, it increases in intensity with the magnitude of the decline. The higher

the loss, the more likely it is that the firm will get support. This is true for the policies in general. However, it is more pronounced for subsidies and other policy support, a component that includes labour support more linked to sales drops. Conversely, this is less conducive for subsidised and guaranteed loans.

Figure 49 reports the coefficients attached to each decline. Focusing on the comparison of policy support measures, the impact of sales losses on the probability of getting the support is more linked to the magnitude of the loss for subsidies and other types of support. Clearly, the higher the losses the stronger the likelihood of getting the support. It should be stressed that this result is obtained after controlling for sector and country fixed effects. This policy appears to be linked to the actual change in the activity mostly. Conversely, the intensity of the change in sales is less determinant for subsidised or guaranteed loans.

Figure 49 / **Impact of sales loss on the likelihood of getting the policy support (Elasticity, change in the probability, pp.)**



NB: The plain bar indicates the coefficient estimated in Table 15 (columns 2-5). The vertical line indicates its 95 % confidence interval. The x-axis indicates the change in sales reported by the company.

Source: Authors' estimations based on EIBIS 2021.

8.2.3. The allotment is mostly unrelated to pre-crisis weakness

We now turn our focus to the discriminatory power of firm-specific characteristics in getting policy support. In particular, we estimate the probability of companies getting the support depending on their status before the crisis. After taking into consideration the impact of sales loss, we investigate the other factors likely to influence policy allotment. We consider factors related to the firm characteristics, its activity, its balance sheet structure or profit and loss accounts. For this, we estimate a linear probability regression, EQ2. Separate models are estimated for each pre-crisis firm characteristic, each controlling for the country, sector, size, age and sales decline.

$$q^{k}_{i,c,s} = \alpha Sales_{i} + \beta X_{i} + \Gamma\theta_{i} + \varepsilon_{i} \qquad \text{EQ. 2}$$

q is the answer to the question on the policy support in the survey. EQ2 differs from EQ1 as, in addition to the change in sales, it also investigates the role of further important firm characteristics (X_i). The set of control variables are the same as in EQ1.

We first estimate the impact of the following firm characteristics: productivity (measured as value-added per employee), investment ratio (measured as the annual growth rate in fixed assets), being digital (implementing at least one type of digital technology), and being an exporter. We then analyse the impact of the following financial indicators: liquidity ratio (cash and equivalent over total assets), return on assets, distressed status (when the interest coverage ratio was below 1 pre-COVID-19), indebtedness (first and last decile of the financial leverage), registering losses in the year before the crisis, and finance constrained (rejected or discouraged for external financing). ([116])

To report the results of EQ2, Table 16 presents the change in the predicted probability of getting the policy support of any type (first column) and policy specific results (column 2 to 4). Some firm characteristics are binary (exporter, digital, distressed, losses, finance constrained) while others are continuous variables (productivity, investment ratio, liquidity ratio, return on assets and financial leverage).

Beyond the control variables, few factors appear to matter. Above all, the firm's productivity level appears as the main discriminant factor. Firms with low pre-COVID-19 productivity are significantly more likely to get policy support than firms with high-level productivity. As such, the policy allotment may have affected the usual processes of intra-sector competition. However, only as support is phased out it will be possible to disentangle whether the COVID-shock and/or the accompanying support have permanently altered firms' competitiveness relative to peers. Being an exporter also significantly matters, albeit to a lesser extent. Digital firms are more likely to get the support, although the difference to non-digital firms is not significant at the 95 % confidence level. The investment ratio before the crisis does not seem to have a predictive impact on obtaining the support.

([116]) The data on firm characteristics are obtained from the merged data of the EIB Group Survey on Investment and Finance (EIBIS) with the Bureau van Dijk (BvD) ORBIS database that contains variables from the firms' financial reports. The variables that are derived from the EIBIS 2021 mostly relate to the previous financial year (2020), with exception of some questions related to the current year or expectations. Therefore, variables such as the dummy variables for Finance constrained, Exporter and Digital refer to the year 2020. The rest of variables are originating from the Orbis database and refers to the pre-COVID-19 year of 2019.

