



Brain-be 2.0

PILLAR 3

STATE OF THE ART

HAIOPOLICY

The impact of COVID-19 and other complex shocks on heterogeneous households and businesses, and implied optimal policies

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Introduction

This project studies the socio-economic impact of COVID-19 on Belgian households and businesses. It quantifies the effects of COVID-19 and various policies to curb the spread of the virus, keep the economy afloat, and support the recovery of the Belgian economy. In particular, it will answer the following questions:

1. Which groups (within both producers and consumers) have been affected most during COVID-19?
2. What economic and socio-demographic factors make these groups vulnerable?
3. What is the impact of different policies on heterogeneous groups of producers and consumers?
4. How can we make the economy more resilient to similar future shocks?

The project brings together a team of experts on production and household economics. The key elements are to (i) collect and combine detailed administrative datasets on businesses and households for Belgium and its three Regions, (ii) leverage this data to conduct detailed *ex post* econometric evaluations on the impact of COVID-19 and related socio-economic policies on diverse businesses and households, (iii) develop a quantitative general equilibrium framework to analyze the effects of the virus and associated policies across the economy, accounting for various dimensions of heterogeneity among producers and households, and (iv) evaluate the realized and potential effects of these policies with the quantitative framework, as well as what would have been the impact if these policies would not have been implemented. This project aims to inform evidence-based policy making, promoting efficiency, equity, and adherence to social norms, while enhancing our economies' resilience against future large shocks.

State of the art

1. Context

COVID-19 has precipitated a global health crisis, resulting in nearly 7 million official deaths and 770 million infections by the end of 2022 (World Health Organization, 2023). This pandemic, together with various emergency policies to contain it, have caused the largest decline in aggregate supply and demand since World War II. Gross Domestic Product (GDP) in most Western countries fell by 5 to 10% in 2020 (World Bank, 2023). In Belgium, GDP declined by 6.1% (National Bank of Belgium, 2023). To put these numbers into perspective: the non-economic shock of COVID-19 caused an economic decline that was three times as large as the impact of the Great Financial Crisis in 2008-2009.

This fall in GDP resulted from a combination of decreased production, due to reduced labor supply from the virus and enforced industry closures, and diminished consumption, stemming from reduced disposable income and significant uncertainty regarding economic prospects both short- and long-term. Moreover, both production and consumption patterns changed drastically during the lockdowns and in the wake of the reopening of the economy. It is not yet clear whether these patterns have converged back to their pre-pandemic values or if we are shifting towards new, distinct patterns of production and consumption.

In response to the crisis, the Belgian federal and regional governments have implemented a battery of emergency policies to curb the spread of the virus and to avoid an economic meltdown. The EU has launched its largest stimulus package in history, currently valued at almost 2 trillion euro. It is a combination of its multi-annual financial framework and the temporary NextGenerationEU instrument to foster a resilient, sustainable, and digital post-COVID Europe (European Commission, 2023). Additionally, in its "Roadmap for Recovery", the European Council urges for further deepening of the Single Market by – inter alia – bolstering key supply chains and reducing over-dependency on third parties (Consilium, 2020). These policies have significantly mitigated potential health and socio-economic fallout (e.g. Zegel et al., 2021). However, they have also led to substantial budgetary costs, with Belgian federal debt and deficit peaks of 112% debt-to-GDP and 9% deficit-to-GDP in 2020, well above the EU Stability and Growth Pact limits of 60% and 3% respectively (Eurostat, 2023).¹

Against this backdrop, our project aims to provide a detailed examination of the multifaceted impacts of COVID-19 on vulnerable groups in Belgium. Our objective is to identify strategies to shield these groups effectively and improve economic resilience against future shocks. The current paper synthesizes the latest academic and policy research findings pertinent to the BELSPO HAIOPOLICY project.

