GAYANE SHAKHMURADYAN

University of Padua

CORPORATE INNOVATION AND RESILIENCE IN THE EURO AREA

September 2025

Marco Fanno Working Papers – 327

Dipartimento di Scienze Economiche e Aziendali 'Marco Fanno'

Università degli Studi di Padova

Corporate Innovation and Resilience in the Euro Area

Gayane Shakhmuradyan*

Abstract

This paper provides evidence on whether innovation enhanced the resilience of publicly traded companies in the euro area during the COVID–19 pandemic. Using financial statements and stock prices of around 1,200 companies observed from the first week of 2019 to the last week of 2021, I find that companies reporting research and development expenses before the crisis induced by the pandemic were less likely to incur a loss due to its impact as well as recovered faster if having incurred a loss. In addition, I examine whether institutions and government policies played a role in fostering resilience. I find that the impact of innovation on resilience is greater in countries that had lower effective corporate tax rates during the pandemic and extended existing tax incentives to mitigate its impact.

Keywords: crisis; innovation; institutions; resilience; taxation
JEL codes: D02; E32; F33; H25; M21; O31

*Ph.D. candidate, Department of Economics and Management, University of Padua, Italy. Email address: gayane.shakhmuradyan@phd.unipd.it. Postal address: 33 Via del Santo, 35123 Padua, Italy. *Acknowledgments:* I am grateful to Diego Campagnolo, Enrico Rettore, and Lorenzo Mori for their feedback on earlier drafts of this paper. From February to June 2024, I was a visiting researcher at the Leibniz Centre for European Economic Research (ZEW) in Mannheim, Germany, where most of the research underlying this paper was conducted. I would like to thank Hanna Hottenrott, head of the Economics of Innovation and Industrial Dynamics Research Unit, for hosting me at ZEW, as well as Annalisa Tassi, Hannah Gundert, Julia Spix, Stefan Weck, and Sophia Wickel, for their time to discuss my research. Earlier versions of the paper were presented at the Berkeley–Padova–Paris Organizational Economics Workshop, held in May 2025 at the University of Padua, as well as at the Deutsche Bundesbank in August 2025. I am grateful to Riccardo Camboni, Falko Fecht, Edoardo Grillo, Florian Heider, and Paola Valbonesi for their invitations to present my research, as well as Juliane Begenau for her feedback on my presentation at the Bundesbank. All remaining errors are my own. *Funding statement:* Financial support for this research was provided by the Italian Ministry of University and Research in the form of a doctoral scholarship at the University of Padua. *Data and code availability statement:* The financial statements and stock price data used in this paper were accessed through institutional subscriptions provided by the Department of Economics and Management at the University of Padua; all other data are publicly available from sources referenced in the text, and replication codes are available upon request.

1 Introduction

The question of what fosters resilience, i.e., the ability of economic agents to withstand and rebound from crises, is of both academic and policy relevance. Interest in resilience within the field of economics arose largely in the aftermath of the global financial crisis (Acemoglu, Ozdaglar, and Tahbaz–Salehi 2015), and it has recently been revived due to the COVID–19 pandemic (Pagano, Wagner, and Zechner 2023; Brunnermeier 2024; Copestake, Estefania–Flores, and Furceri 2024; Eichengreen, Park, and Shin 2024). In particular, scholars have studied supply chain resilience due to the unprecedented disruptions in global supply chains caused by the pandemic (Grossman, Helpman, and Lhuillier 2023; Grossman, Helpman, and Sabal 2024; Acemoglu and Tahbaz–Salehi 2025). [1] Less attention has been devoted to inherent company characteristics that contribute to resilience, such as culture, structure, and governance (Aghion et al. 2021; Ding et al. 2021; Li et al. 2021).

In this paper, I address two interrelated research questions: *Does innovation enhance corporate resilience?* and *Do institutions and government policies implemented during crises affect corporate resilience?* These are important questions to address due to the uncertainty and volatility associated with the current business environment, as well as the aim of governments to design cost–effective measures supporting businesses affected by economic crises. Based on the endogenous growth theory (Schumpeter 1942; Arrow 1962; Romer 1990; Grossman and Helpman 1991; Aghion and Howitt 1992), I hypothesize that companies allocating resources to innovation, i.e., reporting research and development (R&D) expenses, are more resilient. Specifically, I conceive of resilience as crisis *impact resistance* and *recovery speed*, arguing that innovation enhances resilience in two ways: first, it makes companies less likely to incur a loss due to an exogenous crisis, and second, it enables the faster recovery of those companies that incur a loss. Furthermore, drawing on the literature on institutions as a source of economic growth (North 1990; Hall and Jones 1999; Acemoglu, Johnson, and Robinson 2005; Acemoglu 2025), law and finance (La Porta

[1] Notably, the National Bureau of Economic Research hosted two conferences on the resilience of supply chains in 2024 (Spring and Fall), featuring 14 papers in total. See National Bureau of Economic Research (2024a, 2024b) for further details.

et al. 1998), and tax policy and investment (Hall and Jorgenson 1967; Bloom, Griffith, and Van Reenen 2002; Hassett and Hubbard 2002; Zwick and Mahon 2017), I hypothesize that institutions and government policies matter for corporate resilience: the observed impact of innovation on resilience is greater in countries that provide a more favorable environment for business innovation in general and tax incentives for innovation under crisis conditions in particular.

I observe innovation and resilience using financial statements and stock prices of a large sample of companies traded in the euro area (EA) member states—a group of 20 economies that have formed a monetary union since 1999 but retain autonomy over business taxation, and therefore, implemented different fiscal policies in response to the COVID–19 pandemic. Specifically, my baseline sample includes all EA member states as of 1 January 2019 (thereby excluding Croatia, which adopted the euro on 1 January 2023) and around 1,200 companies operating across different industries and locations. To examine the role of fiscal policy in enhancing resilience, I restrict the sample to 17 member states that are also members of the Organization for Economic Cooperation and Development (OECD), as data on corporate income tax rates and incentives, especially those implemented during the COVID–19 pandemic, are provided by the OECD. Finally, to examine the role of institutions, I restrict the sample to 11 member states that have been classified by La Porta et al. (1998) as belonging to either of the four legal origins (English, French, German, and Scandinavian): in major part, those are the member states that formed the EA on 1 January 1999 and founded the OECD in 1960. Overall, I have panel data of around 190,000 company–week observations starting in 2019 and ending in 2021. [2]

By examining the relationship between corporate innovation and resilience, I contribute to several strands of economic literature. First and most importantly, I contribute to the growing literature on economic resilience. Although I am not the first to examine whether

[2]Upon recommendation of the World Health Organization, the pandemic ceased to be an emergency in the EA in May 2023 (World Health Organization 2025). However, I exclude the years 2022 and 2023 due to the war in Ukraine, which constitutes another exogenous crisis affecting its member states starting in February 2022. As noted by Ramey (2016, p. 75), in the presence of two exogenous shocks, it is not possible to identify the *unique causal effects* of one relative to another.

more innovative companies are more resilient (see Ahn, Mortara, and Minshall (2018) and Bertschek, Polder, and Schulte (2019) for earlier evidence), this paper is the first—to the best of my knowledge—to utilize the setting of a monetary union in the absence of a fiscal union (Farhi and Werning 2017) to examine whether the impact of innovation on resilience varies depending on different institutional environments and crisis response policies implemented by national governments. Analogously to La Porta et al. (1998, p. 1114), who asked whether being a shareholder in France gives investors the same privileges as being a shareholder in, for instance, the United States, I ask and provide an answer to the following question: Does being an innovator in France enable the same capacity for resilience as being an innovator in, for instance, Germany? In other words, *Does innovation contribute equally to corporate resilience in countries that are institutionally different and implement different policies during crises?* The answer is "no", as I find that institutions and policies do matter for resilience, and they do so in countries that are comparable along many dimensions relevant to economic outcomes (i.e., founding members of the EA and the OECD), as well as in the process of economic convergence (member states that joined the EA during the early– and mid–2000s). [3]

Secondly, I contribute to the literature on tax policy and business investment, which, dating to Hall and Jorgenson (1967) and as reviewed by Hassett and Hubbard (2002), suggests that tax incentives are cost–effective in stimulating private investment. Most prior research in this area, including the recent contributions by Zwick and Mahon (2017), Guceri and Liu (2019), Dechezleprêtre et al. (2023), and Lichter et al. (2025), has focused on tax incentives provided during growth periods, while economic theory (Bernanke 1983; Dixit and Pindyck 1994; Bloom 2009) and the extant empirical evidence on recessions (Guceri

[3]The answer would most probably have been "yes" if one were to overlook the role of institutions and policies in affecting resilience, as has been the case in recent research examining other factors. For instance, Copestake, Estefania–Flores, and Furceri (2024) study digitization and resilience in a heterogeneous group of 75 economies without considering either the institutional environment of these countries before the pandemic or public policies implemented in response to it. They re–estimate their baseline regression equation excluding one country or region at a time and conclude that the "results are not dependent on any specific country or group of countries" (p. 8). Aizenman et al. (2025) consider institutions but not policies and without reference to La Porta et al. (1998).

and Albinowski 2021; Link et al. 2024) suggest that tax incentives are not effective under uncertainty due to high capital adjustment costs which reduce investment. [4] Studying the extension of the R&D tax credit in Germany in June 2020 and its role in fostering the resilience of innovative companies during the COVID–19 pandemic, I argue that fiscal policy plays a key role in macroeconomic stabilization during crises (Blanchard 2025; Eichenbaum 2025), enabling faster recovery than would otherwise take place. Besides extending the literature on the effectiveness of R&D tax credits in OECD countries (Hall and Van Reenen 2000; Bloom, Griffith, and Van Reenen 2002; Thomson 2017), I thereby contribute to the literature on the growth impact of discretionary fiscal policy during a recessionary period in the EA (Coenen, Straub, and Trabandt 2012, 2013; Devereux et al. 2020).

Finally, I contribute to the literature on monetary–fiscal policy interactions in monetary unions with heterogeneous fiscal space (Beetsma and Jensen 2005; Davig and Leeper 2011; Bellifemine, Couturier, and Jamilov 2025). Having its origins in the literature on optimal currency areas (Mundell 1961; McKinnon 1963; Kenen 1969; Alesina and Barro 2002; Alesina, Barro, and Tenreyro 2002), this literature finds that diverging fiscal policies may jeopardize the integrity and sustainability of a monetary union such as the EA. My findings suggest that the impact of innovation on resilience is stronger in EA member states that were compliant with the Maastricht Treaty before the pandemic, i.e., had debt–to–GDP ratios not exceeding 60%. Thus, the maintenance of fiscal rules (European Commission 2025d) is of paramount importance in an incomplete economic union.

The rest of the paper is organized as follows: Section 2 below describes the empirical setting of my research and the data I use. Section 3 elaborates on my measures and econometric approaches. Section 4 provides the results, Section 5 discusses the results in relation to the extant literature, and Section 6 concludes. Additional descriptive and inferential statistics are provided in the Online Appendix.

[4] Bloom, Bond, and Van Reenen (2007, p. 411) note that "increases in uncertainty around major shocks, like September 11, 2001 and the 1970's oil shocks, could seriously reduce the responsiveness of investment to monetary or fiscal policy." Similarly, Bloom et al. (2018, p. 1062) note that "uncertainty shocks not only impact the economy directly, but also indirectly change the response of the economy to any potential reactive stabilization policy."

2 Empirical Setting and Data

2.1 Empirical Setting

The empirical setting in which I examine corporate resilience in the EA is the COVID–19 pandemic. In its Fall 2020 statement, dated 29 September 2020, the Euro Area Business Cycle Dating Committee of the Centre for Economic Policy Research (CEPR) declared that the expansion that had started in Q2–2013 reached its peak in Q4–2019, and the EA entered a recession in Q1–2020 (Euro Area Business Cycle Network 2020). In its Fall 2021 statement, dated 9 November 2021, the Committee declared that the EA recession that had started after Q4–2019 reached its trough in Q2–2020; therefore, the pandemic–induced recession lasted for only two quarters, the shortest on record (Euro Area Business Cycle Network 2021). Despite its brevity, the recession was severe, as the seasonally adjusted gross domestic product (GDP) in the EA contracted at a rate of 11.8% in Q2–2020, the largest decline since the series was first observed in 1995 (Eurostat 2020).

2.2 Data

To address my first research question, i.e., whether innovation fosters resilience, I construct a panel data set linking financial statements, stock prices, and other characteristics (e.g., industry and location) of companies traded in the EA member states before, during, and after COVID–19 was declared a pandemic on 11 March 2020 (World Health Organization 2025). To examine the role of institutions and policies in fostering resilience and thereby address the second research question, I study public policy responses in individual member states from January 2020 to December 2021. [5] In particular, I study fiscal policies related to the corporate income tax (CIT), as those affect all incorporated businesses in an economy, and incentives for innovation, such as R&D tax credits, which affect innovative enterprises.

[5] Besides the confounding effect of the war in Ukraine, as noted in the introduction, the end of the observation window in 2021 is appropriate as the OECD data on tax policy measures during the pandemic were last updated in April 2021. Similarly, the IMF data on COVID–19 policy responses were last updated in July 2021. See Section 2.2.4 for further details.

I gather and match data from several sources, as elaborated below.

2.2.1 Corporate Identifiers

First, I obtain identifiers of publicly traded companies in the EA from the Bureau van Dijk (BvD) Orbis database. Specifically, I start the data collection with International Securities Identification Numbers (ISINs), i.e., standardized 12–digit alphanumeric codes, the first two digits of which correspond to the two–letter ISO country code in which a company is incorporated (e.g., DE for Germany and FR for France). I retain only companies incorporated in 19 member states constituting the EA as of 1 January 2019 (European Union 2025). [6] From the population of 3,286 companies, [7] I exclude financial companies, i.e., those operating under NACE Rev.2 sections K (finance and insurance) and L (real estate) (Eurostat 2008), as the financial ratios of companies in these industries are not directly comparable with the financial ratios of companies in other industries (Fama and French 1992). [8] Thus, I obtain a sample of 2,495 companies.

2.2.2 Financial Statements

Secondly, I gather financial statement data of all companies in the sample. In particular, I obtain data on net income in 2019, i.e., in the pre–crisis year. I exclude companies with missing net income ($n = 367$), as well as companies reporting negative ($n = 662$) and zero ($n = 18$) net income. This is meant to ensure that losses incurred during the crisis are due to its impact rather than other, company–specific factors (Altman 1968). Thus, my sample is reduced to 1,448 companies. In addition, I obtain data on R&D expenses in 2019 to classify companies as either R&D spenders or non–spenders pre–crisis, as this enables me

---

[6] The countries are, in alphabetical order, the following: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain.

[7] The version of the database I use is 357, last updated 15 January 2025.

[8] These sections include divisions 64–66 and 68, respectively. NACE is an abbreviation in French, standing for *Nomenclature statistique des activités économiques dans la Communauté européenne*, and it is translated as "Statistical classification of economic activities in the European Community." Rev.2 indicates that this is the second edition of the classification, superseding the original classification established in 1999.

to claim temporal exogeneity of the independent variable of innovation with respect to the dependent variables of resilience (see Section 3.4 below). Non–missing non–zero values for R&D are available for 411 companies; therefore, these are classified as R&D spenders. [9] For both R&D spenders and non–spenders, I gather additional financial data from both balance sheets and profit–loss accounts, e.g., total assets, current assets, and current liabilities, as these enable me to calculate measures that serve as controls in econometric estimation (see Section 3.5 below).

2.2.3 Stock Prices

Finally, I gather stock price data of all companies incorporated in 19 EA member states from the LSEG Workspace (formerly Refinitiv Eikon database). Price data for all weeks between W1–2019 and W52–2021 are available for 2,642 companies. Given the median price of EUR 9 and to ensure that extreme observations do not bias my estimates, I exclude companies the stocks of which traded below the 1^{st} percentile (EUR 0.022) and above the 99^{th} percentile (EUR 3,920) of the distribution in any of the weeks ($n = 53$ and $n = 34$, respectively). The matching of the resulting panel with the cross–section of 1,448 companies obtained above using the ISINs and retention of only those companies that appear in both data sets results in a strongly balanced panel of 1,209 companies observed over 156 weeks, i.e., 188,604 company–week observations. [10] In this panel, 379 companies ($\approx 31\%$) are R&D spenders, and it constitutes the basis for most statistical analyses reported below. Online Appendix A provides the distribution of companies by industries (NACE Rev.2 sections and divisions) and locations (EA member states and NUTS 1 regions), for the sample as a whole, as well as separately for R&D spenders and non–spenders. [11]

[9] The Orbis database has data on R&D expenses reported in both Global Standard and Global Detailed formats. My classification is based on the Global Detailed format.

[10] The fact that 2020 was a leap year and included an additional day (29 February) does not affect my week count for that year: the statistical software I use (Stata) has a convention that all years have 52 weeks irrespective of the number of days. See Cox (2022) for further details.

[11] NUTS stands for "*Nomenclature des unités territoriales statistiques*," i.e., Nomenclature of Territorial Units for Statistics. See Eurostat (2025).