Table 16 / **Predicted probability of getting the policy support depending on firm characteristics pre-COVID**

VARIABLES	Any policy support	Subsidized or guaranteed credit	Payment deferral	Subsidies or any other type of financial support
Sales losses				
• **less than 25%**	0.141***	0.011	0.085***	0.133***
	[0.015]	[0.011]	[0.012]	[0.015]
• **between 25 to 50%**	0.246***	0.043***	0.104***	0.247***
	[0.019]	[0.015]	[0.017]	[0.019]
• **more than 50%**	0.269***	0.111***	0.206***	0.290***
	[0.029]	[0.027]	[0.030]	[0.032]
Productivity	-0.044***	-0.024***	-0.021***	-0.024***
	[0.009]	[0.006]	[0.007]	[0.008]
Exporter	0.012	0.033***	0.011	-0.001
	[0.016]	[0.011]	[0.013]	[0.015]
Digital	0.015	0.023**	0.030***	0.010
	[0.014]	[0.010]	[0.011]	[0.013]
Investment ratio	0.011	0.015	0.000	0.013
	[0.014]	[0.010]	[0.011]	[0.014]
Liquidity ratio	-0.303***	-0.205***	-0.328***	-0.102**
	[0.050]	[0.032]	[0.035]	[0.048]
Return on asset	-0.013	-0.012	-0.004	0.019
	[0.026]	[0.017]	[0.021]	[0.025]
Distressed	0.006	0.019	0.020	0.007
	[0.031]	[0.024]	[0.026]	[0.030]
Financial leverage	0.021***	0.031***	0.022***	0.000
	[0.006]	[0.005]	[0.005]	[0.005]
Losses	-0.039	-0.061**	0.003	-0.022
	[0.033]	[0.025]	[0.028]	[0.031]
Finance constrained	0.035	0.016	0.041*	-0.008
	[0.024]	[0.018]	[0.022]	[0.024]
Observations	5.332	5.332	5.332	5.332
R-squared	0.142	0.208	0.115	0.187
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample).

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

Turning to the financial indicators, only firms with low liquidity, those with smaller cash buffers, and higher leverage are more likely to get policy support ([117]). While firms with low return on assets and finance constrained firms are more likely to get support, the difference is not significant. This result suggests that the primary goal of the policy support, avoiding a liquidity dry-out and freezing the corporate ecosystem, was reached. Moreover, the positive and significant correlation with leverage is mainly driven by the subsidised or guaranteed loans and deferral of payments. This indicates that firms already indebted were more likely to benefit from these two types of support. Hence, the policy was effective in maintaining credit provision. Conversely, the allotment of subsidies is not related to the level of indebtedness. Overall, we do not find evidence for Europe that the support was tilted towards firms already weak before the crisis, such as financially distressed or firms registering losses ([118]).

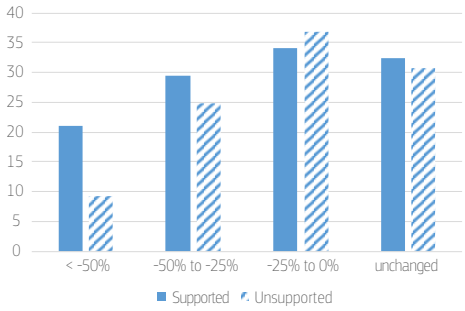
8.3. THE POLICIES' EFFECTIVENESS

In this section, we analyse the role played by policies in supporting the investment recovery. Figure 50 plots the percentage of firms planning to invest more in the current financial year depending on the sale loss they have recorded over the COVID-19 period, distinguishing firms that have benefitted from the support and those that have not. The share of firms planning to invest more tend to increase when sales losses become lower. Moreover, comparing across groups of firms, for the same level of losses, those that have been supported plan to raise investment by more. The difference is especially pronounced for large sales losses. Figure 51 plots the share of firms that have increased their recourse to external finance, debt or equity, depending on whether they have benefitted from policy support. The balance sheet expansion is stronger for those that have been supported. In case of debt, part of the difference reflects the recourse to subsidised loans or guarantees and is therefore accounting the support. This is not the case for equity. Maurin and Pal (2020) points to existence of a tradeoff faced by corporates between investment and leverage. Profits enable the accumulation of cash and liquid assets, real investment, or debt reduction. Hence, lower profits reduce cash balance, and/or increase indebtedness and/or lower investment. Hence, if corporations raise more external finance, the decline in investment is more contained, but indebtedness increases. Raising debt in bad time enables firms to smooth the impact of the shock on investment over time. It also reduces the bankruptcy' risk.

([117]) As an alternative exercise, we also checked the correlation of sales loss during the pandemic with pre-covid firm characteristics and financial indicators. Results show that the pre-crisis financial performance is uncorrelated with the sales loss, while some firm characteristics, such as high productivity and being digital has lower probability of losses.

([118]) Bighelli et al. (2021) reach similar conclusions. The authors show that COVID-19 support was distributed rather efficiently as government subsidies were distributed towards medium productive firms, and only marginally towards the undeserving 'zombies'.