Section 2 describes the consequences of COVID-19 on household outcomes, specifically examining shifts in labor markets, consumption habits, and saving patterns. In Section 3, we pivot to the pandemic's impact on businesses, analyzing firm survival, variations in output, employment trends, and productivity growth. Section 4 provides a review of the federal and regional interventions implemented to mitigate the pandemic's adverse effects. It discusses the budgetary environment of these policies, the main policies on both the employment and firm sides, as well as supra-national global value chain policies. These sections aim to

¹ In February 2022, the onset of the Russian-Ukrainian war induced another massive shock to economic activity, contributing to two-digit inflation rates, and potentially inducing changes in many of the economic variables we study in this project. For example, several of the regional, federal, and EU-level policy instruments have been transformed or adapted to cope with these massive new events. The general context of this project refers to the COVID period 2020-2021, with relevant *pre* and *post* periods where applicable.

elucidate how the pandemic has reshaped economic behaviors of households and businesses, setting the stage for a discussion on broader economic implications.²

Next, Section 5 provides an overview of the state-of-the-art toolbox of modeling frameworks to quantify the impact of COVID-19 on both the production and consumption sides of the economy. Existing frameworks that model micro-to-macro outcomes mostly rely on either production or consumption heterogeneity. We will build on these frameworks to allow for detailed heterogeneity along regional, socio-economic and firm outcomes, while allowing for spillovers from production to consumption and vice versa through input-output linkages. Finally, Section 6 initiates a forward-looking discussion on formulating optimal policy responses to large shocks like COVID-19. This dialogue considers the many interlinked dimensions of heterogeneity, the policy toolbox, and how to start developing a multidimensional approach to policy development.³

By leveraging unprecedented access to granular data on production and consumption patterns, developing new quantitative frameworks to study the impact of large shocks and potential mitigation policies, and building on critical insights from a broad spectrum of stakeholders, this project aims to outline actionable, nuanced strategies that can guide policymakers in constructing interventions that are as inclusive as they are effective.

2. Households: labor market outcomes, consumption, and saving

Inequality along the income distribution

COVID-19 has exacerbated existing labor market inequalities across the income distribution, and among various socio-demographic groups, including differences by region, occupation, gender, parental status, and education. In most OECD countries however, income inequality has in fact declined, thanks to emergency government support mechanisms (Stantcheva, 2022). Yet, several studies argue that, if such measures would not have been taken, inequality would have actually increased, and this mostly at the bottom of the income distribution (Almeida et al., 2021; Aspachs et al., 2022; Brunori et al., 2021; Clark et al., 2021a, b; Li et al., 2022; O'Donoghue et al., 2020; Palomino et al., 2020).

Short-term and long-term effects of policies

The decline in income inequality during the crisis is at least partly the result of short-term policy responses. Such policies, including e.g. temporary unemployment schemes, can smooth temporary imbalances between labor supply and demand, while keeping human capital within the firm and avoiding additional search and matching costs in an uptake of the economy. However, they might also contribute to labor market frictions and the misallocation of human capital resources in the long run, while not addressing structural issues that already exist in the labor markets pre-COVID.

The long-term effects are yet unknown and can turn out to be regressive and persistent: workers at the bottom of the income distribution might ultimately be the first ones to be laid off, or experience permanent wage reductions, resulting in depreciation of human capital, increasing labor market misallocation, and difficulties in finding new jobs as the economy recovers (Phelps, 1972; Blanchard and Summers, 1986;

² Sections 2, 3 and 4 broadly coincide with WP1 (household side) and WP2 (production side) of the project. The policies discussed in Section 4 also relate to WP4 (optimal policies).

³ Sections 5 and 6 broadly coincide with WP3 (an integrated framework) and WP4 (optimal policies) of the project.

Angelopoulos et al., 2021). It is therefore crucial to consider policies that go beyond immediate relief, such as more profound labor market and/or social security reforms.

Gender disparities

Compared to men, women experienced a higher probability of being fired or furloughed, a higher propensity of seeing their hours worked reduced, and a larger decrease in wages (Collins et al., 2021; Andrew et al., 2022; Hipp and Bünning, 2021; Martinez-Bravo and Sanz, 2022). School closures and child-care responsibilities have increased unpaid domestic work, especially for women (Stantcheva, 2022). Women working from home also experienced larger productivity declines than men during the pandemic (Alon et al., 2021). Working mothers have been hit hardest, which has been labeled as a “she-cession” (Alon et al., 2020).