2.2.4 Government Policies

I obtain data on government policy responses to the pandemic from three primary sources: the Oxford University COVID–19 Government Response Tracker (OxCGRT) (Hale et al. 2021; Blavatnik School of Government 2023), the International Monetary Fund's (IMF) COVID–19 Policy Tracker (International Monetary Fund 2021), and the OECD Tax Policy Reforms report (Organization for Economic Cooperation and Development 2021). Data on corporate tax rates and incentives for innovation before and during the pandemic are from two additional sources: the OECD Corporate Tax Statistics Database (Organization for Economic Cooperation and Development 2024b) and the InnoTax Portal, maintained as a part of the European Commission (EC)–OECD Science, Technology, and Innovation Policy (STIP) Compass (Organization for Economic Cooperation and Development 2025b). Each of these five data sources is outlined below.

Oxford Tracker: The most recent version of the OxCGRT data set, available as a GitHub repository since June 2023, provides a systematic record of government responses to COVID–19 in 185 countries and territories (as well as sub–national jurisdictions in eight countries) for three years from 1 January 2020 to 31 December 2022. [12] Overall, it includes 25 indicators organized in five groups: closure and containment, economic, health, vaccine, and miscellaneous; these are combined into four indices: Government Response Index (GRI), Stringency Index (SI), Containment and Health Index (CHI), and Economic Support Index (ESI). All EA member states are in the data set; however, the ESI, as acknowledged by the project team, "does not include support to firms or businesses and does not take into account the total fiscal value of economic support," although it has income support indicators for "payments to firms if explicitly linked to payroll/salaries" (Hale et al. 2023, pp. 10, 53). Therefore, from this data set, I retain only SI and CHI values from 1 January 2020 to 31 December 2021, and I obtain data on fiscal policy related to CIT from IMF and OECD sources, as elaborated below. [13] The time series of both indices is daily, and I use a monthly series with values taken on the first day of each month.

[12] See https://github.com/OxCGRT/covid-policy-tracker.

[13] GRI and SI are highly correlated, as there is an 87.5% overlap in the underlying indicators. See Hale et al. (2023, pp. 97–104) for further details.

IMF Tracker: The IMF Policy Tracker (last updated 2 July 2021) provides an overview of government policies aimed at containing the spread, as well as the economic impact of the COVID–19 pandemic. Besides containment (lockdown and vaccination) policies, it covers fiscal, monetary, and macro–financial policies implemented in 197 economies, including individual member states of the EA and the EA as a whole. Due to the common monetary policy in the latter, I focus on the fiscal policy sections of the Tracker. In particular, I retain data on the size of the fiscal stimulus package as a share of each country's 2019 GDP (e.g., 12.6% for Austria).

OECD Report: The 2021 edition of the annual Tax Policy Reforms report published by the OECD is focused on the COVID–19 pandemic, providing an analysis of tax policy measures in around 70 jurisdictions. An Excel spreadsheet associated with the report, last updated 22 April 2021, contains details on tax policies (e.g., type of tax concerned and date of legislation) in each jurisdiction, and all EA member states—except Cyprus and Malta—have corresponding entries, as these two economies are neither members nor partners of the OECD. [14] Therefore, in further analyses, I focus on 17 EA member states that are also members of the OECD.

OECD Database: The OECD Corporate Tax Statistics Database, last updated 11 July 2024, provides data on corporate income tax rates in OECD member states and partner economies. In particular, it has statistics on statutory and effective tax rates, as well as R&D tax incentives. Data are available at an annual frequency, and I obtain time series for three years (2019–2021) for two indicators in each of the 17 EA member states that are also members of the OECD: effective tax rates and implied tax subsidy rates on R&D (see Online Appendix B). For the former, I consider both effective average and effective marginal tax rates; for the latter, consistently with my sample selection (see Section 2.2.2 above), I consider only the rates for large profitable firms. [15] Since 2019, the OECD has published an annual Corporate Tax Statistics report based on the database, and I refer to

[14] The spreadsheet is available for download from https://www.oecd.org/tax/covid-19-tax-policy-and-other-measures.xlsm; the author retains a copy. The list of current OECD members and partners is available at https://www.oecd.org/en/about/members-partners.html.

[15] Data are available also for small and medium enterprises and loss–making firms.

2019–2021 editions for qualitative information on tax rates and incentives (see Organization for Economic Cooperation and Development (2024a) for the latest edition and references to earlier editions).

EC–OECD Compass: I supplement the OECD corporate tax data with more detailed information on R&D tax credits in each country from the InnoTax Portal of the STIP Compass. Expect four countries (Estonia, Finland, Latvia, and Luxembourg), all EA member states that are also members of the OECD had expenditure–based tax credits for R&D as of 1 January 2020 (see Online Appendix B). [16] The oldest is the French R&D tax credit *(crédit d'impôt recherche, CIR)*, in force since 1983, and three countries (Greece, Slovakia, and Slovenia) allowed for full (100%) deduction of R&D from taxable income both before and during the pandemic.

2.2.5 Institutions

Based on extensive background research in the field of law, La Porta et al. (1998) classify 49 economies as belonging to four legal origins: English, French, German, and Scandinavian. The overlap between the economies they classify and my sample of EA–OECD member states that provided R&D tax incentives during the pandemic is 11. These economies are representative of all four legal origins, as listed below:

1. **English:** Ireland;
2. **French:** Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain;
3. **German:** Austria and Germany;
4. **Scandinavian:** Finland.

[16] Chapter 5 of the OECD Corporate Tax Statistics report (Organization for Economic Cooperation and Development 2024a) provides a discussion of expenditure–based vs. income–based tax incentives for R&D. Estonia and Luxembourg have never had tax incentives, and therefore, there are no profiles for either country in the InnoTax Portal. Finland introduced an expenditure–based tax credit in 2021. The tax credit in Latvia, introduced in 2014, ceased to be in force in 2018. See https://stip.oecd.org/innotax/countries/Finland and https://stip.oecd.org/innotax/countries/Latvia for further details.

English and Scandinavian legal origins are each represented by only one country in my sample (Ireland and Finland, respectively); therefore, I focus on the distinction between countries belonging to French and German origins. La Porta et al. (1998) find that on average, countries belonging to the German civil law origin provide greater protection to investors than those belonging to the French civil law origin. Similarly, I expect to find a stronger impact of innovation on corporate resilience in Austria and Germany as compared to the seven countries belonging to the French civil law origin (Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain). More narrowly, I expect to find a stronger impact of innovation on corporate resilience in Germany than in France.

Among the post–socialist economies that La Porta et al. (1998) did not classify, but the classification of which is possible due to their subsequent research (La Porta, Lopez–de–Silanes, and Shleifer 2008), Lithuania belongs to the French origin, while Slovakia and Slovenia belong to the German origin. I report the results below without these countries and include them in additional analyses reported in Online Appendix C.

3 Measures and Econometric Estimation

3.1 Resilience Measures

Originating in natural sciences, the concept of resilience has been adopted in several social sciences over the past centuries (Alexander 2013), including business administration and management (Meyer 1982; Linnenluecke 2017; Hillmann and Guenther 2021). According to Holling (1996, p. 33), the conception of resilience that may serve as a basis for its definition in economics, termed *engineering resilience*, focuses on "stability near an equilibrium steady state, where resistance to disturbance and speed of return to the equilibrium are used to measure the property." Holling (1996) contrasts the engineering conception of resilience to *ecological resilience* (Holling 1973), arguing that the latter "emphasizes conditions far from any equilibrium steady state, where instabilities can flip a system into another regime of behavior—that is, to another stability domain."

In line with the engineering conception, I measure resilience by two variables that are new to the economic literature: *impact resistance* and *recovery speed*. Impact resistance (IR) is a binary variable, such that, when measured with stock price (P):

$$IR = \begin{cases} 1 & \text{if } P_t \geq P_{t-s} \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

When calculated with weekly data, s in Equation 1 above equals 52, i.e., the number of weeks in a typical calendar year. For monthly and quarterly observations, s = 12 and s = 4, respectively.

Recovery speed (RS) is a count variable corresponding to the number of weeks, months, or quarters it takes to recover the stock price to its pre–crisis levels:

$$RS \in \mathbb{N}. \tag{2}$$

In the context of the pandemic–induced recession in the euro area, whereby the trough of the recession using weekly data can be dated to W12–2020 (see Online Appendix Figure A4), and there are observations up to W52–2021, the following is true:

$$1 \leq RS \leq 92. \tag{3}$$

For monthly and quarterly data in the same context, the maximum values for RS are 20 and 6, respectively. RS is not defined for companies that did not incur a loss throughout the crisis (i.e., IR = 1 in all weeks, months, or quarters).[17]

[17] The conception and measurement of resilience as *recovery speed* is analogous to the *duration* measure constructed in macro–econometric models of business cycle dating; the measure of *impact resistance* is close to the binary *state* variable constructed in the same models. See Harding and Pagan (2016), especially chapters 2 and 5, for further details on the econometric analysis of recurrent events in macroeconomics and finance. In my sample, *recovery speed* is not computed for only a small share of companies (89 of 1,209, i.e., around 7%), and most companies recover within 50 weeks; see Table A6 and Figure A5.

3.2 Innovation Measures

I measure innovation by R&D expenses. As opposed to patents, which capture the output of innovative activities of firms, R&D expenses capture the input of such activities and have been widely used in the innovation and productivity literature (Griliches 1998; Smith 2006). More importantly, R&D expenses are a better measure of the theoretical construct I aim to operationalize, i.e., the *allocation of resources* to innovation (Arrow 1962).

As noted in Section 2.2.2 above, the BvD Orbis database provides data on corporate R&D expenses. Therefore, my first measure of innovation, *R&D spender* (RDS), equals one if a company reported R&D expenses in 2019 and zero otherwise. For most companies that report R&D, I calculate a second measure of innovation, *R&D intensity* (RDI), equal to R&D expenses in 2019 divided by operating revenues (turnover) in the same year:

$$RDI = \frac{R\&D\ Expenses}{Revenues}. \tag{4}$$

I report the results below using *RDS* as the independent variable, while the results based on *RDI* are provided in Online Appendix C. [18]

3.3 Fiscal Policy Measures

In line with the resilience measures, I adopt two measures of fiscal policy: *containment tax cut* (CTC) and *recovery tax cut* (RTC). Both are binary variables, calculated based on the effective average tax rate (EATR). Specifically,

$$CTC = \begin{cases} 1 & \text{if } EATR_{2020} < EATR_{2019} \\ 0 & \text{otherwise.} \end{cases} \tag{5}$$

[18] It is important to note that BvD data on R&D expenses are incomplete, as R&D costs that are incurred but do not meet the recognition criteria of the *International Accounting Standard (IAS) 38: Intangible Assets* (International Financial Reporting Standards 2025) are reported in narrative sections of corporate reports rather than financial statements. I performed a textual analysis of annual reports filed in 2019 to ascertain whether companies allocate resources to innovation. The results based on textual classification are available as a supplement upon request.

Similarly:

$$RTC = \begin{cases} 1 & \text{if } EATR_{2021} < EATR_{2020} \\ 0 & \text{otherwise.} \end{cases} \tag{6}$$

The OECD Corporate Tax Statistics Database suggests that EATR in 2020 was lower than a year before in only five EA member states: Austria, Belgium, Finland, France, and Germany (see Online Appendix Table B1, column 1). Among these, the generosity of R&D incentives, as measured by the implied tax subsidy rate (ITSR) (see Table B1, column 3), increased in only two countries: Finland and Germany. The Finnish case is special as the R&D tax credit was introduced in 2021 (legislated in 2020), and therefore, the ITSR turned to zero in 2020 and 2021 from its negative (-0.01) value in 2019. The German R&D tax credit (*Forschungszulage*) was in place before the pandemic (legislated in December 2019; in force from 1 January 2020), and the rate increased from -0.02 in 2019 to 0.19 in 2020 and 2021. Notably, following the adoption of a fiscal stimulus package on 3 June 2020, the maximum amount of expenses qualifying for the R&D tax credit increased from EUR 2 million to EUR 4 million, and this extension is effective for the six–year period between 1 July 2020 and 30 June 2026 (Federal Government of Germany 2020).

The OECD database further suggests that EATR in 2021 was lower than EATR in 2020 in four EA member states: France, Germany, Greece, and Italy (see Online Appendix Table B1, column 1). ITSR in 2021 was higher than in 2020 in two countries: Belgium and Italy. Notably, the generosity of the French R&D tax credit was lower during the pandemic than before it, as the ITSR decreased in both observed years: from 0.43 to 0.39 in 2020 and from 0.39 to 0.37 in 2021, respectively (see Table B1, column 3).

3.4 Econometric Estimation

I adopt three econometric approaches to examine whether more innovative companies are more resilient and whether fiscal policy enhances corporate resilience. First, I estimate binary outcome (logit) regression models for panel data to test the relationship between being an R&D spender and my first measure of resilience, *impact resistance* (Cameron and Trivedi 2022, pp. 1139–1190). Second, I estimate count data (Poisson) regression models for panel data to examine the relationship between being an R&D spender and my second measure of resilience, *recovery speed* (Ibid.). In each case, I have one baseline specification and two augmented specifications including firm–level controls and country–level fiscal policy variables. Third, to examine the role of fiscal policy in fostering corporate resilience in the country that extended its existing R&D tax credit during the pandemic (Germany), I estimate a two–way fixed effects difference–in–differences (TWFE DID) regression model. Each approach is elaborated below.

3.4.1 Binary Outcome Models

My measure of impact resistance is a binary variable, and it equals one if a company does not incur a loss due to a crisis in a specific week. Therefore, I estimate the following random effects logit model as a baseline:

$$\Pr(IR_{it} = 1 \mid RDS_i, \alpha_i) = \Lambda(\alpha_i + \beta RDS_i), \tag{7}$$

where IR_{it} is the crisis impact resistance of company i at time t; RDS_i is its status in terms of R&D expense (spender or non–spender); and α_i is a random effect (RE).

The augmented specification with controls (see Section 3.5) has the following form:

$$\Pr(IR_{it} = 1 \mid RDS_i, x_i, \alpha_i) = \Lambda(\alpha_i + \beta RDS_i + \boldsymbol{x}_i'\boldsymbol{\gamma}). \tag{8}$$

The specification accounting for fiscal policy has interaction terms:

$$\begin{aligned} &\Pr(IR_{it} = 1 \mid NonRDS_i \times CTC_c + RDS_i \times NoCTC_c + RDS_i \times CTC_c, x_i, \alpha_i) \\ &= \Lambda(\alpha_i + \beta_1 NonRDS_i \times CTC_c + \beta_2 RDS_i \times NoCTC_c + \beta_3 RDS_i \times CTC_c + \boldsymbol{x}_i'\boldsymbol{\gamma}), \end{aligned} \tag{9}$$

where CTC is an indicator equal to one for each country c that implemented a containment tax cut during the pandemic and zero otherwise.

I expect the β coefficient in both Equations 7 and 8 to be positive, i.e., R&D spenders are less likely to incur a loss due to the crisis, *ceteris paribus*. Additionally, I expect the β_3 coefficient to be greater than the coefficient β_1 in Equation 9, i.e., a containment tax cut matters more for the crisis impact resistance of R&D spenders than non–spenders.

3.4.2 Count Data Models

My measure of recovery speed is a count variable equal to the number of weeks it takes for a company that has incurred a loss due to a crisis to recover to pre–crisis levels. Therefore, I estimate an RE Poisson regression model for only those companies that incurred a loss due to the crisis and subsequently recovered:

$$\mathrm{E}(RS_{it} \mid RDS_i, \alpha_i) = \exp(\alpha_i + \beta RDS_i), \tag{10}$$

where RS_{it} is the recovery speed of company i at time t; RDS_i is its status in terms of R&D expense (spender or non–spender); and α_i is a random effect.

The augmented specification with controls has the following form:

$$\mathrm{E}(RS_{it} \mid RDS_i, x_i, \alpha_i) = \exp(\alpha_i + \beta RDS_i + \boldsymbol{x}_i'\boldsymbol{\gamma}). \tag{11}$$

The specification accounting for fiscal policy has interaction terms:

$$\begin{aligned} &\mathrm{E}(RS_{it} \mid NonRDS_i \times RTC_c + RDS_i \times NoRTC_c + RDS_i \times RTC_c, x_i, \alpha_i) \\ &= \exp(\alpha_i + \beta_1 NonRDS_i \times RTC_c + \beta_2 RDS_i \times NoRTC_c + \beta_3 RDS_i \times RTC_c + \boldsymbol{x}_i'\boldsymbol{\gamma}), \end{aligned} \tag{12}$$

where RTC is an indicator equal to one for each country c that implemented a recovery tax cut during the pandemic and zero otherwise.

I expect the β coefficient in both Equations 10 and 11 to be negative, i.e., R&D spenders affected by the crisis recover faster than non–spenders, *ceteris paribus*. Additionally, I expect the β_3 coefficient to be greater than the coefficient β_1 in Equation 12, i.e., a recovery tax cut matters more for the crisis recovery speed of R&D spenders than non–spenders.