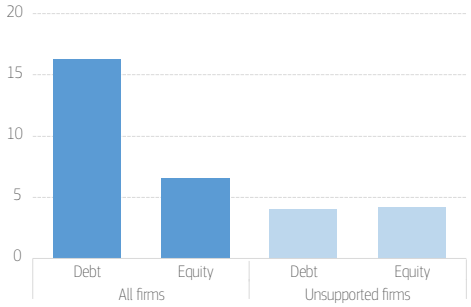
Figure 50 / **Investment plans conditional on COVID-19 sales losses and policy support *(% of respondents)***



NB: The x-axis reflects the sale losses reported by the company. The y-axis reports the percentage of firms surveyed that plan to raise investment in the current financial year.

Source: Computations based on the EIBIS 2021.

Figure 51 / **Policy support and balance sheet expansion *(% of respondents)***



Source: Computations based on the EIBIS 2021.

8.3.1. Some evidence that the policy support contributes to the investment rebound

In the EIBIS 2021, several questions are related to investment, either planned or achieved. The question we use in this section relates to the change in financial plans, whether firms revised their investment plans due to the COVID-19 pandemic, and if so, in which direction, upwards or downwards. We consider the firms that plan to invest more in the current financial year, i.e. those reported in Figure 50.

We aim isolating the channel through which the policy impacts investment while controlling for the characteristics that influence the decision to invest. For this purpose, we estimate the following equation:

$$q_{i,c,s} = \alpha Sales_i + \beta Pol_i^k + \gamma Sales_i \times Pol_i^k + Z_i + \Gamma\theta_i + \varepsilon_i \qquad \text{EQ. 3}$$

As before, q is the dummy variable reflecting the firm's answer to the survey regarding investments. *Sales* is set of dummy variables indicating the decline in sales the firm reported by 25 % gaps. *Pol* indicates that the firm has benefitted from at least one policy support measure. Each dummy takes the value one when the answer is positive and zero otherwise. EQ 3 also includes an interaction term between policy access and the sales decline indicators. This allows to assess whether firms that suffered larger losses (any were more likely to access the support) reacted to the policy support relatively less or more. Z is a set of real and financial characteristic. Labour productivity is always incorporated in the

equations, as a standard determinant of investment ([119]). It is considered before the COVID-19 crisis to minimise the risk of being impacted by the decline in sales during the crisis. Besides, we alternatively consider the financial leverage, firms in financial distress, and the capital ratio. Financial distress is the dummy variable considered as before while the two other characteristics are taken as continuous variables. Financial leverage is defined as the sum of loans and long-term debt divided by fixed assets. The capital ratio is defined as shareholder's funds over total assets ([120]). We expect a positive coefficient, considering that those with a financial leverage has access to external financing in forms of loans are able to invest more than those relying just on their internal sources (no financial leverage). Nevertheless, above a threshold, financial leverage might indicate debt overhang and in therefore have a negative impact on investment plans. As creditor risk increases with financial distress, this is also expected to have a negative coefficient. Conversely, for the same reasons, the capital ratio is expected to have a positive impact. As before, the regressions include dummies to account for the sector, size, age and the country effects. Standard errors are heteroskedasticity robust.

Table 17 highlights the result that firms which benefitted from policy support are more likely to increase investment in 2021. First, in all the estimations, the policy allotment has a positive association with investment plans. Conversely, recording large sales losses has a negative and always significant association. The positive coefficient on the interaction effect *Sales* × *Pol* indicates that for the same decline in losses, investment prospects are more positive for firms that have benefitted from policy support than for those that have not. This result may suggest that the support has cushioned firms balance sheets and enabled them to rebound stronger. While positive across most of the estimations, the effect is mostly not significant, however. Finally, the firm's characteristics and financial indicators do not matter significantly. The coefficient on sales remains relatively constant across estimations, which suggest that the sale shock is relatively orthogonal to firm characteristics, consistently with the findings of Section 8.2. Firms reporting a sales loss of more than 25 % are 6 to 8 pp less likely to increase investment.

([119]) Estimations results are not sensitive to the inclusion of productivity in the set of regressors.
([120]) All these variables are winsorised to 3 % and 97 %.