The labor force is experiencing a significant reduction in its pool of highly skilled female professionals due to increased responsibilities in caregiving and education, forcing gender equality backwards by a decade (Taub, 2020). There is room for both businesses and governments to consider policies that allow to balance professional and caregiving responsibilities, both from a human-centric and an efficiency point of view, such as flexible working arrangements, expanded childcare services, or incentives for shared parental leave.

Labor market frictions and misallocation

Lower-income workers tend to work in occupations with limited possibilities to work remotely, with a higher exposure to health risks, and a higher probability to be in short term contracts, to be fired or furloughed (Adams-Prassl et al., 2020a; Chetty et al., 2020; Li et al., 2022; Piyapromdee and Spittal, 2020). In the short run, heterogeneity across sectors in terms of the ability to work remotely affects sector-level and aggregate employment and output (Grassi, Konings and Magerman, 2020). In the long run, the crisis has accelerated digitalization, online activities, and automation in many sectors, thereby substituting away from low-skilled labor.

These frictions generate mismatches in the labor market that might persist over time (Stiglitz, 2021), and which can further accelerate automation and digitalization, increasing labor market frictions and capital intensity in sectors where labor and capital are substitutes in production. Empirically, increasing automation has also been shown to increase income inequality (Hémous and Olsen, 2022). Moreover, the clustering of economic activities across regions can further contribute to geographical inequality (Crowley and Doran, 2020; De Fraja et al., 2021; Bonacini et al., 2021). Again, there might be room for policies at both the business and government levels to support this transition, such as digital literacy programs, vocational training, lifelong learning, reskilling, or structural changes in the education system.

Household saving and consumption patterns

The pandemic led to a significant increase in household saving, from 12% of disposable income in ‘normal’ times up to 21% in 2020 (National Bank of Belgium, 2021). However, this trend is very different along the income distribution: low-income quantiles reduced consumption less during the lockdown and in a transitory fashion, while high-income quantiles took larger consumption cuts, which seem persistent (Chetty et al., 2020; Hacıoğlu-Hoke et al., 2021). While increased saving might be optimal to smooth consumption in uncertain times, elevated levels of saving may be suboptimal to support the recovery of the economy.

During the lockdown, mostly the consumption of non-essential goods dropped (Carvalho et al., 2021b). Afterwards, consumption of durables (including housing) increased sharply, contributing to significant price hikes in construction and property prices, among others. Demand for goods and services rapidly increased, leading to supply chain bottlenecks in terms of lower quantities and/or higher prices across the world.⁴ If demand shifts are permanent, they will also trigger changes in the supply of consumption goods, both for final demand producers, as well as through producers that directly or indirectly supply such final demand producers.

Households have different consumption baskets along the income distribution, which have shown to induce higher inflation levels for the lower part of the distribution (Cavallo, 2020; Germain and Hindriks, 2020; Jaravel, 2021). While evidence suggests that policies such as social tariffs on electricity and gas that favor low-income households are more effective in stabilizing consumption of the financially vulnerable in Belgium, such policies might interact with automatic indexation in ways that affect its effectiveness and create spillovers to the entire income distribution (Peersman and Wauters, 2022; Capéau et al., 2022).

The contributions of HAIOPOLICY

Unfortunately, a comprehensive analysis of Belgium with respect to the impact of COVID-19 on income inequality, saving or consumption patterns is missing within the OECD (Stantcheva, 2022). In the absence of timely and granular data during the crisis, previous work has mostly used either microsimulation models to perform projections (Almeida et al., 2021; Brunori et al., 2021; Palomino et al., 2020) or provided short-term inference (Aspachs et al., 2022; Clark et al., 2021a, b). Little is known about the *ex post* total impact of COVID-19 and associated labor market policies.