3.4.3 TWFE DID Model

For publicly traded companies in Germany, I estimate the following model to quantify the differential impact of fiscal policy on stock prices of R&D spenders:

$$\ln(Price_{it}) = \phi_i + \gamma_t + \alpha D_{it} + \epsilon_{it}, \tag{13}$$

where i denotes companies, and t denotes time (156 weeks spanning from W1–2019 to W52–2021 inclusive). D is a binary variable equal to one for R&D spenders in the post–legislation period following the extension of the R&D tax credit (W27–2020 onward) and zero otherwise; ϕ_i denotes company fixed effects; γ_t stands for week fixed effects; and ϵ_{it} is an error term clustered at the company level. My interest lies in estimating the parameter α, i.e., the average treatment effect on the treated (ATET). This parameter is identified if the two assumptions of parallel trends and Granger causality hold. I test both assumptions and provide appropriate test statistics and diagnostic graphs. [19]

3.5 Controls

While estimating RE logit and Poisson regression models, as specified above, I control for several factors that simultaneously affect corporate innovation and resilience. First and most importantly, I control for *industry*, as there are differences in the allocation of resources to innovation across industries, some being more R&D–intensive than others (Malerba 2006; Smith 2006), and the impact of the COVID–19 pandemic was uneven across industries: those that enabled work from home to a greater extent were less affected by the pandemic than other industries (del Rio–Chanona et al. 2020; Dingel and Neiman 2020; Guerrieri et al. 2022; Cirelli and Gertler 2025). Industry is identified by the NACE Rev.2 section in which a company operates: most companies in my sample operate in

[19] All analyses were carried out with Stata 18 software and reproduced using Stata 19. Specifically, I utilized the `xtdidregress` command to estimate the ATET, as well as the `estat ptrends` and `estat granger` commands to obtain test statistics on the validity of parallel trends and Granger causality assumptions. Figures were obtained using `estat trendplots` and `estat grangerplot` commands, respectively. See StataCorp (2025) for further details.

manufacturing industries, i.e., Section C (see Online Appendix Figure A1), and R&D spenders have a greater representation in these industries; however, the sample overall is representative of 17 NACE Rev.2 sections and 74 divisions within those sections (see Online Appendix Tables A1–A3). [20]

Second, I control for *location*, as there are geographic disparities in the allocation of resources to innovation across and within the EA member states (European Commission 2025c, 2025e), and the impact of the pandemic was spatially uneven, varying depending on socio–economic characteristics and crisis response policies (Muggenthaler, Schroth, and Sun 2021; Cancedda et al. 2024). Location is identified by the country in which a company is incorporated, as well as the region of the corporate headquarters within a country. Most companies in the sample are located in France and Germany (see Online Appendix Figure A2); Île–de–France is the region with the largest share of companies, followed by Bayern, while the sample overall is representative of 53 NUTS 1 regions (see Online Appendix Tables A4 and A5).

Third, I control for *liquidity*, as financially less constrained companies are more likely to allocate resources to innovation (O'Sullivan 2006; Hall and Lerner 2010) and withstand exogenous crises (Williams et al. 2017; Fahlenbrach, Rageth, and Stulz 2021). Liquidity is measured by the pre–crisis current ratio, i.e., current assets in 2019 divided by current liabilities in the same year. [21] Appendix Table A6 provides t–test statistics, suggesting that R&D spenders have greater liquidity and crisis impact resistance than non–spenders, on average, as well as recover faster.

Finally, I control for *age*, as older companies are more likely to allocate resources to innovation (Akcigit, Hanley, and Stantcheva 2022) and have experience of prior crises (Smith et al. 2024). Age is measured by years since incorporation: the mean age in my sample is 46, and R&D spenders are older, on average, than non–spenders.

[20] There are 21 NACE Rev.2 sections in total, and I excluded two sections (K and L) at the research design stage (see Section 2.2.1 above). No publicly traded companies operate in sections T and U.

[21] I prefer liquidity as a measure of financial constraints instead of leverage due to the reason (as noted in Section 2.1 above) that the recession induced by the pandemic was very short, and it therefore did not materially affect the long–run financial condition of most companies.

4 Results

4.1 Main Results

4.1.1 RE Logit Regression Results

RE logit regression results, as reported in Table 1 below, suggest that R&D spenders were less likely to incur a loss due to the crisis induced by the pandemic, *ceteris paribus*. The baseline coefficient estimate (see column 1, $\beta = 0.256, se = 0.081$) increases in size and retains its significance at the 1% level when industry fixed effects for NACE Rev.2 sections are included in the regression specification (see column 2, $\beta = 0.282, se = 0.086$). It weakens but remains significant when both industry and location fixed effects are included (see column 3, $\beta = 0.216, se = 0.092$), suggesting that cross–country heterogeneity is an important factor affecting the relationship between innovation and resilience in the EA. Interpretation of this coefficient after exponentiation ($e^{0.216} \approx 1.241$) implies that, holding constant the industry in which a company operates, as well as its location, being an R&D spender is associated with approximately 24% higher odds of not incurring a loss due to the crisis. The coefficient estimate when other controls are included is also positive and significant (see column 4, $\beta = 0.242, se = 0.108$); the inclusion of industry fixed effects for NACE Rev.2 divisions and location fixed effects for NUTS regions (see columns 5 and 6, respectively) weakens the coefficient, but it retains its significance at conventional levels.

The inclusion of interaction terms with fiscal policy in impact resistance regressions (see Table 2 below) yields expected results: the estimated coefficient of the interaction term *R&D spender* × *CTC* without controls (see column 1, $\delta = 0.322, se = 0.100$) is more than three times larger than the coefficient of the interaction term *Non–spender* × *CTC* ($\delta = 0.103, se = 0.088$). Exponentiation of the coefficient ($e^{0.322} \approx 1.380$) implies that, as compared to the baseline (*Non–spender* × *No CTC*), being an R&D spender in a country that implemented a containment tax cut is associated with approximately 38% higher odds of being crisis impact resistant. The coefficient increases in size and retains significance at the 1% level when industry fixed effects for NACE Rev.2 sections and other controls are included in the regression specification (see columns 2–3).

4.1.2 RE Poisson Regression Results

RE Poisson regression results, as reported in Table 3 below, suggest that R&D spenders that incurred a loss due to the crisis recovered faster than non–spenders, on average (see column 1, $\beta = -0.158, se = 0.035$). Exponentiation of the coefficient ($e^{-0.158} \approx 0.854$) suggests that being an R&D spender is associated with approximately 15% reduction in the expected number of recovery weeks. The coefficient weakens when control variables are included, but it retains significance at the 5% level throughout different specifications (see columns 2–5). Similar to the impact resistance regressions, the inclusion of interaction terms with fiscal policy in recovery regressions (see Table 4 below) yields expected results: the estimated coefficient of the interaction term *R&D spender* × *RTC* ($\delta = -0.226, se = 0.047$) is around four times larger than the coefficient of the interaction term *Non–spender* × *RTC* ($\delta = -0.060, se = 0.036$). Its exponentiation ($e^{-0.226} \approx 0.798$) suggests that being an R&D spender in a country that implemented a recovery tax cut is associated with around 20% reduction in the expected number of recovery weeks. The coefficient of the interaction term weakens in size but retains significance at the 5% level when control variables are included (see Table 4, columns 2–4).

4.1.3 TWFE DID Regression Results

TWFE DID regression results suggest that fiscal policy has a causal effect on resilience: the interaction term *R&D spender* × *Post* for all companies in Germany (see Table 5, column 1 below) is positive and significant at the 5% level ($\alpha = 0.100, se = 0.045$), suggesting that the stock prices of R&D spenders increased by 10%, on average, in the post–legislation period following the extension of the R&D tax credit, i.e., starting 1 July 2020. The parallel trends and Granger causality assumptions hold ($F = 0.09$ and $F = 2.31$, respectively), as can be observed also from panels A and B of Figure 1 below. The coefficient is slightly larger and still significant at the 5% level for manufacturing companies (see Table 5, column 2, $\alpha = 0.155, se = 0.057$), but it is marginally insignificant for companies in service industries (see Table 5, column 3, $\alpha = 0.123, se = 0.076$).

Table 1: RE Logit Regression Results

	Baseline	Augmented				
	(1)	(2)	(3)	(4)	(5)	(6)
R&D spender	0.256	0.282	0.216	0.242	0.231	0.159
	(0.081)	(0.086)	(0.092)	(0.108)	(0.087)	(0.086)
Industry (NACE section) FE		✓	✓	✓		
Industry (NACE division) FE					✓	
Location (country) FE			✓	✓		
Location (NUTS region) FE						✓
Other controls				✓		
Constant	1.267	1.558	1.019	0.709	1.537	1.024
	(0.048)	(0.286)	(0.301)	(0.413)	(0.318)	(0.201)
n (companies)	1,209	1,209	1,209	1,193	1,209	1,209
N (company–week obs.)	188,604	188,604	188,604	186,108	188,604	188,604
Log pseudo–L	-97,859.56	-97,833.51	-97,807.75	-96,384.50	-97,790.96	-97,811.63
Wald χ^2	9.95	183.19	246.57	131.58	—	—

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1. Column 1 estimates the regression model specified in Equation 7, while columns 2–6 estimate the regression model specified in Equation 8. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

Table 2: RE Logit Regression Results Accounting for Fiscal Policy

	(1)	(2)	(3)	(4)	(5)
Non–spender × *CTC*	0.103	0.083	0.161	0.070	2.041
	(0.088)	(0.089)	(0.102)	(0.088)	(1.005)
R&D spender × *No CTC*	0.272	0.310	0.183	0.216	0.183
	(0.157)	(0.156)	(0.183)	(0.155)	(0.162)
R&D spender × *CTC*	0.322	0.330	0.490	0.285	2.194
	(0.100)	(0.104)	(0.124)	(0.104)	(1.010)
Industry (NACE section) FE		✓	✓		
Industry (NACE division) FE				✓	
Location (NUTS region) FE					✓
Other controls			✓		
Constant	1.214	1.549	2.281	1.535	-1.014
	(0.067)	(0.286)	(0.357)	(0.317)	(1.025)
n (companies)	1,209	1,209	1,193	1,209	1,209
N (company–week obs.)	188,604	188,604	186,108	188,604	188,604
Log pseudo–L	-97,858.84	-97,833.07	-96,409.47	-97,790.54	-97,808.43
Wald χ^2	11.59	163.94	114.47	—	—

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1, and all columns estimate the regression model specified in Equation 9, with (columns 2–5) and without (column 1) controls. CTC stands for containment tax cut, as defined in Equation 5. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

Table 3: RE Poisson Regression Results

	Baseline	Augmented				
	(1)	(2)	(3)	(4)	(5)	(6)
R&D spender	-0.158	-0.128	-0.083	-0.086	-0.122	-0.104
	(0.035)	(0.038)	(0.039)	(0.040)	(0.040)	(0.037)
Industry (NACE section) FE		✓	✓	✓		
Industry (NACE division) FE					✓	
Location (country) FE			✓	✓		
Location (NUTS region) FE						✓
Other controls				✓		
Constant	3.709	3.455	3.476	3.465	3.505	3.707
	(0.018)	(0.178)	(0.198)	(0.201)	(0.186)	(0.111)
n (companies)	1,120	1,120	1,120	1,105	1,120	1,120
N (company–week obs.)	43,551	43,551	43,551	42,985	43,551	43,551
Log pseudo–L	-127,314.56	-127,296.65	-127,277.32	-125,602.78	-127,263.66	-127,278.09
Wald χ^2	57,955.26	91,083.64	90,000.94	289,131.92	1,501.86	1,798.52

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3. Column 1 estimates the regression model specified in Equation 10, while columns 2–6 estimate the regression model specified in Equation 11. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

Table 4: RE Poisson Regression Results Accounting for Fiscal Policy

	(1)	(2)	(3)	(4)	(5)
Non–spender × RTC	-0.060	-0.037	-0.035	-0.034	-1.202
	(0.036)	(0.038)	(0.038)	(0.039)	(0.490)
R&D spender × No RTC	-0.149	-0.107	-0.090	-0.094	-0.053
	(0.056)	(0.060)	(0.061)	(0.064)	(0.060)
R&D spender × RTC	-0.226	-0.182	-0.195	-0.177	-1.338
	(0.047)	(0.050)	(0.051)	(0.053)	(0.492)
Industry (NACE section) FE		✓	✓		
Industry (NACE division) FE				✓	
Location (NUTS region) FE					✓
Other controls			✓		
Constant	3.746	3.461	3.427	3.508	3.680
	(0.028)	(0.174)	(0.176)	(0.182)	(0.114)
n (companies)	1,120	1,120	1,105	1,120	1,120
N (company–week obs.)	43,551	43,551	42,985	43,551	43,551
Log pseudo–L	-127,313.16	-127,295.76	-125,620.79	-127,262.73	-127,275.25
Wald χ^2	58,330.80	90,056.32	99,252.96	153,830.94	279.73

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3, and all columns estimate the regression model specified in Equation 12, with (columns 2–5) and without (column 1) controls. RTC stands for recovery tax cut, as defined in Equation 6. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

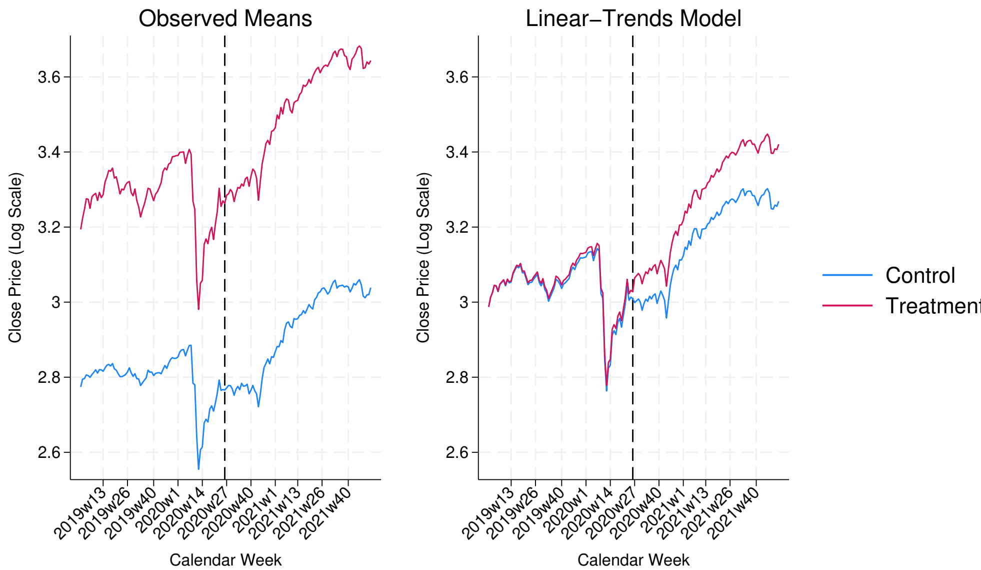
Table 5: TWFE DID Regression Results

	All	Manufacturing	Non–Manufacturing
ATET: *R&D spender* × *Post*	0.100	0.155	0.123
	(0.045)	(0.057)	(0.076)
	[0.012; 0.187]	[0.041; 0.269]	[-0.028; 0.273]
Company FE	✓	✓	✓
Week FE	✓	✓	✓
n (all companies)	246	126	120
n (control group)	121	38	83
n (treatment group)	125	88	37
N (company–week obs.)	38,376	19,656	18,720
Parallel trends test	$F_{(1,245)} = 0.09$	$F_{(1,125)} = 1.74$	$F_{(1,119)} = 1.07$
Granger causality test	$F_{(77,245)} = 2.31$	$F_{(77,125)} = 9.03$	$F_{(77,119)} = 5.63$

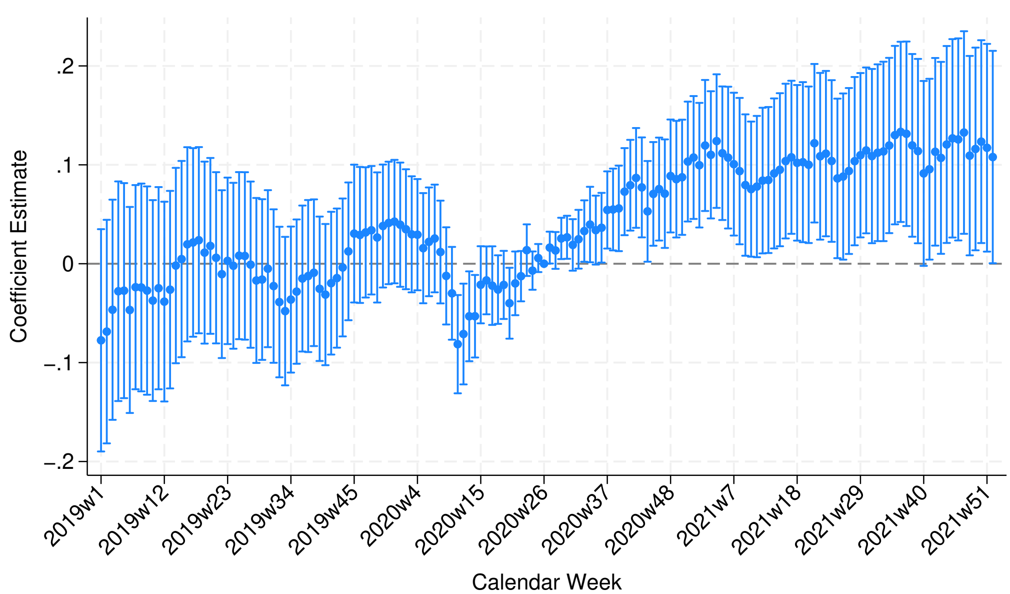
Notes: The dependent variable in all columns is the natural logarithm of company stock price, and all columns estimate the regression model specified in Equation 13. The classification of a company as an R&D spender is based on the BvD Orbis database; "post" indicates weeks after the legislation on the extension of the R&D tax credit took effect, i.e., W27–2020 onward. Manufacturing companies are those operating under Section C of the NACE Rev.2 classification; non–manufacturing companies are those operating under other sections (see Appendix A). Robust standard errors clustered at the company level in parentheses below coefficient estimates; 95% confidence intervals in brackets. The null hypothesis for the parallel trends test is that linear trends in the pre–treatment time period are parallel; the null hypothesis for the Granger causality test is that there is no effect in anticipation of treatment.