Table 17 / **Factors explaining the likelihood of increasing investment in the current financial year**

VARIABLES	(1)	(2)	(3)	(4)
Policy support	0.011	0.024**	0.000	-0.008
	[0.011]	[0.011]	[0.014]	[0.018]
Sales losses				
• less than 25%		-0.027**	-0.019	-0.024
		[0.013]	[0.016]	[0.024]
• between 25 to 50%		-0.065***	-0.035*	-0.084**
		[0.015]	[0.020]	[0.035]
• more than 50%		-0.112***	-0.104***	-0.060
		[0.022]	[0.030]	[0.057]
Policy support X sales losses				
• less than 25%				0.010
				[0.031]
• between 25 to 50%				0.069
				[0.042]
• more than 50%				-0.053
				[0.065]
Pre-covid productivity	0.000	-0.001	-0.003	-0.003
	[0.007]	[0.007]	[0.009]	[0.009]
Financial Leverage			0.011*	0.011*
			[0.006]	[0.006]
Distressed			0.012	0.013
			[0.018]	[0.018]
Capital ratio			0.026	0.027
			[0.029]	[0.029]
Constant	0.370***	0.399***	0.404***	0.407***
	[0.074]	[0.074]	[0.096]	[0.096]
Observations	8.819	8.819	5.756	5.756
R-squared	0.025	0.028	0.025	0.025
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: Linear Probability Model estimated with firm size dummies (small, medium and large), sectors (as in Figure 46) and firm age dummies: Less than 2 years; 2 years to less than 5 years; 5 years to less than 10 years; 10 years to less than 20 years; 20 years or more. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample). Some financial variables are not available for all firms and consequently the sample size is lower. Sector level estimates are reported in Appendix.

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

8.3.2. Some evidence that the policy support has enabled financial expansion

We turn to the analysis of the policy support on the liability side of corporate balance sheets. We focus on whether the company has raised new equity from current stakeholders or not. We estimate EQ3 for the answers to this question ([121]).

The results are reported in Table 18. Across all the estimations, the policy support raises the likelihood of increasing the equity base, an effect always significant at a 1 % confidence level. Somewhat surprisingly, sales losses also raise the probability of increasing the equity base. The conjunction of these two effects may suggest that recapitalisation needs resulting from large losses become more likely with the policy allotment. Getting it would increase the probability of crowd-in equity investors. Such interpretation is somewhat supported by the estimated impact of firm characteristics. The higher the financial leverage and the lower the capital ratio pre-COVID19, the more likely the increase in the equity base. Hence, the change in the financial structure possibly corrects balance sheet weakness ([122]).

Table 18 / **Factors explaining the recapitalisation (*firms that have raised new equity*)**

VARIABLES	(1)	(2)	(3)	(4)
Policy support	0.024***	0.016***	0.020***	0.023***
	[0.005]	[0.006]	[0.006]	[0.008]
Sales losses				
• less than 25 %		0.008	0.008	0.015
		[0.006]	[0.007]	[0.010]
• between 25 to 50 %		0.045***	0.032***	0.035*
		[0.009]	[0.011]	[0.018]
• more than 50 %		0.068***	0.057***	0.046
		[0.016]	[0.019]	[0.035]
Policy support X sales losses				
• less than 25 %				-0.012
				[0.014]
• between 25 to 50 %				-0.005
				[0.022]
• more than 50 %				0.013
				[0.041]
Pre-covid productivity	-0.015***	-0.014***	-0.011**	-0.011**
	[0.004]	[0.004]	[0.005]	[0.005]

([121]) On equity, we consolidate two answers from Q68. Raising new equity (from the market, from external private investors) and raising new equity from current owners. We consider these two possibilities jointly.

([122]) See Maurin and Pal (2020) or Carletti et al. (2020) for the need to increase the capital base of corporates after the sharp fall in profits during the COVID-19 crisis.

VARIABLES	(1)	(2)	(3)	(4)
Financial Leverage			0.003	0.003
			[0.003]	[0.003]
Distressed			0.051***	0.052***
			[0.011]	[0.011]
Capital ratio			-0.024*	-0.024*
			[0.013]	[0.013]
Constant	0.204***	0.186***	0.141***	0.140***
	[0.043]	[0.043]	[0.054]	[0.054]
Observations	8,819	8,819	5,756	5,756
R-squared	0.036	0.042	0.047	0.047
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: See notes Table 17.