This project aims to fill that gap by leveraging detailed household data for nuanced socio-demographic analyses, thereby enhancing our understanding of policy effectiveness, and informing strategies to bolster economic resilience. It builds on the team's results from the COVIVAT consortium on Belgian households⁵, as well as its empirical work on the causal impact of COVID-19 and government intervention on the Flemish and Belgian economy (e.g. Konings, Magerman and Van Esbroeck, 2023). As granular and recent data is now available, we will complement the earlier projections results with causal *ex post* analysis for income inequality and labor market outcomes, with a particular focus on entry and exit into the job market and job transitions (the "extensive margin"), as well as changes in wages and hours worked (the "intensive margin"), and this for detailed socio-demographic groups, including by gender, region, occupations, and education.⁶ This project will also provide a comprehensive overview of the changes in consumption and saving across the income distribution during and after COVID-19, using detailed data on households' consumptions and saving across various socio-demographic and geographic groups before, during and after COVID-19.

In Section 5, we will integrate the discussion from this section into our project's broader economic framework. We will explore how these micro-level dynamics interact with the production side of the economy,

⁴ Inflation started to pick up significantly over the second half of 2021 in Belgium, much before the invasion of Russia in Ukraine, which triggered the energy crisis and subsequent two-digit inflation numbers in 2022. Supply chain bottlenecks in 2020 and 2021 mostly arrived through mismatches of supply and demand for goods such as construction inputs during and right after the lockdowns due to increased demand on the one hand, and production and transportation constraints from the lockdowns and health impact of the virus on the other.

⁵ <https://sites.google.com/view/covivat/>

⁶ Another potential consequence of increased frictions in labor markets is a negative impact on productivity, both on the extensive margin, and the intensive margin. Studying these frictions is not possible in an *ex post* causal setup, as it requires taking a stance on what the optimal allocation, as well as the current level of misallocation is. This project will develop an integrated model of labor market outcomes along both the extensive and intensive margins and the impact of misallocation on productivity, and sectoral and aggregate employment, output, and inequality, discussed in Section 5.

and ultimately influence macroeconomic factors. Specifically, we will incorporate socio-demographic household heterogeneity in consumption and saving as key parameters within our integrated general equilibrium model, allowing us to simulate the economic impacts of COVID-19 across different socio-economic groups and sectors. This approach enables us to quantify the long-term effects of the pandemic and policy responses on the economy, focusing on labor market structure, income distribution, and sectoral shifts.

3. Businesses: survival, output, employment, and productivity

Firm responses to COVID-19

COVID-19's impact on the economy's production side has varied greatly. Some sectors, like accommodation, hospitality, culture, and entertainment, have been closed for extensive periods in 2020 and 2021, reducing their output and employment by up to 80-90% (Statbel, 2021). Other sectors, such as ICT and digital services were clear winners during the pandemic as many activities turned online, generating large positive growth rates in terms of both output and employment. Apart from sector-specific characteristics and evolutions, these outcomes can also be in part driven by demand side effects, as consumption patterns shifted towards essential goods during the lockdowns (Carvalho et al., 2021b), and the consumption of durables shot up afterwards, on top of potential supply chain disruptions throughout the pandemic.

Even within specific sectors, firm performances during the crisis have varied widely. It is well-documented that firms evolve over time in any period: even if *ex ante* conditions for firms are similar, and after controlling for time, location and industry differences, firm growth rates exhibit a large degree of heterogeneity (Ericson and Pakes, 1995). There is substantial simultaneous firm entry and exit (Dunne et al., 1988), and simultaneous job creation and destruction (Davis and Haltiwanger, 1992; Davis et al., 1996). Small, young, and/or less productive firms have significantly higher probabilities of exiting the market in any economic environment (Caves, 1998), and COVID-19 has had a larger impact on these firms, with evidence for Spain (Fernández-Cerezo et al., 2023), and more generally across 34 countries (Muzi et al., 2022).