Figure 1: Graphical Diagnostics for Parallel Trends and Granger Causality

(a) Parallel Trends



(b) Granger Causality



Notes: The sample includes 246 publicly traded companies incorporated in Germany; of these, 125 are R&D spenders based on the BvD Orbis data classification. Treatment is defined as being an R&D spender after the legislation on the extension of the R&D tax credit took effect, i.e., W27–2020 onward.

4.2 Heterogeneity Analyses

4.2.1 Legal Origins

Tables 6 and 7 below provide heterogeneity analyses of RE logit and Poisson regressions by legal origins. As noted in Section 2.2.5 above, the French civil law origin includes seven countries (Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain), while the German civil law origin includes two countries (Austria and Germany). There are more companies located in the combined sample of seven countries ($n = 716$) than in the combined sample of two countries ($n = 278$); therefore and due to the balanced nature of the panel, the number of company–week observations in the former group is substantially larger ($N = 111{,}696$) than in the latter ($N = 43{,}368$), and any differences in coefficient estimates cannot be attributed to sample size.

The baseline estimate for resilience as crisis impact resistance in French civil law countries (see Table 6, Panel A, column 1 below) is positive but insignificant ($\beta = 0.173, se = 0.114$); it stays insignificant as additional controls are added to the regression specification (see Table 6, Panel A, columns 2–3). By contrast, the baseline estimate for resilience as impact resistance in German civil law countries (see Table 6, Panel B, column 1 below) is positive and significant at the 10% level ($\beta = 0.271, se = 0.150$); it increases—in both size and significance—as additional controls are added to the regression specification (see Table 6, Panel B, columns 2–3 below): for instance, $\beta = 0.352$ ($se = 0.186$) in the specification controlling for industry fixed effects, company age, and liquidity.

The baseline estimate for resilience as crisis recovery speed in French civil law countries (see Table 7, Panel A, column 1 below) is negative but insignificant ($\beta = -0.071, se = 0.046$); it stays insignificant as additional controls are added to the regression specification (see Table 7, Panel A, columns 2–3). By contrast, the baseline coefficient estimate for resilience as recovery speed in German civil law countries (see Table 7, Panel B, column 1 below) is negative and significant at the 5% level ($\beta = -0.166, se = 0.070$); it increases—in both size and significance—as additional controls are added to the regression specification (see Table 7, Panel B, columns 2–3 below): for instance, $\beta = -0.216$ ($se = 0.084$) in the specification controlling for liquidity, age, and industry fixed effects.

4.2.2 Fiscal Space and Stimulus

Government debt was below 60% of GDP in nine EA member states before the pandemic: Estonia, Germany, Ireland, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, and Slovakia (see Online Appendix Table B3). These countries were compliant with the debt criterion of sustainable fiscal policy, as set out in the Maastricht Treaty, as well as the Stability and Growth Pact (European Parliament 2025); therefore, their governments had more fiscal space for effective crisis response (Romer and Romer 2019). Heterogeneity analyses provided in Table 8 below suggest that the relationship between innovation and resilience as crisis impact resistance is much stronger in countries with lower pre–crisis debt–to–GDP ratios (baseline coefficient estimate of $\beta = 0.327, se = 0.141$, as compared to $\beta = 0.172, se = 0.101$, see Panel A, column 1, and Panel B, column 1, respectively).

The average size of the fiscal stimulus package implemented in 19 EA member states in response to the pandemic, as measured by the change in the primary budget balance from 2019 to 2020 (Muggenthaler, Schroth, and Sun 2021), was 6.4% of GDP (median: 6.7%) (see Online Appendix Table B3). Countries that implemented larger than average packages include Austria, Belgium, Cyprus, France, Greece, Italy, Lithuania, Malta, Slovenia, and Spain. Heterogeneity analyses (see Table 9 below) suggest that the impact of innovation on resilience as crisis impact resistance is stronger in countries that implemented *below* average stimulus packages (baseline coefficient estimate of $\beta = 0.385, se = 0.128$, as compared to $\beta = 0.040, se = 0.106$); therefore, it is the targeted nature of fiscal policy enhancing innovation, as discussed in the preceding section, that mattered during the response phase of the pandemic, rather than its size.

Regression results for resilience as recovery speed (see Table 10 below) suggest that R&D spenders in countries implementing larger stimulus packages recovered faster than non–spenders, on average; however, this relationship does not hold once industry differences are accounted for. Similar to the impact resistance regressions, the relationship holds for countries implementing below average stimulus packages, and this is robust to the inclusion of industry fixed effects ($\beta = -0.203, se = 0.066$, as compared to $\beta = -0.047, se = 0.047$).[22]

[22] See Appendix Tables C5 and C6 for results based on an alternative measure of fiscal stimulus.

Table 6: Heterogeneity Analysis by Legal Origins for Resilience as Impact Resistance

	Panel A. French Civil Law			Panel B. German Civil Law		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.173	0.156	0.271	0.271	0.407	0.352
	(0.114)	(0.115)	(0.154)	(0.150)	(0.168)	(0.186)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.190	1.134	1.684	1.272	1.365	3.152
	(0.055)	(0.436)	(0.534)	(0.113)	(0.168)	(0.453)
n (companies)	716	716	711	278	278	270
N (company–week obs.)	111,696	111,696	110,916	43,368	43,368	42,120
Log pseudo–L	-60,109.66	-60,093.75	-59,708.04	-21,881.73	-21,863.95	-21,161.28
Wald χ^2	2.29	134.51	41.49	3.26	–	1.61e+08

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. French civil law includes seven countries: Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain; German civil law includes two countries: Austria and Germany. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

Table 7: Heterogeneity Analysis by Legal Origins for Resilience as Recovery Speed

	Panel A. French Civil Law			Panel B. German Civil Law		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	-0.071	-0.042	-0.045	-0.166	-0.209	-0.216
	(0.046)	(0.048)	(0.049)	(0.070)	(0.080)	(0.084)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	3.728	3.642	3.631	3.670	2.982	2.839
	(0.021)	(0.318)	(0.318)	(0.050)	(0.080)	(0.139)
n (companies)	669	669	665	259	259	251
N (company–week obs.)	27,342	27,342	27,192	9,339	9,339	9,066
Log pseudo–L	-80,209.13	-80,196.20	-79,738.20	-27,097.78	-27,089.62	-26,293.61
Wald χ^2	41,345.22	84,668.49	90,195.55	10,554.63	6,804.71	6,738.99

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3. In both panels, column 1 estimates the regression model specified in Equation 10, while columns 2 and 3 estimate the regression model specified in Equation 11. French civil law includes seven countries: Belgium, France, Greece, Italy, the Netherlands, Portugal, and Spain; German civil law includes two countries: Austria and Germany. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations.

Table 8: Heterogeneity Analysis by Fiscal Space for Resilience as Impact Resistance

	Panel A. Narrow Fiscal Space			Panel B. Wide Fiscal Space		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.172	0.165	0.155	0.327	0.482	0.516
	(0.101)	(0.104)	(0.134)	(0.141)	(0.152)	(0.170)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.241	1.598	2.253	1.335	1.508	2.701
	(0.055)	(0.166)	(0.268)	(0.098)	(0.452)	(0.515)
n (companies)	813	813	803	396	396	390
N (company–week obs.)	126,828	126,828	125,268	61,776	61,776	60,840
Log pseudo–L	-67,133.49	-67,116.45	-66,263.73	-30,722.09	-30,705.39	-30,114.96
Wald χ^2	2.92	192.35	48.69	5.37	38.68	53.85

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. Fiscal space is measured by the pre–crisis (2019) debt–to–GDP ratio. Countries with narrow fiscal space (having debt over 60% of GDP) are Austria, Belgium, Cyprus, Finland, France, Greece, Italy, Portugal, Slovenia, and Spain; countries with wide fiscal space are Estonia, Germany, Ireland, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, and Slovakia. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations. Online Appendix B provides government finance statistics.

Table 9: Heterogeneity Analysis by Fiscal Stimulus for Resilience as Impact Resistance

	Panel A. Limited Fiscal Stimulus			Panel B. Broad Fiscal Stimulus		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.385	0.491	0.487	0.040	0.042	0.057
	(0.128)	(0.143)	(0.157)	(0.106)	(0.107)	(0.162)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.335	1.459	2.018	1.234	1.626	2.765
	(0.089)	(0.551)	(0.610)	(0.057)	(0.140)	(0.995)
n (companies)	469	469	462	740	740	731
N (company–week obs.)	73,164	73,164	72,072	115,440	115,440	114,036
Log pseudo-L	-35,953.66	-35,938.10	-35,236.76	-61,898.05	-61,881.60	-61,137.08
Wald χ^2	9.06	44.96	66.03	0.14	167.54	23.93

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. Fiscal stimulus is measured by the change in primary budget balance from 2019 to 2020. Countries that implemented limited (with respect to the average of 6.4% of GDP) fiscal packages include the following: Estonia, Finland, Germany, Ireland, Latvia, Luxembourg, the Netherlands, Portugal, and Slovakia; countries that implemented broad fiscal packages include Austria, Belgium, Cyprus, France, Greece, Italy, Lithuania, Malta, Slovenia, and Spain. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations. Online Appendix B provides government finance statistics.

Table 10: Heterogeneity Analysis by Fiscal Stimulus for Resilience as Recovery Speed

	Panel A. Limited Fiscal Stimulus			Panel B. Broad Fiscal Stimulus		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	-0.197	-0.206	-0.203	-0.082	-0.048	-0.047
	(0.057)	(0.065)	(0.066)	(0.044)	(0.046)	(0.047)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	3.667	3.709	3.683	3.728	3.164	3.129
	(0.036)	(0.257)	(0.262)	(0.021)	(0.167)	(0.162)
n (companies)	431	431	424	689	689	681
N (company–week obs.)	15,456	15,456	15,171	28,095	28,095	27,814
Log pseudo–L	-44,932.06	-44,925.31	-44,083.14	-82,372.98	-82,356.02	-81,521.69
Wald χ^2	16,748.76	41,764.10	39,948.26	42,640.54	87,522.09	91,870.35

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3. In both panels, column 1 estimates the regression model specified in Equation 10, while columns 2 and 3 estimate the regression model specified in Equation 11. Fiscal stimulus is measured by the change in primary budget balance from 2019 to 2020. Countries that implemented limited (with respect to the average of 6.4% of GDP) fiscal packages include the following: Estonia, Finland, Germany, Ireland, Latvia, Luxembourg, the Netherlands, Portugal, and Slovakia; countries that implemented broad fiscal packages include Austria, Belgium, Cyprus, France, Greece, Italy, Lithuania, Malta, Slovenia, and Spain. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations. Online Appendix B provides government finance statistics.

4.2.3 Non–Fiscal Policy Responses

As discussed in Section 2.2.4, non–fiscal policy responses to the pandemic included closure, containment, and vaccination policies. I proxy these with the OxCGRT *Stringency* and *Containment and Health* indices, respectively (Hale et al. 2021; Hale et al. 2023). The former includes eight indicators, while the latter includes 14 indicators, as laid out below:

- Stringency Index (SI): school closure; workplace closure; cancellation of public events; restrictions on gatherings; public transport closure; stay at home requirements; restrictions on internal movement; and restrictions on international travel.

- Containment and Health Index (CHI): all eight indicators above, in addition to: public information campaigns; testing policy; contact tracing; facial covering; vaccination policy; and protection of the elderly.

Both indices are standardized, ranging from zero to 100. SI values in 2020 were above the median (50.00) in six countries: France, Germany, Ireland, Italy, Portugal, and Spain; SI values in 2021 were above the median in all but four countries of the EA (Estonia, Finland, Lithuania, and Luxembourg). CHI values in 2020 were above the median in only two countries: France and Italy; similar to the SI, CHI values in 2021 were above the median in all but three countries of the EA (Estonia, Finland, and Latvia). Heterogeneity analyses for resilience as impact resistance (see Table 11 below) suggest that R&D spenders were less likely to incur a loss in countries that had more stringent crisis response policies (baseline coefficient estimate of $\beta = 0.314, se = 0.097$, as compared to $\beta = 0.121, se = 0.148$).

Table 11: Heterogeneity Analysis by Non–Fiscal Policy Responses

	Panel A. Less Stringent			Panel B. More Stringent		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.121	0.119	-0.062	0.314	0.340	0.452
	(0.148)	(0.157)	(0.225)	(0.097)	(0.104)	(0.119)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.458	1.636	2.599	1.178	1.377	2.273
	(0.098)	(0.357)	(0.575)	(0.054)	(0.395)	(0.701)
n (companies)	406	406	399	803	803	794
N (company–week obs.)	63,336	63,336	62,224	125,268	125,268	123,864
Log pseudo–L	-31,603.14	-31,589.73	-31,051.26	-66,248.04	-66,232.92	-65,346.06
Wald χ^2	0.66	74.81	40.86	10.47	100.57	86.25

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. Stringency is measured by the OxCGRT 2020 Stringency Index. Countries that implemented less stringent policies include the following: Austria, Belgium, Cyprus, Estonia, Finland, Greece, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Slovakia, and Slovenia; countries that implemented more stringent policies include France, Germany, Ireland, Italy, Portugal, and Spain. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations, as well as non–fiscal policy response statistics.

5 Discussion

The analyses carried out and presented in this paper suggest that innovation enhances corporate resilience, and this relationship is moderated by fiscal policies aimed at crisis containment and recovery. Most notably, I find that the impact of innovation on resilience—defined as crisis impact resistance and recovery speed—is stronger in countries that provided fiscal incentives for innovation during the COVID–19 pandemic, such as Germany. My findings are aligned with the long–standing literature on the effectiveness of tax incentives for business investment and innovation (Hall and Jorgenson 1967; Hassett and Hubbard 2002; Zwick and Mahon 2017; Dechezleprêtre et al. 2023) but contrast with economic theory and recent evidence suggesting that tax incentives are not effective during crises (Bloom, Bond, and Van Reenen 2007; Bloom 2009; Guceri and Albinowski 2021; Link et al. 2024). More importantly, my research on innovation and resilience brings a novel insight into the field of macroeconomics: the provision of tax incentives for innovation during a recession may contain its severity as well as enable faster recovery.

This paper complements several recent papers on economic resilience. Specifically, it relates to research examining firm–level characteristics that contribute to resilience (Aghion et al. 2021; Ding et al. 2021; Li et al. 2021), as well as research on resilience in supply chains (Grossman, Helpman, and Lhuillier 2023; Grossman, Helpman, and Sabal 2024). My findings are in contrast to a recent study on digitization and resilience (Copestake, Estefania–Flores, and Furceri 2024), which does not find differential effects across a large number of countries and regions: I find that the impact of innovation on resilience is heterogeneous across 17 member states of the EA that are also members of the OECD, and this is largely due to fiscal policies they implement. Furthermore, I find heterogeneous effects across countries belonging to French and German legal origins.

As the absence of a fiscal union has been and remains a bottleneck in the process of European integration (European Parliament 2025), my findings support the need for greater coordination of fiscal policies in the EA. [23] There has been coordination in the realm

[23] An insightful speech on this topic is the Feldstein Lecture delivered by Dr. Mario Draghi at the 2023 NBER Summer Institute. See National Bureau of Economic Research (2023).

of multinational enterprise taxation due to the OECD Base Erosion and Profit Shifting Project (Organization for Economic Cooperation and Development 2025a), as well as after the establishment of the European Fiscal Board (European Commission 2025b). However, policies on corporate income taxation in general and incentives for innovation, in particular, are set by national governments, and there is wide variation in both respects, as evidenced by effective average tax rates and implied tax subsidy rates. My findings suggest that fiscal policies before and during a union–wide recession differentially affect corporate resilience in individual member states of a monetary union; therefore, as well as due to interactions between monetary and fiscal policy (Beetsma and Jensen 2005; Reichlin et al. 2021), fiscal integration is indispensable for a long–lasting economic union.

6 Conclusion

This paper provided evidence on how innovation affects corporate resilience in euro area member states—countries that are in a monetary union but do not form a fiscal union, thus retaining autonomy over business taxation and expenditure. Drawing on prior research in the field of economics, I argued and found support for the hypothesis that fiscal policies aimed at crisis containment and recovery moderate the relationship between corporate innovation and resilience: the observed impact of the allocation of resources to R&D on resilience—defined as crisis impact resistance and recovery speed—is stronger in countries that had lower effective average corporate tax rates during the COVID–19 pandemic and, at the same time, higher implied tax subsidy rates for R&D. I also found evidence on the role of institutions in the study of corporate innovation and resilience: the observed impact of innovation on resilience is greater in German civil law countries.

References

Acemoglu, Daron. 2025. "Nobel Lecture: Institutions, Technology, and Prosperity." *American Economic Review* 115 (6): 1709–1748. https://doi.org/10.1257/aer.115.6.1709.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2005. "Institutions as a Fundamental Cause of Long–Run Growth." In *Handbook of Economic Growth,* edited by Philippe Aghion and Steven N. Durlauf, vol. 1A, 385–472. Amsterdam: Elsevier. https://doi.org/10.1016/S1574-0684(05)01006-3.

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz–Salehi. 2015. "Systemic Risk and Stability in Financial Networks." *American Economic Review* 105 (2): 564–608. https://doi.org/10.1257/aer.20130456.