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

8.3.3. Some evidence that the policy support fastens firms digitalisation

In this section we focus on the question that relates to the investment response taken as a response to the COVID-19 pandemic, whether firms have taken any actions or made investments to (1) develop new products, services or processes, (2) transform their supply chain (3) become more digital. While we do not find conclusive and significant impact of the policy support in terms of developing new products, services or processes and transforming their supply chain, there is much clear reaction of firms in terms of digital transformation. The crisis has strengthened the case for European firms to digitalise, deeper and faster. Therefore as a last question, we consider the role of the policy support and the strengthening of the equity base in the digital transition. We estimate the following equation:

$$q_{i,c,s} = \alpha Sales_i + \beta Pol_i^k + \gamma Sales_i \times Pol_i^k + \phi Equity_i + Z_i + \Gamma\theta_i + \varepsilon_i \qquad \text{EQ. 4}$$

In EQ3, *Equity* relates to the question on financial expansion, whether firms have raised equity or debt ([123]). Other explanatory variables are defined as in previous equations.

([123]) The considered external financing options are related specifically to the COVID-19 reaction and variables are derived from the EIBIS 2021 survey question: '*Has your company taken any of the following actions as a result of the COVID-19 pandemic?*' with 3 possible answers*: a) Increased its debt position (with banks, trade partners, tax administration, b) Raised new equity (from the market, from external private investors), c) Raised new equity from current owners), d) Made changes to investment plans.*

Table 19 shows the results explaining the likelihood to increase digitalisation. Interestingly, in all the estimations, sales losses hurt digitalisation, reducing the likelihood to digitalise more by 5 to 9 pp. However, the effect is compensated by the policy allotment. Firms that received the policy support while suffering large sale losses, are more likely to digitalise than those that did suffer sales losses but did not get the policy support, by 4 to 5 pp. Furthermore, digitalisation spending increases with pre-crisis productivity. This result comes after conditioning on the sector and country in which the firms operate. Hence, in the same country and sector, the more productive firms are more likely to digitalise further. This dynamic may contribute to widening the productivity gap as digitalisation is likely to foster productivity. Finally, stronger firms, i.e. those not in distress, having lower leverage or higher capital base, are more likely to digitalise. However, these effects are not significant at 10 %.

More interestingly, in all the cases, firms that have increased their external financing are more likely to digitalise, an effect that is always significant at 10 % at least. Hence, increased equity raises the probability to digitalise by 4 to 5 pp. A similar, but slightly stronger effect is found for debt. When considered jointly with the factors contributing to explain the stronger equity base, this finding suggests that the policy support deployed at the occasion of the crisis could have fostered the crowing-in of investors and thereby speeding up the digital transformation of European firms.

Previous literature points also to the different sensitivity of tangible versus intangible investments depending on the type of shock. Altomonte et al., (2022) suggest that during demand shock (such as the COVID-19 shock) tangibles are more affected than intangibles (such as digital investments). Moreover, digitalization might play a role in terms of resilience of firms during crises, as firms belonging to more digital sectors has been in a better position to remain or even increase the number of employees during the COVID-19 shocks (see Teruel et al., 2022).

Whereas aggregate effects may be slow to materialise, the micro literature generally acknowledges that digital technology adoption generates productivity gains at the firm-level. A number of studies have estimated the impact of ICT and digitalisation on firm-level productivity and seem to converge towards a positive effect of ICT investment on productivity and innovation (Hall et al., 2013; Castiglione, 2012; Cette et al., 2020; Borowiecki et al., 2021) and a positive impact on value added (Dhyne et al., 2018) ([124]). A select number of studies, however, do find more limited direct effects of these technologies on productivity at a micro level, see e.g. Acemoglu et al. (2014), Bartelsman et al. (2017) and DeStefano et al. (2018) ([125]).

([124]) See Gal et al. (2019) and ECB (2021) for a detailed review of this literature.

([125]) Estimating the effect of digitalisation or ICT adoption on productivity is complicated by the fact that digital technology adoption translates into productivity through a combination of numerous other factors (Gal et al., 2019), possibly explaining the less conclusive firm-level evidence. Recent research, for example, has shown that managerial quality, in particular, is extremely important in driving productivity differences across firms (Bloom et al., 2012). Moreover, a lack of digital skills is commonly cited by SMEs as one of the main obstacles to the adoption of new technologies (EIB, 2020).