Acemoglu, Daron, and Alireza Tahbaz–Salehi. 2025. "The Macroeconomics of Supply Chain Disruptions." *Review of Economic Studies* 92 (2): 656–695. https://doi.org/10.1093/restud/rdae038.

Aghion, Philippe, Nicholas Bloom, Brian Lucking, Raffaella Sadun, and John Van Reenen. 2021. "Turbulence, Firm Decentralization, and Growth in Bad Times." *American Economic Journal: Applied Economics* 13 (1): 133–169. https://doi.org/10.1257/app.20180752.

Aghion, Philippe, and Peter Howitt. 1992. "A Model of Growth through Creative Destruction." *Econometrica* 60 (2): 323–351. https://doi.org/10.2307/2951599.

Ahn, Joon Mo, Letizia Mortara, and Tim Minshall. 2018. "Dynamic Capabilities and Economic Crises: Has Openness Enhanced a Firm's Performance in an Economic Downturn?" *Industrial and Corporate Change* 27 (1): 49–63. https://doi.org/10.1093/icc/dtx048.

Aizenman, Joshua, Hiro Ito, Donghyun Park, Jamel Saadaoui, and Gazi Salah Uddin. 2025. "Global Shocks, Institutional Development, and Trade Restrictions: What Can We Learn from Crises and Recoveries between 1990 and 2022?" *NBER Working Paper* 33757. https://doi.org/10.3386/w33757.

Akcigit, Ufuk, Douglas Hanley, and Stefanie Stantcheva. 2022. "Optimal Taxation and R&D Policies." *Econometrica* 90 (2): 645–684. https://doi.org/10.3982/ECTA15445.

Alesina, Alberto, and Robert J. Barro. 2002. "Currency Unions." *Quarterly Journal of Economics* 117 (2): 409–436. https://doi.org/10.1162/003355302753650283.

Alesina, Alberto, Robert J. Barro, and Silvana Tenreyro. 2002. "Optimal Currency Areas." *NBER Macroeconomics Annual* 17: 301–345. https://doi.org/10.1086/ma.17.3585292.

Alexander, David E. 2013. "Resilience and Disaster Risk Reduction: An Etymological Journey." *Natural Hazards and Earth System Sciences* 13 (11): 2707–2716. https://doi.org/10.5194/nhess-13-2707-2013.

Altman, Edward I. 1968. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." *Journal of Finance* 23 (4): 589–609. https://doi.org/10.2307/2978933.

Arrow, Kenneth J. 1962. "Economic Welfare and the Allocation of Resources for Invention." In *The Rate and Direction of Inventive Activity: Economic and Social Factors,* edited by Richard R. Nelson, 609–626. Princeton: Princeton University Press.

Beetsma, Roel M., and Henrik Jensen. 2005. "Monetary and Fiscal Policy Interactions in a Micro–Founded Model of a Monetary Union." *Journal of International Economics* 67 (2): 320–352. https://doi.org/10.1016/j.jinteco.2005.03.001.

Bellifemine, Marco, Adrien Couturier, and Rustam Jamilov. 2025. "Monetary Unions with Heterogeneous Fiscal Space." *Journal of International Economics* 156: 104092. https://doi.org/10.1016/j.jinteco.2025.104092.

Bernanke, Ben S. 1983. "Irreversibility, Uncertainty, and Cyclical Investment." *Quarterly Journal of Economics* 98 (1): 85–106. https://doi.org/10.2307/1885568.

Bertschek, Irene, Michael Polder, and Patrick Schulte. 2019. "ICT and Resilience in Times of Crisis: Evidence from Cross–Country Micro Moments Data." *Economics of Innovation and New Technology* 28 (8): 759–774. https://doi.org/10.1080/10438599.2018.1557417.

Blanchard, Olivier J. 2025. "Fiscal Policy as a Stabilization Tool: The Case for Quasi–Automatic Stabilizers, with an Application to the VAT." *NBER Working Paper* 33698. https://doi.org/10.3386/w33698.

Blavatnik School of Government. 2023. "COVID–19 Government Response Tracker." https://www.bsg.ox.ac.uk/research/covid-19-government-response-tracker.

Bloom, Nicholas. 2009. "The Impact of Uncertainty Shocks." *Econometrica* 77 (3): 623–685. https://doi.org/10.3982/ECTA6248.

Bloom, Nicholas, Max Floetotto, Nir Jaimovich, Itay Saporta–Eksten, and Stephen J. Terry. 2018. "Really Uncertain Business Cycles." *Econometrica* 86 (3): 1031–1065. https://doi.org/10.3982/ECTA10927.

Bloom, Nicholas, Rachel Griffith, and John Van Reenen. 2002. "Do R&D Tax Credits Work? Evidence from a Panel of Countries 1979–1997." *Journal of Public Economics* 85 (1): 1–31. https://doi.org/10.1016/S0047-2727(01)00086-X.

Bloom, Nick, Stephen Bond, and John Van Reenen. 2007. "Uncertainty and Investment Dynamics." *Review of Economic Studies* 74 (2): 391–415. https://doi.org/10.1111/j.1467-937X.2007.00426.x.

Brunnermeier, Markus K. 2024. "Presidential Address: Macrofinance and Resilience." *Journal of Finance* 79 (6): 3683–3728. https://doi.org/10.1111/jofi.13403.

Cameron, Adrian C., and Pravin K. Trivedi. 2022. *Microeconometrics Using Stata.* Second edition. College Station, TX: Stata Press.

Cancedda, Christian, Alessio Cappellato, Luigi Maninchedda, Leonardo Meacci, Sofia Peracchi, Claudia Salerni, Elena Baralis, Flavio Giobergia, and Stefano Ceri. 2024. "Social and Economic Variables Explain COVID–19 Diffusion in European Regions." *Nature Scientific Reports* 14: 6142. https://doi.org/https://doi.org/10.1038/s41598-024-56267-z.

Cirelli, Fernando, and Mark Gertler. 2025. "Economic Winners versus Losers and the Unequal Pandemic Recession." *American Economic Journal: Macroeconomics* 17 (3): 342–371. https://doi.org/10.1257/mac.20220285.

Coenen, Günter, Roland Straub, and Mathias Trabandt. 2012. "Fiscal Policy and the Great Recession in the Euro Area." *American Economic Review* 102 (3): 71–76. https://doi.org/10.1257/aer.102.3.71.

———. 2013. "Gauging the Effects of Fiscal Stimulus Packages in the Euro Area." *Journal of Economic Dynamics and Control* 37 (2): 367–386. https://doi.org/10.1016/j.jedc.2012.09.006.

Copestake, Alexander, Julia Estefania–Flores, and Davide Furceri. 2024. "Digitalization and Resilience." *Research Policy* 53 (3): 104948. https://doi.org/10.1016/j.respol.2023.104948.

Cox, Nicholas. 2022. "Stata Tip 145: Numbering Weeks within Months." *Stata Journal* 22 (1): 224–230. https://doi.org/10.1177/1536867X221083928.

Davig, Troy, and Eric M. Leeper. 2011. "Monetary–Fiscal Policy Interactions and Fiscal Stimulus." *European Economic Review* 55 (2): 211–227. https://doi.org/10.1016/j.euroecorev.2010.04.004.

Dechezleprêtre, Antoine, Elias Einiö, Ralf Martin, Kieu–Trang Nguyen, and John Van Reenen. 2023. "Do Tax Incentives Increase Firm Innovation? An RD Design for R&D, Patents, and Spillovers." *American Economic Journal: Economic Policy* 15 (4): 486–521. https://doi.org/10.1257/pol.20200739.

del Rio–Chanona, Maria R., Penny Mealy, Anton Pichler, François Lafond, and Doyne J. Farmer. 2020. "Supply and Demand Shocks in the COVID–19 Pandemic: An Industry and Occupation Perspective." *Oxford Review of Economic Policy* 36 (S1): S94–S137. https://doi.org/10.1093/oxrep/graa033.

Devereux, Michael P., İrem Güçeri, Martin Simmler, and Eddy H. F. Tam. 2020. "Discretionary Fiscal Responses to the COVID–19 Pandemic." *Oxford Review of Economic Policy* 36 (S1): S225–S241. https://doi.org/10.1093/oxrep/graa019.

Ding, Wenzhi, Ross Levine, Lin Chen, and Wensi Xie. 2021. "Corporate Immunity to the COVID–19 Pandemic." *Journal of Financial Economics* 141 (2): 802–830. https://doi.org/10.1016/j.jfineco.2021.03.005.

Dingel, Jonathan I., and Brent Neiman. 2020. "How Many Jobs Can Be Done at Home?" *Journal of Public Economics* 189: 104235. https://doi.org/10.1016/j.jpubeco.2020.104235.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty.* Princeton: Princeton University Press.

Eichenbaum, Martin. 2025. "Practical Stabilization Policy in the Twenty–First Century." *AEA Papers and Proceedings* 115: 158–162. https://doi.org/10.1257/pandp.20251115.

Eichengreen, Barry, Donghyun Park, and Kwanho Shin. 2024. "Economic Resilience: Why Some Countries Recover More Robustly than Others from Shocks." *Economic Modelling* 136: 106748. https://doi.org/10.1016/j.econmod.2024.106748.

Euro Area Business Cycle Network. 2020. "Fall 2020 Statement of the Dating Committee on the Current State of the Economic Activity in the Euro Area." https://eabcn.org/news/fall-2020-statement-dating-committee-current-state-economic-activity-euro-area.

———. 2021. "Fall 2021 Statement of the Dating Committee on the Current State of the Economic Activity in the Euro Area." https://eabcn.org/news/fall-2021-statement-dating-committee-current-state-economic-activity-euro-area.

European Central Bank. 2025a. "Macroeconomic and Sectoral Statistics: Debt." https://data.ecb.europa.eu/publications/macroeconomic-and-sectoral-statistics/3030644.

———. 2025b. "Macroeconomic and Sectoral Statistics: Revenue, Expenditure and Balance." https://data.ecb.europa.eu/publications/macroeconomic-and-sectoral-statistics/3030642.

European Commission. 2025a. "AMECO Database." https://economy-finance.ec.europa.eu/economic-research-and-databases/economic-databases/ameco-database_en.

———. 2025b. "European Fiscal Board (EFB)." https://commission.europa.eu/topics/fiscal-policy/european-fiscal-board-efb_en.

———. 2025c. "European Innovation Scoreboard." https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en.

———. 2025d. "Fiscal Rules in EU Member States." https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/national-fiscal-frameworks-eu-member-states/fiscal-rules-eu-member-states_en.

———. 2025e. "Regional Innovation Scoreboard." https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/regional-innovation-scoreboard_en.

European Parliament. 2025. "Economic and Monetary Union, Taxation and Competition Policies." https://www.europarl.europa.eu/factsheets/en/section/194/economic-and-monetary-union-taxation-and-competition-policies.

European Union. 2025. "Countries Using the Euro." https://european-union.europa.eu/institutions-law-budget/euro/countries-using-euro_en.

Eurostat. 2008. "NACE Rev. 2 – Statistical Classification of Economic Activities." https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-ra-07-015.

———. 2020. "GDP Main Aggregates and Employment Estimates for the Second Quarter of 2020: GDP Down by 11.8% and Employment Down by 2.9% in the Euro Area." https://ec.europa.eu/eurostat/web/products-euro-indicators/-/2-08092020-ap.

———. 2025. "NUTS – Nomenclature of Territorial Units for Statistics: Overview." https://ec.europa.eu/eurostat/web/nuts.

Fahlenbrach, Rüdiger, Kevin Rageth, and René M. Stulz. 2021. "How Valuable Is Financial Flexibility when Revenue Stops? Evidence from the COVID–19 Crisis." *Review of Financial Studies* 34 (11): 5474–5521. https://doi.org/10.1093/rfs/hhaa134.

Fama, Eugene F., and Kenneth R. French. 1992. "The Cross–Section of Expected Stock Returns." *Journal of Finance* 47 (2): 427–465. https://doi.org/10.1111/j.1540-6261.1992.tb04398.x.

Farhi, Emmanuel, and Iván Werning. 2017. "Fiscal Unions." *American Economic Review* 107 (12): 3788–3834. https://doi.org/10.1257/aer.20130817.

Federal Government of Germany. 2020. "Economic Stimulus Package." https://www.bundesregierung.de/breg-en/news/konjunkturpaket-1757640.

Griliches, Zvi. 1998. *R&D and Productivity: The Econometric Evidence.* Chicago: University of Chicago Press.

Grossman, Gene M., and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy.* Cambridge, MA: MIT Press.

Grossman, Gene M., Elhanan Helpman, and Hugo Lhuillier. 2023. "Supply Chain Resilience: Should Policy Promote International Diversification or Reshoring?" *Journal of Political Economy* 131 (12): 3462–3496. https://doi.org/10.1086/725173.

Grossman, Gene M., Elhanan Helpman, and Alejandro Sabal. 2024. "Optimal Resilience in Multitier Supply Chains." *Quarterly Journal of Economics* 139 (4): 2377–2425. https://doi.org/10.1093/qje/qjae024.

Guceri, Irem, and Maciej Albinowski. 2021. "Investment Responses to Tax Policy under Uncertainty." *Journal of Financial Economics* 141 (3): 1147–1170. https://doi.org/10.1016/j.jfineco.2021.04.032.

Guceri, Irem, and Li Liu. 2019. "Effectiveness of Fiscal Incentives for R&D: Quasi–Experimental Evidence." *American Economic Journal: Economic Policy* 11 (1): 266–291. https://doi.org/10.1257/pol.20170403.

Guerrieri, Veronica, Guido Lorenzoni, Ludwig Straub, and Iván Werning. 2022. "Macroeconomic Implications of COVID–19: Can Negative Supply Shocks Cause Demand Shortages?" *American Economic Review* 112 (5): 1437–1474. https://doi.org/10.1257/aer.20201063.

Hale, Thomas, Noam Angrist, Rafael Goldszmidt, Beatriz Kira, Anna Petherick, Toby Phillips, Samuel Webster, et al. 2021. "A Global Panel Database of Pandemic Policies (Oxford COVID–19 Government Response Tracker)." *Nature Human Behaviour* 5 (1): 529–538. https://doi.org/10.1038/s41562-021-01079-8.

Hale, Thomas, Anna Petherick, Toby Phillips, Jessica Anania, Bernardo Andretti de Mello, Noam Angrist, Roy Barnes, et al. 2023. "Variation in Government Responses to COVID–19." *Blavatnik School of Government Working Paper* 032 (June): version 15. https://www.bsg.ox.ac.uk/research/publications/variation-government-responses-covid-19.

Hall, Bronwyn, and John Van Reenen. 2000. "How Effective Are Fiscal Incentives for R&D? A Review of the Evidence." *Research Policy* 29 (4–5): 449–469. https://doi.org/10.1016/S0048-7333(99)00085-2.

Hall, Bronwyn H., and Josh Lerner. 2010. "The Financing of R&D and Innovation." In *Handbook of the Economics of Innovation,* edited by Bronwyn H. Hall and Nathan Rosenberg, 1: 609–639. Amsterdam: Elsevier. https://doi.org/10.1016/S0169-7218(10)01014-2.

Hall, Robert E., and Charles I. Jones. 1999. "Why Do Some Countries Produce So Much More Output Per Worker than Others?" *Quarterly Journal of Economics* 114 (1): 83–116. https://doi.org/10.1162/003355399555954.

Hall, Robert E., and Dale W. Jorgenson. 1967. "Tax Policy and Investment Behavior." *American Economic Review* 57 (3): 391–414.

Harding, Don, and Adrian Pagan. 2016. *The Econometric Analysis of Recurrent Events in Macroeconomics and Finance.* Princeton: Princeton University Press.

Hassett, Kevin A., and Glenn R. Hubbard. 2002. "Tax Policy and Business Investment." In *Handbook of Public Economics,* edited by Alan J. Auerbach and Martin Feldstein, 3: 1293–1343. Amsterdam: Elsevier. https://doi.org/10.1016/S1573-4420(02)80024-6.

Hillmann, Julia, and Edeltraud Guenther. 2021. "Organizational Resilience: A Valuable Construct for Management Research?" *International Journal of Management Reviews* 23 (1): 7–44. https://doi.org/10.1111/ijmr.12239.

Holling, Crawford S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4: 1–23.

———. 1996. "Engineering Resilience versus Ecological Resilience." In *Engineering within Ecological Constraints,* edited by Peter C. Schultze, 31–44. Washington, D.C.: National Academy Press. https://doi.org/10.17226/4919.

International Financial Reporting Standards. 2025. "IAS 38: Intangible Assets." https://www.ifrs.org/issued-standards/list-of-standards/ias-38-intangible-assets/.

International Monetary Fund. 2021. "Policy Responses to COVID–19." https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

Kenen, Peter B. 1969. "The Theory of Optimum Currency Areas: An Eclectic View." In *Monetary Problems of the International Economy,* edited by Robert A. Mundell and Alexander K. Swoboda, 41–60. Chicago: University of Chicago Press.

La Porta, Rafael, Florencio Lopez–de–Silanes, and Andrei Shleifer. 2008. "The Economic Consequences of Legal Origins." *Journal of Economic Literature* 46 (2): 285–332. https://doi.org/10.1257/jel.46.2.285.

La Porta, Rafael, Florencio Lopez–de–Silanes, Andrei Shleifer, and Robert W. Vishny. 1998. "Law and Finance." *Journal of Political Economy* 106 (6): 1113–1155. https://doi.org/10.1086/250042.