Table 19 / **Likelihood of becoming more digital**

VARIABLES	(1) covresp_3	(2) covresp_3	(3) covresp_3	(5) covresp_3
policy_any = 1	0.041***	0.045***	0.046***	0.037**
	[0.011]	[0.011]	[0.014]	[0.018]
Sales losses				
• less than 25 %		0.007	0.018	0.016
		[0.012]	[0.015]	[0.023]
• between 25 to 50 %		-0.036**	-0.017	-0.044
		[0.015]	[0.019]	[0.032]
• more than 50 %		-0.036	-0.027	-0.089*
		[0.022]	[0.029]	[0.048]
Policy support X sales losses				
• less than 25 %				0.004
				[0.030]
• between 25 to 50 %				0.039
				[0.039]
• more than 50 %				0.085
				[0.059]
Debt increase	0.046***	0.052***	0.047***	0.046**
	[0.015]	[0.015]	[0.018]	[0.018]
Equity injection	0.044**	0.048**	0.058**	0.058**
	[0.021]	[0.021]	[0.028]	[0.028]
Financial Leverage			-0.000	-0.000
			[0.005]	[0.005]
Distressed			-0.026	-0.026
			[0.017]	[0.017]
Capital ratio			0.011	0.010
			[0.027]	[0.027]
Constant	-0.136*	-0.128*	-0.065	-0.060
	[0.070]	[0.071]	[0.090]	[0.090]
Observations	8,819	8,819	5,756	5,756
R-squared	0.092	0.093	0.097	0.097
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: See notes Table 17.

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

CONCLUSION

In Europe, the policy support deployed during the crisis has been massive and multifaceted. The strong and swift recovery suggests that it has reached its goal and shielded the corporate ecosystem. Some have argued that government support is exposed to moral hazard problems: Because it was not selective, it is exposed to moral hazard risk: firms that would have otherwise disappeared have been kept afloat. Public support might therefore lower the growth prospects of the European economy in the longer term.

Our findings do not support this view as we do not find a link showing that more support went to firms that were already weak before the crisis. The main explanatory factor to get the policy support was the change in sales during the crisis period and firm weakness indicators do not appear to explain the allotment. We do find that firms with low liquidity buffers received more support and that this difference was significant. But this suggests that the first goal of the policy, avoiding a liquidity dry-out and freezing the corporate ecosystem, was achieved.

Moreover, we find some evidence that supported firms are more positive about their investment outlook. They may have been in a better position to crowd-in investors and recapitalise. Finally, we find evidence that the conjunction of policy support and stronger equity base accelerates the digital transformation of European corporates, a transformation that the crisis has made even more necessary. While some firms are now stronger, pockets of vulnerability have developed and not all firms have taken the opportunity to transform. Some firms took advantage of the policy support to adjust, and to strengthen their digitalisation. Others did not, and vulnerability might emerge.

After avoiding the liquidity crunch during the temporary halt of the economic activity in 2020, there is a clear need for new policy tools to support corporate solvency. Policy makers can design targeted policies supporting resource allocation towards the sectors more in need. The equity-type instruments are needed as a second step for rebalancing the balance sheet structure of corporates, affected by both strong losses and increasing indebtedness resulted also from successful liquidity support. Moreover, higher long-term growth can be achieved with common public-private efforts in direction of adopting new digital solutions. While corporates are increasingly in favour of digital investments in a post-pandemic world, technological readiness in terms of digital infrastructure and skills are crucial, also to avoid widening cross-regional gaps. Targeted grants might further accelerate digital investments on the firm level.

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APPENDIX

Table A / **Summary statistics**

	N	Mean	St. Dev.	Min	Max
Policy support					
New subsidised or guaranteed credit	11742	17%	38%	0	1
Deferral of payments	11742	16%	37%	0	1
Subsidies or any other financial support	11742	36%	48%	0	1
Any support	11742	55%	50%	0	1
Firm size indicators					
small (5-49)	11626	0,307	0,461	0,0	1,0
medium (50-249)	11626	0,222	0,415	0,0	1,0
large (250+)	11626	0,471	0,499	0,0	1,0
Firm age indicators					
Less than 2 years	11802	0,002	0,048	0,0	1,0
2 years to less than 5 years	11802	0,020	0,141	0,0	1,0
5 years to less than 10 years	11802	0,055	0,229	0,0	1,0
10 years to less than 20 years	11802	0,155	0,362	0,0	1,0
20 years or more	11802	0,767	0,423	0,0	1,0
Change in sales					
more than 50% decline	11651	0,047	0,211	0,0	1,0
25% to 50% decline	11651	0,119	0,324	0,0	1,0
less than 25% decline	11651	0,319	0,466	0,0	1,0
Firm responses					
Increase investment in 2021	11805	0,399	0,490	0,0	1,0
Debt increase	11805	0,163	0,369	0,0	1,0
Equity injection	11805	0,064	0,245	0,0	1,0
Investment in Digitalisation	11805	0,458	0,498	0,0	1,0
Firm performance indicators					
Productivity	9447	10,673	0,866	0,7	16,8
Exporter	11770	0,528	0,499	0,0	1,0
Digital	11779	0,612	0,487	0,0	1,0
Investment ratio	10004	0,092	0,401	-0,6	2,0
Liquidity ratio	10541	0,112	0,138	0,0	0,6
Returns on asset	9706	0,139	0,285	-0,7	1,0
Financially constrained	11407	0,047	0,212	0,0	1,0
Lossmaker	9712	0,164	0,37	0,0	1,0
Distressed: interest coverage ratio below 1	6928	0,197	0,398	0,0	1,0
Capital ratio	10794	0,391	0,253	-0,337	0,912
Financial leverage	9458	0,63	1,063	0,0	6,3