Li, Kai, Xing Liu, Feng Mai, and Tengfei Zhang. 2021. "The Role of Corporate Culture in Bad Times: Evidence from the COVID–19 Pandemic." *Journal of Financial and Quantitative Analysis* 56 (7): 2545–2583. https://doi.org/10.1017/S0022109021000326.

Lichter, Andreas, Max Löffler, Ingo E. Isphording, Thu–Van Nguyen, Felix Poege, and Sebastian Siegloch. 2025. "Profit Taxation, R&D Spending, and Innovation." *American Economic Journal: Economic Policy* 17 (1): 432–463. https://doi.org/10.1257/pol.20220580.

Link, Sebastian, Manuel Menkhoff, Andreas Peichl, and Paul Schule. 2024. "Downward Revision of Investment Decisions after Corporate Tax Hikes." *American Economic Journal: Economic Policy* 16 (4): 194–222. https://doi.org/10.1257/pol.20220530.

Linnenluecke, Martina K. 2017. "Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda." *International Journal of Management Reviews* 19 (1): 4–30. https://doi.org/10.1111/ijmr.12076.

Malerba, Franco. 2006. "Sectoral Systems: How and Why Innovation Differs across Sectors." In *The Oxford Handbook of Innovation,* edited by Jan Fagerberg, David C. Mowery, and Richard R. Nelson, 380–406. Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199286805.003.0014.

McKinnon, Ronald I. 1963. "Optimum Currency Areas." *American Economic Review* 53 (4): 717–725.

Meyer, Alan D. 1982. "Adapting to Environmental Jolts." *Administrative Science Quarterly* 27 (4): 515–537. https://doi.org/10.2307/2392528.

Muggenthaler, Philip, Joachim Schroth, and Yiqiao Sun. 2021. "The Heterogeneous Economic Impact of the Pandemic across Euro Area Countries." *ECB Economic Bulletin* 5 (Box 3). https://www.ecb.europa.eu/press/economic-bulletin/focus/2021/html/ecb.ebbox202105_03~267ada0d38.en.html.

Mundell, Robert A. 1961. "A Theory of Optimum Currency Areas." *American Economic Review* 51 (4): 657–665.

National Bureau of Economic Research. 2023. "15th Annual Feldstein Lecture, Mario Draghi – The Next Flight of the Bumblebee: The Path to Common Fiscal Policy in the Eurozone." https://www.nber.org/research/videos/2023-15th-annual-feldstein-lecture-mario-draghi-next-flight-bumblebee-path-common-fiscal-policy.

———. 2024a. "Economics of Supply Chains, Spring 2024." https://www.nber.org/conferences/economics-supply-chains-spring-2024.

———. 2024b. "Resilience in Supply Chains, Fall 2024." https://www.nber.org/conferences/resilience-supply-chains-fall-2024.

North, Douglas C. 1990. *Institutions, Institutional Change, and Economic Performance.* Cambridge: Cambridge University Press.

Organization for Economic Cooperation and Development. 2021. *Tax Policy Reforms 2021: Special Edition on Tax Policy during the COVID–19 Pandemic.* Paris: OECD Publishing. https://doi.org/10.1787/427d2616-en.

———. 2024a. *Corporate Tax Statistics 2024.* Paris: OECD Publishing. https://doi.org/10.1787/9c27d6e8-en.

———. 2024b. "Corporate Tax Statistics Database." https://www.oecd.org/en/data/datasets/corporate-tax-statistics-database.html.

———. 2025a. "Base Erosion and Profit Shifting (BEPS)." https://www.oecd.org/en/topics/policy-issues/base-erosion-and-profit-shifting-beps.html.

Organization for Economic Cooperation and Development. 2025b. "STIP Compass InnoTax Portal." https://stip.oecd.org/innotax/countries.

O'Sullivan, Mary. 2006. "Finance and Innovation." In *The Oxford Handbook of Innovation,* edited by Jan Fagerberg, David C. Mowery, and Richard R. Nelson, 240–265. Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199286805.003.0009.

Pagano, Marco, Christian Wagner, and Josef Zechner. 2023. "Disaster Resilience and Asset Prices." *Journal of Financial Economics* 150 (2): 103712. https://doi.org/10.1016/j.jfineco.2023.103712.

Ramey, Valerie A. 2016. "Macroeconomic Shocks and Their Propagation." In *Handbook of Macroeconomics,* edited by John B. Taylor and Harald Uhlig, vol. 2A, 71–162. Amsterdam: Elsevier. https://doi.org/10.1016/bs.hesmac.2016.03.003.

Reichlin, Lucrezia, Klaus Adam, Warwick McKibbin, Michael McMahon, Ricardo Reis, Giovanni Ricco, and Beatrice Weder di Mauro. 2021. *The ECB Strategy: The 2021 Review and Its Future.* London: CEPR Press.

Romer, Christina D., and David H. Romer. 2019. "Fiscal Space and the Aftermath of Financial Crises: How It Matters and Why." *Brookings Papers on Economic Activity* Spring: 293–331.

Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98 (5): S71–S102. https://doi.org/10.1086/261725.

Schumpeter, Joseph A. 1942. *Capitalism, Socialism, and Democracy.* New York: Harper.

Smith, Celina, Emanuela Rondi, Alfredo De Massis, and Matthias Nordqvist. 2024. "Rising Every Time We Fall: Organizational Fortitude and Response to Adversities." *Journal of Management* 50 (5): 1865–1910. https://doi.org/10.1177/01492063231164969.

Smith, Keith. 2006. "Measuring Innovation." In *The Oxford Handbook of Innovation,* edited by Jan Fagerberg, David C. Mowery, and Richard R. Nelson, 148–178. Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199286805.003.0006.

StataCorp. 2025. *Stata 19 Causal Inference and Treatment–Effects Estimation Reference Manual.* College Station, TX: Stata Press.

Thomson, Russell. 2017. "The Effectiveness of R&D Tax Credits." *Review of Economics and Statistics* 99 (3): 544–549. https://doi.org/10.1162/REST_a_00559.

Williams, Trenton A., Daniel A. Gruber, Kathleen A. Sutcliffe, Dean A. Shepherd, and Eric Yanfei Zhao. 2017. "Organizational Response to Adversity: Fusing Crisis Management and Resilience Research Streams." *Academy of Management Annals* 11 (2): 733–769. https://doi.org/10.5465/annals.2015.0134.

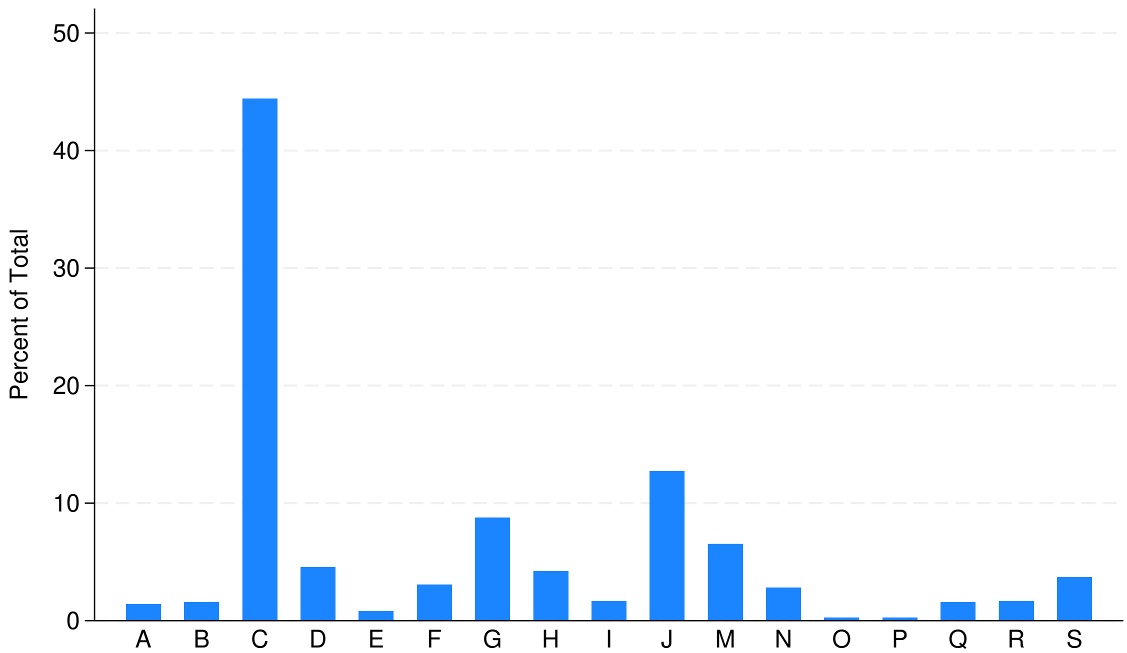
World Health Organization. 2025. "Coronavirus Disease (COVID–19) Pandemic." https://www.who.int/europe/emergencies/situations/covid-19.

Zwick, Eric, and James Mahon. 2017. "Tax Policy and Heterogeneous Investment Behavior." *American Economic Review* 107 (1): 217–248. https://doi.org/10.1257/aer.20140855.

Online Appendix

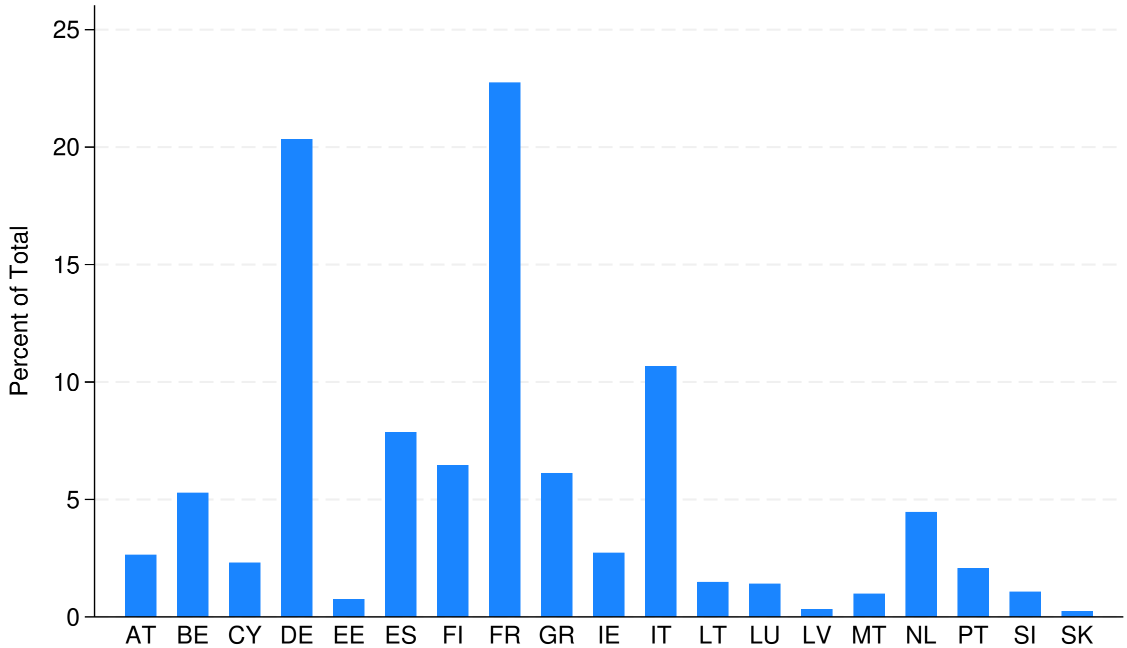
A Descriptive Statistics

Figure A1: Distribution of the Sample by Industries



Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019. NACE Rev.2 section codes are as follows: A (agriculture, forestry, and fishing), B (mining and quarrying), C (manufacturing), D (electricity, gas, steam, and air conditioning supply), E (water supply, sewerage, waste management, and remediation), F (construction), G (wholesale and retail trade; repair of motor vehicles and motorcycles), H (transportation and storage), I (accommodation and food services), J (information and communications), M (professional, scientific and technical services), N (administrative and support services), O (public administration and defense; compulsory social security), P (education), Q (human health and social work), R (arts, entertainment and recreation), and S (other services). Sections K (finance and insurance) and L (real estate) were excluded at the research design stage due to the incomparability of financial ratios of companies in those industries with companies in other industries (Fama and French 1992). See Eurostat (2008) for further details on the NACE Rev.2 classification.

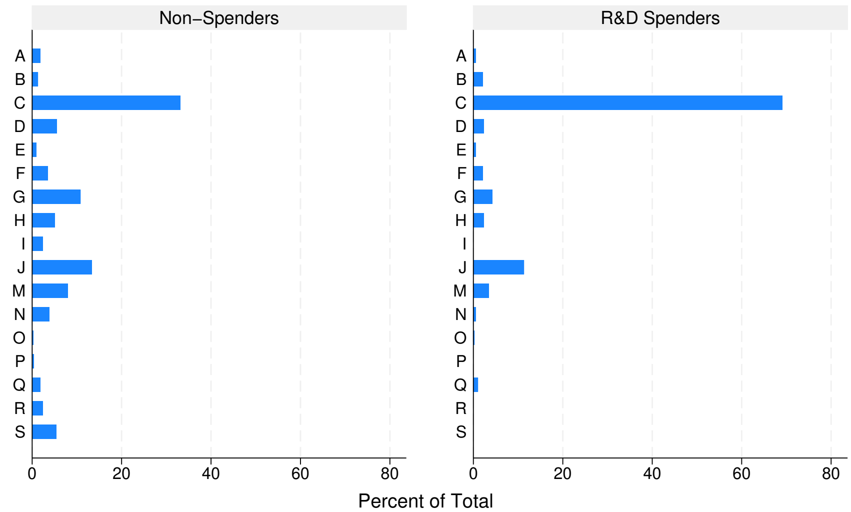
Figure A2: Distribution of the Sample by Locations



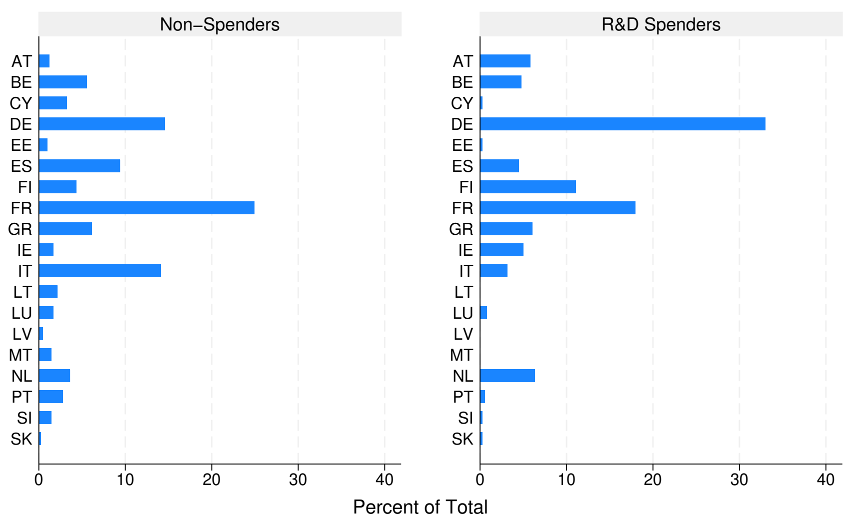
Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019. Country codes are as follows: AT (Austria), BE (Belgium), CY (Cyprus), DE (Germany), EE (Estonia), ES (Spain), FI (Finland), FR (France), GR (Greece), IE (Ireland), IT (Italy), LT (Lithuania), LU (Luxembourg), LV (Latvia), MT (Malta), NL (Netherlands), PT (Portugal), SI (Slovenia), and SK (Slovakia).

Figure A3: Distribution of R&D Spenders and Non–Spenders by Industries and Locations

(a) Industries: NACE Rev.2 Sections



(b) Locations: EA Member States



Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders based on BvD Orbis data classification. NACE Rev.2 section and country codes as defined above.

Table A1: Distribution of the Sample by Industries (NACE Rev.2 Manufacturing Divisions)

NACE Rev.2 Division	All Companies	R&D Spenders
Division 10: Manufacture of Food Products	2.81	3.17
Division 11: Manufacture of Beverages	2.32	1.06
Division 12: Manufacture of Tobacco Products	0.08	0.00
Division 13: Manufacture of Textiles	1.49	0.79
Division 14: Manufacture of Wearing Apparel	1.32	1.06
Division 15: Manufacture of Leather and Related Products	0.50	1.06
Division 16: Manufacture of Wood and Wood and Cork Products, except Furniture	0.74	0.79
Division 17: Manufacture of Paper and Paper Products	1.24	1.58
Division 18: Printing and Reproduction of Recorded Media	0.91	0.53
Division 19: Manufacture of Coke and Refined Petroleum Products	0.33	0.79
Division 20: Manufacture of Chemicals and Chemical Products	3.64	7.12
Division 21: Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	2.81	7.39
Division 22: Manufacture of Rubber and Plastic Products	1.41	3.43
Division 23: Manufacture of Other Non–Metallic Mineral Products	1.90	1.85
Division 24: Manufacture of Basic Metals	1.32	2.11
Division 25: Manufacture of Fabricated Metal Products, except Machinery and Equipment	1.24	2.64
Division 26: Manufacture of Computer, Electronic, and Optical Products	6.62	11.87
Division 27: Manufacture of Electrical Equipment	2.07	6.98
Division 28: Manufacture of Machinery and Equipment (n.e.c.)	6.12	2.90
Division 29: Manufacture of Motor Vehicles, Trailers, and Semi–Trailers	2.15	3.96
Division 30: Manufacture of Other Transport Equipment	0.99	1.58
Division 31: Manufacture of Furniture	0.17	0.00
Division 32: Other Manufacturing	2.07	3.43
Division 33: Repair and Installation of Machinery and Equipment	0.17	0.26

Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders. Numbers denote the percent of total within the full sample and within the subsample of R&D spenders, respectively. See Eurostat (2008) for further details on the NACE Rev.2 classification; n.e.c. stands for "not elsewhere classified."