Table A1 / **Correlation table**

		1	2	3	4	5	6	7	8	9	10
1	More than 50% sales decline	1									
2	25% to 50% sales decline	-0,12	1								
3	Less than 25% sales decline	-0,16	-0,25	1							
4	New subsidised or guaranteed credit	0,06	0,05	0,01	1						
5	Deferral of payments	0,12	0,07	0,03	0,19	1					
6	Subsidies or any other financial support	0,15	0,15	0,07	0,05	0,19	1				
7	Increase investment in 2021	-0,05	-0,04	0,00	0,01	0,02	0,01	1			
8	Debt increase	0,15	0,12	0,00	0,36	0,26	0,09	0,00	1		
9	Equity injection	0,09	0,06	-0,02	0,05	0,07	0,04	0,02	0,12	1	
10	Investment in Digitalisation	-0,02	-0,03	0,04	0,03	0,05	0,06	0,08	0,04	0,02	1
11	Productivity	-0,10	-0,09	0,06	0,00	-0,04	-0,06	0,03	-0,06	-0,09	0,15
12	Exporter	-0,11	-0,01	0,07	0,02	0,03	0,06	0,09	0,00	0,01	0,09
13	Digital	-0,03	-0,04	0,02	0,02	0,02	0,02	0,07	0,01	0,02	0,20
14	Investment ratio	0,01	0,00	-0,02	0,01	0,01	-0,01	0,00	0,00	0,04	-0,02
15	Liquidity ratio	0,04	0,03	-0,02	-0,10	-0,13	-0,05	-0,06	-0,10	-0,04	-0,06
16	Returns on asset	0,00	0,00	-0,02	-0,03	-0,04	0,00	0,00	-0,02	0,00	-0,01
17	Financially constrained	0,09	0,05	-0,04	0,02	0,06	0,02	0,01	0,10	0,09	-0,02
18	Lossmaker	0,05	0,03	-0,01	-0,03	0,03	-0,01	-0,01	0,03	0,09	-0,02
19	Distressed: interest coverage ratio below 1	0,05	0,01	-0,01	-0,02	0,04	-0,02	-0,01	0,02	0,08	-0,02
20	Financial leverage	-0,01	0,01	-0,02	0,11	0,08	0,00	0,01	0,09	0,02	0,00
21	Capital ratio	-0,05	-0,02	0,03	-0,09	-0,13	-0,02	-0,01	-0,12	-0,08	0,00

		11	12	13	14	15	16	17	18	19	20
11	**Productivity**	1									
12	**Exporter**	0,14	1								
13	**Digital**	0,14	0,18	1							
14	**Investment ratio**	-0,06	-0,03	0,01	1						
15	**Liquidity ratio**	-0,04	-0,13	-0,08	0,06	1					
16	**Returns on asset**	0,01	-0,02	0,00	0,12	0,15	1				
17	**Financially constrained**	-0,12	-0,03	-0,03	0,01	0,00	-0,02	1			
18	**Lossmaker**	-0,09	-0,03	-0,02	-0,06	-0,08	-0,33	0,0741	1		
19	**Distressed: interest coverage ratio below 1**	-0,07	-0,03	-0,02	-0,06	-0,09	-0,33	0,0778	0,8447	1	
20	**Financial leverage**	-0,01	0,02	-0,01	0,02	-0,10	-0,01	0,019	0,0671	0,0464	1
21	**Capital ratio**	0,0687	0,07	0,01	-0,01	0,26	-0,05	-0,05	-0,26	-0,25	-0,34

Table A2 / **Factors explaining the likelihood of increasing investment in the current financial year by main sectors**