Table A2: Distribution of the Sample by Industries (NACE Rev.2 Non–Manufacturing Divisions)

NACE Rev.2 Division	All Companies	R&D Spenders
Division 01: Crop and Animal Production, Hunting and Related Service Activities	0.24	0.53
Division 02: Forestry and Logging	0.08	0.00
Division 03: Fishing and Aquaculture	0.08	0.00
Division 06: Extraction of Crude Petroleum and Natural Gas	0.33	0.53
Division 07: Mining of Metal Ores	0.33	0.79
Division 08: Other Mining and Quarrying	0.25	0.26
Division 09: Mining Support Service Activities	0.66	0.53
Division 35: Electricity, Gas, Steam and Air Conditioning Supply	4.55	2.37
Division 36: Water Collection, Treatment and Supply	0.41	0.00
Division 37: Sewerage	0.08	0.26
Division 38: Waste Collection, Treatment and Disposal Activities	0.25	0.00
Division 39: Remediation Activities and Other Waste Management Services	0.08	0.26
Division 41: Construction of Buildings	1.41	0.79
Division 42: Civil Engineering	0.41	0.06
Division 43: Specialized Construction Activities	0.25	0.26
Division 45: Wholesale and Retail Trade and Repair of Motor Vehicles and Motorcycles	0.33	0.00
Division 46: Wholesale Trade, except Motor Vehicles and Motorcycles	5.29	3.43
Division 47: Retail Trade, except Motor Vehicles and Motorcycles	3.14	0.79
Division 49: Land Transport and Transport via Pipelines	0.58	0.53
Division 50: Water Transport	0.66	0.26
Division 51: Air Transport	0.33	0.26
Division 52: Warehousing and Support Activities for Transportation	2.23	1.32
Division 53: Postal and Courier Activities	0.41	0.00
Division 55: Accommodation	1.24	0.00
Division 56: Food and Beverage Service Activities	0.41	0.00

Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders. Numbers denote the percent of total within the full sample and within the subsample of R&D spenders, respectively. See Eurostat (2008) for further details on the NACE Rev.2 classification.

Table A3: Distribution of the Sample by Industries (NACE Rev.2 Non–Manufacturing Divisions, Continued)

NACE Rev.2 Division	All Companies	R&D Spenders
Division 58: Publishing Activities	3.23	5.28
Division 59: Motion Picture, Video, and Television Program Production, Sound Recording and Music Publishing Activities	0.66	0.26
Division 60: Programming and Broadcasting Activities	0.74	0.00
Division 61: Telecommunications	3.06	2.37
Division 62: Computer Programming, Consultancy and Related Activities	4.80	3.43
Division 63: Information Service Activities	0.25	0.00
Division 69: Legal and Accounting Activities	0.08	0.00
Division 70: Activities of Head Offices; Management Consultancy Activities	2.23	0.53
Division 71: Architectural and Engineering Activities; Technical Testing and Analysis	0.83	0.53
Division 72: Scientific Research and Development	0.33	0.26
Division 73: Advertising and Market Research	1.08	0.53
Division 74: Other Professional, Scientific and Technical Activities	1.99	1.58
Division 77: Rental and Leasing Activities	0.50	0.00
Division 78: Employment Activities	0.33	0.00
Division 79: Travel Agency, Tour Operator, Reservation Service, and Related Activities	0.83	0.26
Division 80: Security and Investigation Activities	0.41	0.00
Division 81: Services to Buildings and Landscape Activities	0.25	0.00
Division 82: Office Administrative, Office Support and Other Business Support Activities	0.50	0.26
Division 84: Public Administration and Defense; Compulsory Social Security	0.25	0.26
Division 85: Education	0.25	0.00
Division 86: Human Health Activities	1.57	1.06
Division 92: Gambling and Betting Activities	0.33	0.00
Division 93: Sports Activities and Amusement and Recreation Activities	1.32	0.00
Division 94: Activities of Membership Organizations	3.64	0.00
Division 96: Other Personal Service Activities	0.08	0.00

Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders. Numbers denote the percent of total within the full sample and within the subsample of R&D spenders, respectively. See Eurostat (2008) for further details on the NACE Rev.2 classification.

Table A4: Distribution of the Sample by Locations (NUTS 1 Regions, Germany and France)

NUTS 1 Region	All Companies	R&D Spenders
DE1: Baden–Württemberg	2.98	6.07
DE2: Bayern	5.13	8.18
DE3: Berlin	1.08	2.11
DE5: Bremen	0.58	0.26
DE6: Hamburg	1.24	1.58
DE7: Hessen	1.82	2.90
DE9: Niedersachsen	0.91	1.58
DEA: Nordrhein–Westfalen	3.97	6.07
DEB: Rheinland–Pfalz	1.08	1.32
DEC: Saarland	0.17	0.26
DED: Sachsen	0.08	0.26
DEE: Sachsen–Anhalt	0.17	0.26
DEF: Schleswig–Holstein	0.58	1.06
DEG: Thüringen	0.58	1.06
FR1: Île–de–France	13.23	11.35
FRB: Centre–Val de Loire	0.17	0.36
FRC: Bourgogne–Franche–Comté	0.74	0.79
FRD: Normandie	0.17	0.00
FRE: Hauts–de–France	0.08	0.00
FRF: Grand Est	1.32	0.00
FRG: Pays de la Loire	0.50	0.53
FRH: Bretagne	0.41	0.53
FRI: Nouvelle–Aquitaine	0.83	0.53
FRJ: Occitanie	0.58	0.26
FRK: Auvergne–Rhône–Alpes	3.06	2.64
FRL: Provence–Alpes–Côte d'Azur	1.41	1.06

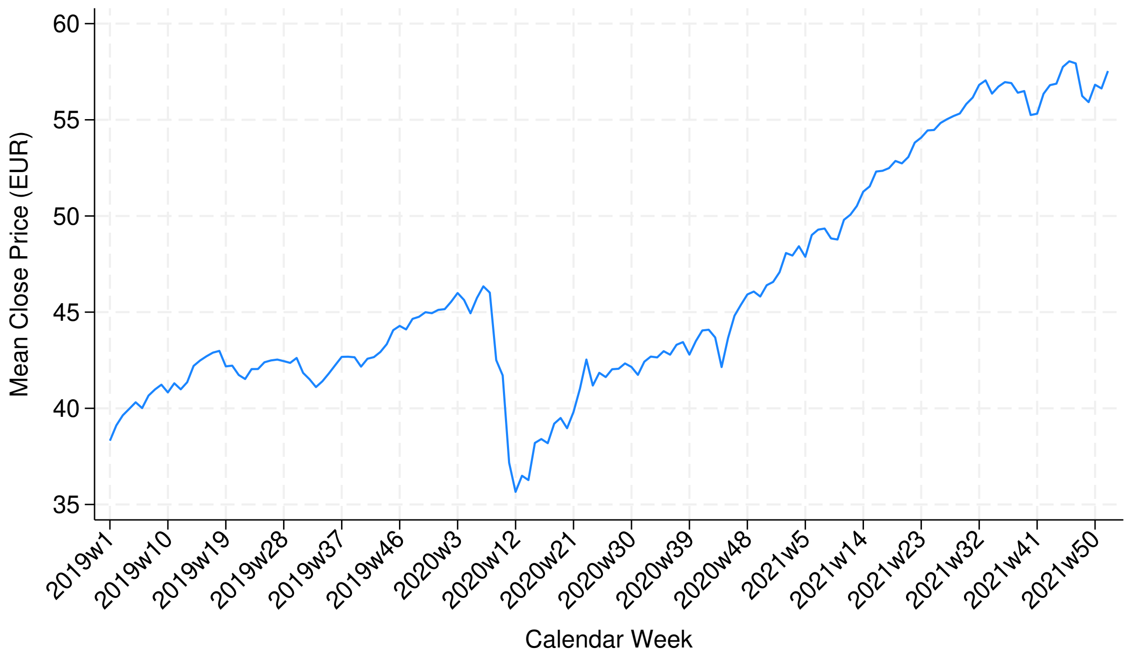
Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders. Numbers denote the percent of total within the full sample and within the subsample of R&D spenders, respectively. See Eurostat (2025) for further details on the NUTS classification.

Table A5: Distribution of the Sample by Locations (NUTS 1 Regions, Other Member States)

NUTS 1 Region	All Companies	R&D Spenders
AT1: Ostösterreich	1.41	2.37
AT2: Südösterreich	0.33	1.06
AT3: Westösterreich	0.91	2.37
BE1: Région de Bruxelles–Capitale/Brussels Hoofdstedelijk Gewest	2.15	2.37
BE2: Vlaams Gewest	2.40	1.85
BE3: Région Wallonne	0.74	0.53
EL3: Attiki	4.47	3.96
EL4: Nisia Aigaiou, Kriti	0.17	0.26
EL5: Voreia Ellada	1.24	1.58
EL6: Kentriki Ellada	0.25	0.26
ES1: Noroeste	0.50	0.26
ES2: Noreste	1.24	0.79
ES3: Comunidad de Madrid	4.22	2.64
ES4: Centro (ES)	0.17	0.00
ES5: Este	0.49	0.79
ES6: Sur	0.08	0.00
ES7: Canarias	0.17	0.00
FI1: Manner–Suomi	6.37	11.8
FI2: Åland	0.08	0.00
ITC: Nord–Ovest	4.80	1.58
ITF: Sud	0.25	0.00
ITH: Nord–Est	2.73	0.26
ITI: Centro (IT)	2.89	1.32
NL2: Oost–Nederland	0.41	0.79
NL3: West–Nederland	3.47	4.49
NL4: Zuid–Nederland	0.58	1.06
PT1: Continente	2.07	0.53

Notes: The sample includes 1,209 publicly traded companies in 19 EA member states as of 1 January 2019, of which 379 are R&D spenders. Numbers denote the percent of total within the full sample and within the subsample of R&D spenders, respectively. Nine member states (Cyprus, Estonia, Ireland, Latvia, Lithuania, Luxembourg, Malta, Slovakia, and Slovenia) do not have regional divisions due to their small size. See Eurostat (2025) for further details on the NUTS classification.

Figure A4: Time Series of Weekly Stock Prices



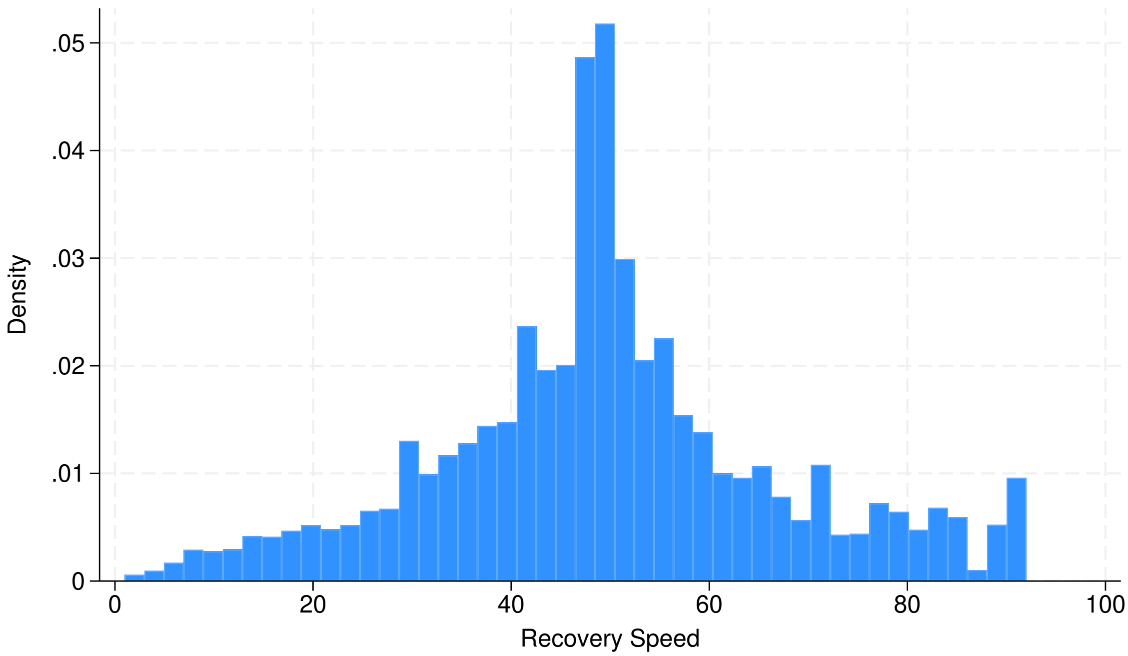
Note: The sample includes 1,209 publicly traded companies in 19 EA member states observed for 156 weeks from W1–2019 to W52–2021.

Table A6: t–test Statistics

Variable	Sample	Obs.	Mean	SD	Difference	p–value
Impact resistance	All	188,604	0.735	0.441		
	Non–spenders	129,480	0.723	0.447	-0.038	0.000
	R&D spenders	59,124	0.761	0.426		
Recovery speed	All	43,551	49.631	17.664		
	Non–spenders	31,388	51.066	17.691	5.139	0.000
	R&D spenders	12,163	45.927	17.045		
Log *Liquidity*	All	186,108	0.438	0.708		
	Non–spenders	126,984	0.409	0.779	-0.091	0.000
	R&D spenders	59,124	0.500	0.519		
Age	All	188,604	46.203	39.042		
	Non–spenders	129,480	43.467	35.505	-8.728	0.000
	R&D spenders	59,124	52.195	45.272		

Notes: The sample includes 1,209 publicly traded companies in 19 EA member states observed weekly from W1–2019 to W52–2021, of which 379 are R&D spenders based on 2019 annual financial statements. Unequal variances are assumed.

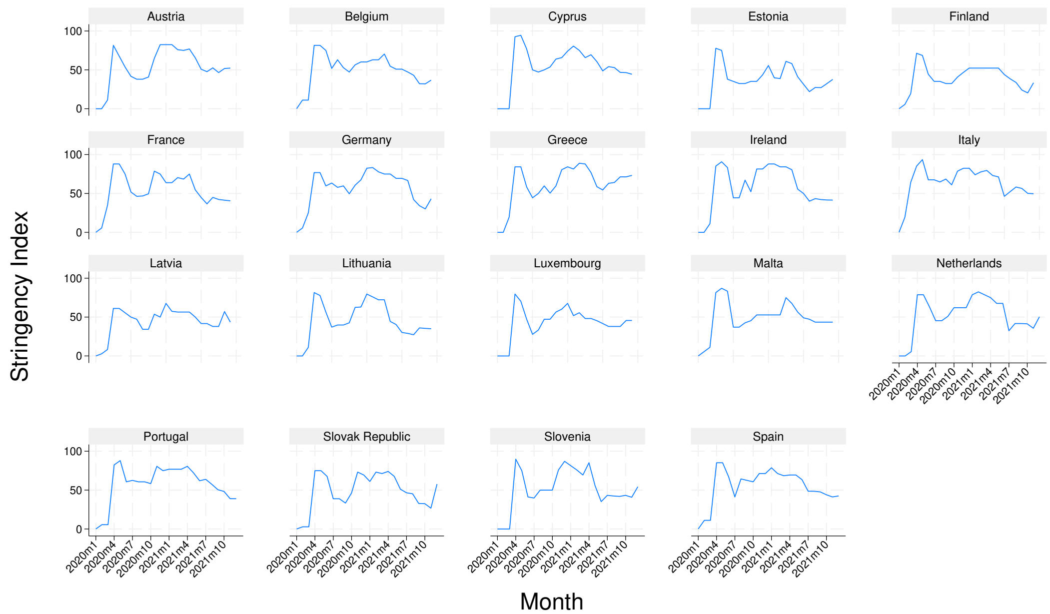
Figure A5: Distribution of the Recovery Speed Variable



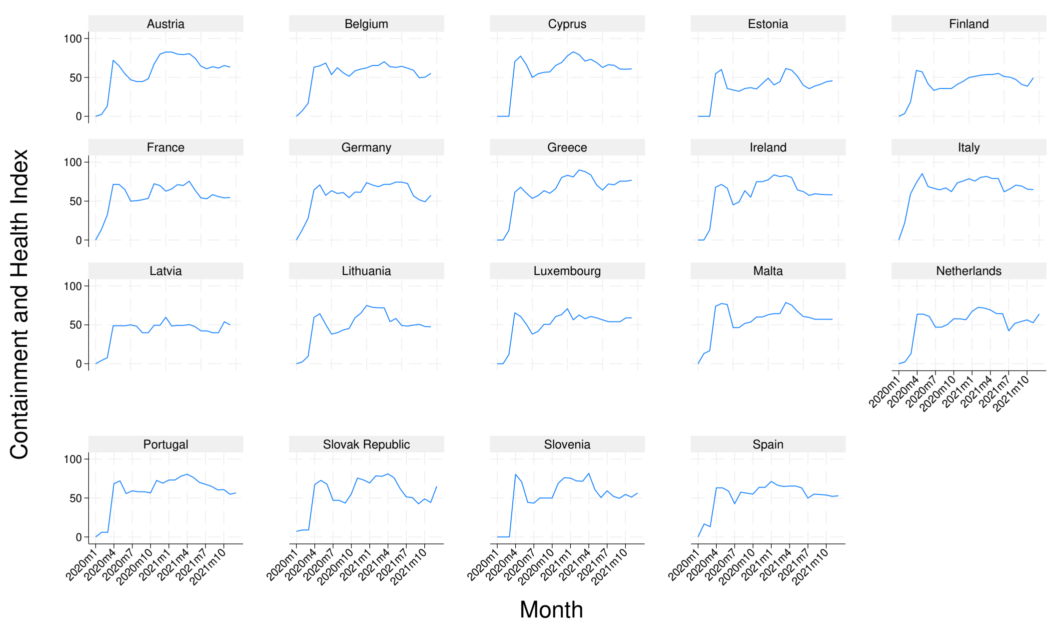
Note: The recovery speed is computed for the majority (1,120 of 1,209, i.e., approximately 93%) of the sampled publicly traded companies.