	(1)	(2)	(3)	(4)
	Manufacturing	**Services**	**Construction**	**Utilities**
policy_any = 1	0.031	0.001	-0.007	-0.023
	[0.024]	[0.029]	[0.029]	[0.028]
Sales losses				
• less than 25 %	**-0.047***	-0.025	-0.001	0.019
	[0.026]	[0.032]	[0.035]	[0.032]
• between 25 to 50 %	**-0.087*****	-0.025	0.002	-0.022
	[0.034]	[0.040]	[0.042]	[0.043]
• more than 50 %	-0.056	**-0.107****	-0.029	-0.055
	[0.067]	**[0.044]**	[0.063]	[0.058]
Financial Leverage	-0.004	0.012	0.008	0.016
	[0.013]	[0.009]	[0.011]	[0.016]
Distressed	-0.039	0.021	0.029	0.050
	[0.031]	[0.037]	[0.039]	[0.035]
Capital ratio	-0.044	0.008	0.029	0.066
	[0.052]	[0.058]	[0.060]	[0.058]
Pre-covid productivity	-0.020	-0.007	0.001	0.013
	[0.016]	[0.019]	[0.019]	[0.017]
Observations	2,044	1,393	1,196	1,358
R-squared	0.032	0.036	0.039	0.038
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: Linear Probability Model estimated with firm size dummies (small, medium and large), sectors (as in Figure 46) and firm age dummies: Less than 2 years; 2 years to less than 5 years; 5 years to less than 10 years; 10 years to less than 20 years; 20 years or more. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample).

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

Table A3 / **Factors explaining the recapitalisation (*firms that have raised new equity*) by main sectors**

	(1)	(2)	(3)	(4)
	Manufacturing	**Services**	**Construction**	**Utilities**
policy_any = 1	0.023**	0.016	0.025**	0.022*
	[0.011]	[0.015]	[0.013]	[0.013]
Sales losses				
• less than 25 %	-0.008	-0.000	0.034*	0.022
	[0.012]	[0.015]	[0.019]	[0.014]
• between 25 to 50 %	0.026	0.020	0.031	0.073***
	[0.019]	[0.022]	[0.024]	[0.026]
• more than 50 %	0.100*	0.086***	-0.005	0.068*
	[0.051]	[0.032]	[0.030]	[0.036]
Financial Leverage	0.003	-0.001	0.005	0.012
	[0.007]	[0.005]	[0.006]	[0.009]
Distressed	0.070***	0.063***	0.010	0.037**
	[0.019]	[0.024]	[0.021]	[0.019]
Capital ratio	-0.058**	-0.036	-0.041	0.010
	[0.023]	[0.028]	[0.027]	[0.031]
Pre-covid productivity	-0.018**	-0.005	-0.006	-0.001
	[0.009]	[0.012]	[0.010]	[0.009]
Observations	2,044	1,393	1,196	1,358
R-squared	0.075	0.060	0.060	0.064
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: Linear Probability Model estimated with firm size dummies (small, medium and large), sectors (as in Figure 46) and firm age dummies: Less than 2 years; 2 years to less than 5 years; 5 years to less than 10 years; 10 years to less than 20 years; 20 years or more. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample).

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

Table A4 / **Likelihood of becoming more digital**

	(1)	(2)	(3)	(4)
	Manufacturing	**Services**	**Construction**	**Utilities**
policy_any = 1	0.050**	0.088***	0.059**	0.018
	[0.023]	[0.029]	[0.027]	[0.028]
Sales losses				
• less than 25 %	-0.000	-0.018	-0.003	0.067**
	[0.024]	[0.032]	[0.032]	[0.031]
• between 25 to 50 %	-0.039	0.014	-0.037	-0.035
	[0.032]	[0.040]	[0.036]	[0.042]
• more than 50 %	-0.081	-0.031	-0.048	-0.017
	[0.062]	[0.046]	[0.055]	[0.057]
Financial Leverage	-0.004	0.007	0.001	0.007
	[0.012]	[0.009]	[0.009]	[0.015]
Distressed	-0.029	-0.017	-0.042	-0.031
	[0.029]	[0.037]	[0.035]	[0.034]
Capital ratio	0.044	-0.046	-0.012	-0.004
	[0.049]	[0.057]	[0.052]	[0.055]
Pre-covid productivity	0.034**	0.018	0.013	0.059***
	[0.015]	[0.017]	[0.015]	[0.016]
Observations	2,044	1,393	1,196	1,358
R-squared	0.087	0.090	0.112	0.113
Firm controls	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes

NB: Linear Probability Model estimated with firm size dummies (small, medium and large), sectors (as in Figure 46) and firm age dummies: Less than 2 years; 2 years to less than 5 years; 5 years to less than 10 years; 10 years to less than 20 years; 20 years or more. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. The control group for the sales dummies is the sample of firms with a positive sales growth or no change in their sales (around 50 % of the sample).

Source: Authors' estimations based on the EIBIS2021 matched with the ORBIS database.

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