Figure A6: Non–Fiscal Policy Responses to the Pandemic in EA Member States

(a) Stringency



(b) Containment and Health



Source: Hale et al. (2021) and own calculations.

B Government Finance Statistics

Table B1: Corporate Effective Tax Rates and R&D Tax Subsidy Rates in EA–OECD Member States, 2019–2021

Country / Year	EATR			EMTR			ITSR (R&D)		
	2019	2020	2021	2019	2020	2021	2019	2020	2021
Austria	24.37	23.87	23.87	27.70	23.27	23.27	0.17	0.17	0.17
Belgium	26.73	23.29	23.39	15.03	18.14	19.05	0.15	0.15	0.16
Estonia	17.00	17.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00
Finland	19.73	19.40	19.40	22.74	20.03	20.03	-0.01	0.00	0.00
France	31.75	29.53	26.02	25.24	22.64	17.50	0.43	0.39	0.37
Germany	28.32	28.03	26.41	27.67	24.92	9.18	-0.02	0.19	0.19
Greece	22.96	22.96	21.05	22.47	22.47	20.07	0.08	0.29	0.26
Ireland	12.36	12.36	12.36	13.21	13.21	13.21	0.29	0.27	0.27
Italy	19.37	20.24	14.44	-39.35	-31.39	-84.94	0.07	0.11	0.20
Latvia	17.00	17.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00
Lithuania	13.67	13.67	13.67	7.25	7.25	7.25	0.31	0.31	0.31
Luxembourg	23.54	23.54	23.54	20.83	20.83	20.83	-0.01	-0.01	-0.01
Netherlands	23.71	23.71	23.71	21.89	21.89	21.89	0.15	0.15	0.15
Portugal	28.35	28.42	28.42	15.30	16.01	16.01	0.39	0.39	0.39
Slovakia	19.20	19.20	19.20	11.41	11.41	11.41	0.41	0.55	0.55
Slovenia	17.38	17.38	17.38	10.15	10.15	10.15	0.21	0.21	0.21
Spain	23.45	23.45	23.45	19.55	19.55	19.55	0.33	0.33	0.33

Source: Organization for Economic Cooperation and Development (2024b)

Notes: EATR stands for effective average tax rate, and EMTR stands for effective marginal tax rate; both are measured as a percent of taxable income. ITSR stands for implied tax subsidy rate, and it is measured as 1 minus the B–index, an indicator of how much before–tax income a representative firm needs to break even on a unit of R&D expense. See Organization for Economic Cooperation and Development (2024a) for further details.

Table B2: Corporate R&D Tax Incentives in EA–OECD Member States, 2019–2021

Country	Policy	Year	Base	Rate (%)		
				2019	2020	2021
Austria	Research premium	2002	CIT	14	14	14
Belgium	R&D investment deduction	1992	CIT	13.5	13.5	13.5
Finland	R&D cooperation deduction	2021	CIT	–	–	150
France	R&D tax credit *(crédit d'impôt recherche, CIR)*	1983	CIT	30	30	30
Germany	R&D tax credit *(Forschungszulage)*	2020	CIT	–	25	25
Greece	R&D tax allowance	2004	CIT	100	100	100
Ireland	R&D corporation tax credit	2004	CIT	25	25	25
Italy	R&D tax credit	2020	CIT	–	10	10
Lithuania	R&D tax credit	2008	CIT	200	200	200
Netherlands	R&D tax credit	1994	SSC	32	32	32
Portugal	R&D tax credit	1997	CIT	32.5	32.5	32.5
Slovakia	R&D tax allowance	2015	CIT	100	100	100
Slovenia	R&D tax allowance	2005	CIT	100	100	100
Spain	R&D tax credit	2015	CIT	25	25	25

Source: Organization for Economic Cooperation and Development (2025b).

Notes: Year refers to the year in which the policy took effect, as opposed to the year when it was legislated if the two differ. Base refers to the tax base for the policy (corporate income tax, CIT, or social security contribution, SSC). In case of multiple rates (e.g., small vs. large firms and capital vs. labor costs), only the base rate applicable to large firms is reported. In case of multiple policies (e.g., Belgium), the oldest policy applicable to most firms is reported. Three member states (Estonia, Latvia, and Luxembourg) did not provide R&D tax incentives during the observed period.

Table B3: Public Finances in EA Member States, 2019–2021

Country	Debt (% GDP)	Budget Balance (% GDP)				
					Δ	Δ
	2019	2019	2020	2021	(2020–2019)	(2021–2020)
Austria	71.0	2.0 [0.3]	-6.9 [-4.3]	-4.6 [-4.1]	-8.9 [-4.6]	2.3 [0.2]
Belgium	97.6	0.0 [-0.8]	-7.1 [-4.0]	-3.7 [-3.3]	-7.1 [-3.2]	3.4 [0.7]
Cyprus	92.3	3.2 [2.0]	-3.5 [-1.1]	0.1 [-0.8]	-6.7 [-3.1]	3.6 [0.3]
Estonia	9.0	-0.1 [-2.3]	-5.4 [-5.2]	-2.5 [-4.9]	-5.3 [-2.9]	2.9 [0.3]
Finland	65.3	-0.1 [-1.4]	-4.9 [-4.4]	-2.1 [-2.8]	-4.8 [-3.0]	2.8 [1.6]
France	98.2	-0.9 [-2.5]	-7.7 [-3.9]	-5.2 [-4.8]	-6.8 [-1.4]	2.5 [-0.9]
Germany	58.7	2.1 [0.9]	-3.7 [-2.5]	-2.6 [-2.7]	-5.8 [-3.4]	1.1 [-0.2]
Greece	183.2	3.8 [2.7]	-6.6 [-2.3]	-4.6 [-3.7]	-10.4 [-5.0]	2.0 [-1.4]
Ireland	55.9	1.7 [1.3]	-3.9 [-4.4]	-0.6 [-6.2]	-5.6 [-5.7]	3.3 [-1.8]
Italy	133.9	1.9 [1.2]	-6.0 [-1.4]	-5.5 [-4.8]	-7.9 [-2.6]	0.5 [-3.4]
Latvia	37.9	0.6 [-0.1]	-3.4 [-2.0]	-6.7 [-7.1]	-4.0 [-1.9]	-3.3 [-5.1]
Lithuania	35.6	1.3 [0.4]	-5.7 [-5.4]	-0.7 [-1.7]	-7.0 [-5.8]	5.0 [3.7]
Luxembourg	22.3	3.0 [2.4]	-2.9 [-2.4]	1.1 [-0.7]	-0.1 [-4.8]	-1.8 [1.7]
Malta	39.3	2.0 [0.1]	-7.5 [-5.0]	-6.0 [-6.6]	-9.5 [-5.1]	1.5 [-1.6]
Netherlands	47.7	2.6 [1.7]	-2.9 [-0.4]	-1.7 [-1.7]	-5.5 [-2.1]	1.2 [-1.3]
Portugal	116.1	3.0 [1.1]	-2.9 [0.6]	-0.5 [1.3]	-5.9 [-0.5]	2.4 [0.7]
Slovakia	48.0	0.0 [-0.7]	-4.1 [-3.1]	-4.0 [-4.4]	-4.1 [-2.4]	0.1 [-1.3]
Slovenia	66.0	2.3 [0.9]	-6.1 [-4.4]	-3.4 [-4.2]	-8.4 [-5.3]	2.7 [0.2]
Spain	97.7	-0.8 [-3.3]	-7.7 [-2.5]	-4.5 [-2.0]	-6.9 [0.8]	3.2 [0.5]
EA 19 average	72.4	1.5 [0.2]	-4.9 [-3.1]	-3.0 [-3.4]	-6.4 [-3.3]	1.9 [-0.4]

Source: European Central Bank (2025a, 2025b) and own calculations.

Notes: Debt refers to total government debt. Budget balance refers to the primary deficit/surplus. Cyclically adjusted primary balance statistics, sourced from the AMECO database (European Commission 2025a), are provided in square brackets.

C Additional Results

Table C1: RE Logit Regression Results Based on R&D Intensity

	Baseline	Augmented			
	(1)	(2)	(3)	(4)	(5)
Log *R&D intensity*	0.097	0.080	0.084	0.080	0.030
	(0.040)	(0.040)	(0.044)	(0.048)	(0.050)
Log *Liquidity*		0.163	0.123	0.117	0.098
		(0.133)	(0.142)	(0.151)	(0.140)
Age			-0.012	-0.011	-0.012
			(0.002)	(0.002)	(0.002)
Industry (NACE section) FE				✓	✓
Location (country) FE					✓
Constant	1.930	1.815	2.447	1.891	0.734
	(0.195)	(0.213)	(0.276)	(1.280)	(1.529)
n (companies)	366	366	366	366	365
N (company–week obs.)	57,096	57,096	57,096	57,096	56,940
Log pseudo–L	-28,023.77	-28,023.09	-27,996.66	-27,991.55	-27,972.52
Wald χ^2	5.96	7.48	30.03	113.31	—

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1 of the manuscript. Column 1 estimates the regression model specified in Equation 7, while columns 2–5 estimate the regression model specified in Equation 8. Robust standard errors clustered at the company level in parentheses below coefficient estimates. See Appendix A above for descriptive statistics, including the distribution of companies across industries and locations.

Table C2: RE Poisson Regression Results Based on R&D Intensity

	Baseline	Augmented			
	(1)	(2)	(3)	(4)	(5)
Log *R&D intensity*	-0.031	-0.029	-0.029	-0.025	-0.009
	(0.015)	(0.015)	(0.015)	(0.017)	(0.019)
Log *Liquidity*		-0.036	-0.034	-0.046	-0.039
		(0.062)	(0.063)	(0.064)	(0.063)
Age			0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)
Industry (NACE section) FE				✓	✓
Location (country) FE					✓
Constant	3.419	3.444	3.411	3.763	3.933
	(0.075)	(0.083)	(0.090)	(0.489)	(0.536)
n (companies)	338	338	338	338	338
N (company–week obs.)	11,744	11,744	11,744	11,744	11,744
Log pseudo–L	-33,919.43	-33,919.31	-33,919.01	-33,915.32	-33,904.20
Wald χ^2	14,161.63	14,246.91	14,596.96	689,004.00	2,281.13

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3 of the manuscript. Column 1 estimates the regression model specified in Equation 10, while columns 2–5 estimate the regression model specified in Equation 11. Robust standard errors clustered at the company level in parentheses below coefficient estimates. See Appendix A above for descriptive statistics, including the distribution of companies across industries and locations.

Table C3: Extended Heterogeneity Analysis by Legal Origins for Resilience as Impact Resistance

	Panel A. French Civil Law			Panel B. German Civil Law		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.158	0.155	0.286	0.229	0.369	0.299
	(0.115)	(0.116)	(0.161)	(0.155)	(0.168)	(0.188)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.208	1.299	2.203	1.334	3.272	4.787
	(0.056)	(0.334)	(0.565)	(0.118)	(1.637)	(1.295)
n (companies)	734	734	729	294	294	286
N (company–week obs.)	114,504	114,504	113,724	45,864	45,864	44,616
Log pseudo–L	-61,369.36	-61,353.28	-60,961.04	-22,976.92	-22,955.73	-22,248.17
Wald χ^2	1.89	141.82	38.64	2.17	84.57	110.65

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1 of the manuscript. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. French civil law includes eight countries: Belgium, France, Greece, Italy, Lithuania, the Netherlands, Portugal, and Spain; German civil law includes four countries: Austria, Germany, Slovakia, and Slovenia. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Appendix A above for descriptive statistics, including the distribution of companies across industries and locations.

Table C4: Extended Heterogeneity Analysis by Legal Origins for Resilience as Recovery Speed

	Panel A. French Civil Law			Panel B. German Civil Law		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	-0.069	-0.041	-0.043	-0.174	-0.215	-0.220
	(0.046)	(0.049)	(0.049)	(0.068)	(0.077)	(0.081)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	3.726	3.500	3.485	3.686	2.987	2.849
	(0.021)	(0.280)	(0.284)	(0.048)	(0.077)	(0.136)
n (companies)	684	684	680	270	270	262
N (company–week obs.)	27,927	27,927	27,777	9,887	9,887	9,614
Log pseudo–L	-81,947.03	-81,932.76	-81,474.47	-28,748.19	-28,738.70	-27,942.82
Wald χ^2	41,322.98	83,899.32	91,447.85	11,344.29	440.10	16,691.17

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3 of the manuscript. In both panels, column 1 estimates the regression model specified in Equation 10, while columns 2 and 3 estimate the regression model specified in Equation 11. French civil law includes eight countries: Belgium, France, Greece, Italy, Lithuania, the Netherlands, Portugal, and Spain; German civil law includes four countries: Austria, Germany, Slovakia, and Slovenia. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Appendix A above for descriptive statistics, including the distribution of companies across industries and locations.

Table C5: Alternative Heterogeneity Analysis by Fiscal Stimulus for Resilience as Impact Resistance

	Panel A. Limited Fiscal Stimulus			Panel B. Broad Fiscal Stimulus		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	0.232	0.232	0.362	0.263	0.306	0.270
	(0.116)	(0.122)	(0.165)	(0.121)	(0.132)	(0.146)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	1.255	2.304	2.699	1.294	1.245	1.869
	(0.058)	(0.611)	(0.782)	(0.086)	(0.211)	(0.307)
n (companies)	764	764	757	445	445	436
N (company–week obs.)	119,184	119,184	118,092	69,420	69,420	68,016
Log pseudo-L	-62,638.28	-62,622.92	-61,941.29	-35,220.82	-35,200.78	-34,448.61
Wald χ^2	4.00	141.28	39.65	4.72	130.96	63.64

Notes: The dependent variable in all columns is impact resistance, as specified in Equation 1 of the manuscript. In both panels, column 1 estimates the regression model specified in Equation 7, while columns 2 and 3 estimate the regression model specified in Equation 8. Fiscal stimulus is measured by the change in cyclically adjusted primary balance from 2019 to 2020. Countries that implemented limited (with respect to the average of 3.3% of GDP) fiscal packages include the following: Belgium, Cyprus, Estonia, Finland, France, Italy, Latvia, Netherlands, Portugal, Slovakia, and Spain; countries that implemented broad fiscal packages include Austria, Germany, Greece, Ireland, Lithuania, Luxembourg, Malta, and Slovenia. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations. Online Appendix B provides government finance statistics.

Table C6: Alternative Heterogeneity Analysis by Fiscal Stimulus for Resilience as Recovery Speed

	Panel A. Limited Fiscal Stimulus			Panel B. Broad Fiscal Stimulus		
	(1)	(2)	(3)	(1)	(2)	(3)
R&D spender	-0.100	-0.054	-0.058	-0.214	-0.220	-0.225
	(0.047)	(0.050)	(0.051)	(0.054)	(0.060)	(0.061)
Industry (NACE section) FE		✓	✓		✓	✓
Other controls			✓			✓
Constant	3.712	3.340	3.346	3.704	3.503	3.468
	(0.022)	(0.409)	(0.402)	(0.034)	(0.149)	(0.154)
n (companies)	706	706	700	414	414	405
N (company–week obs.)	28,180	28,180	27,895	15,371	15,371	15,090
Log pseudo–L	-82,587.59	-82,573.97	-81,715.62	-44,725.16	-44,714.48	-43,899.65
Wald χ^2	39,246.99	78,558.80	86,964.77	19,079.23	28,221.58	28,904.78

Notes: The dependent variable in all columns is recovery speed, as specified in Equation 3 of the manuscript. In both panels, column 1 estimates the regression model specified in Equation 10, while columns 2 and 3 estimate the regression model specified in Equation 11. Fiscal stimulus is measured by the change in cyclically adjusted primary balance from 2019 to 2020. Countries that implemented limited (with respect to the average of 3.3% of GDP) fiscal packages include the following: Belgium, Cyprus, Estonia, Finland, France, Italy, Latvia, Netherlands, Portugal, Slovakia, and Spain; countries that implemented broad fiscal packages include Austria, Germany, Greece, Ireland, Lithuania, Luxembourg, Malta, and Slovenia. Robust standard errors clustered at the company level in parentheses below coefficient estimates. Other controls include liquidity and age. See Online Appendix A for descriptive statistics, including the distribution of companies across industries and locations. Online Appendix B provides government finance statistics.