Cros et al. (2021) use French firm-level data to show that the typical mechanisms triggering bankruptcy, such as low productivity and debt, also predict firm exit during COVID-19. Tielens et al. (2020) and Chundakkadan et al. (2022) study the impact of capital constraints on firm-level outcomes during COVID. Tielens and Piette (2022) find similar results for Belgium. Moreover, while the crisis reduced sales for 75% of firms, with often substantial losses, the remaining top 25% of firms performed at least as good as in normal times (Dhyne and Duprez, 2021).

The impact of policies on firm outcomes

A few papers have studied the impact of policy support on firm-level outcomes. Dvouletý et al. (2021) perform an EU cross-country meta-analysis of government support on firm outcomes and the process of creative destruction. They find that various flavors of government financial support measures increase firm survival, labor use, capital, sales, and/or firm productivity. Davies et al. (2023) find that support in the Netherlands reduced the overall exit rate of companies by 16% in 2020. Harasztosi et al. (2022) study the impact of support policies on firm outcomes across the EU and find that support was not tilted towards already weak firms before the crisis, but that low liquidity firms were more likely to be supported, which subsequently raised the likelihood of increasing their equity base. Hurley et al. (2021) study the uptake of government loans by UK SMEs.

However, government interventions might inadvertently slow the process of creative destruction, as infra-marginally productive firms remain in the market at the expense of resources that could have gone to more productive firms (Konings, Magerman and Van Esbroeck, 2023). As a result, such policies could unintentionally contribute to a further aggregate productivity slowdown already present in many EU countries (Andrews et al., 2016). Evaluating the impact of COVID and firm-level support measures on the process of creative destruction, Bighelli et al. (2021) use firm-level data for Croatia, Finland, Slovakia, and Slovenia, and show that government subsidies were distributed towards medium productive firms, and only marginally towards “zombie firms”. In contrast, Freeman et al. (2021) show that COVID-19 support measures such as furlough schemes, subsidies and tax deferrals in the Netherlands distorted the process of creative destruction. In Flanders, the share of supported firms that have a negative value added in 2019 is in fact lower (9%) than the share of firms with negative value added in the economy (14%) (Konings, Magerman and Van Esbroeck, 2023).

In Zegel et al. (2021), we study the impact of the VLAIO support mechanisms on survival and growth prospects of individual firms and aggregate output and provide a counterfactual analysis on these outcomes in the absence of VLAIO support. The suggestive impact is massive: in the absence of these firm-level support measures, Belgian GDP would have seen an additional decline of 6.5 billion euro in 2020.

The contributions of HAIOPOLICY

Similar to the discussion on household analysis in Section 2, this project aims to provide a comprehensive analysis on the impact of COVID-19 and related policies on the production side of the economy. There is quite some evidence on short-term outcomes for firm performance in Belgium. However, these analyses have been often restricted to 2020 or 2021, due to the late arrival of official firm statistics such as annual accounts. This makes it hard to evaluate whether the effects of COVID-19 and/or flanking policies are temporary or permanent. For example, while firm exits were historically low in 2020 and 2021 due to extensive moratoria on bankruptcies, they have in fact increased with 40% in 2022 and another 10% in 2023 (Statbel, 2024a). One of the contributions of this project is to evaluate the long-term *ex post* effects of both COVID-19 and related policies on firm survival and performance.

This part of the project builds on the team’s experience of studying the impact of COVID-19 on employment, productivity, output, using detailed firm-level data from the National Social Security Office and the National Bank of Belgium (Konings and Magerman, 2021), as well as the impact of firm-level subsidies on the probability of survival, employment, and productivity for Flanders (Koning, Magerman and Van Esbroeck, 2023).

To study the *ex ante* long-term effects and recovery policies, we leverage the team’s earlier work on impact analysis for COVID-19 policies, e.g. simulating the impact of the recovery program for Flanders across 180 projects allocated to various sectors of the economy in terms of output, value added, and employment, combined with information on detailed production and consumption chains for the Belgian Regions from the Multi-Regional Input-Output tables at the Federal Planning Bureau (Konings and Magerman, 2023). We will use simulation methods to project the various impacts in the long run across several types of policies, including the recovery policies targeted by the NextGenerationEU program.

This project will extend both the *ex post* and *ex ante* evaluations of COVID-19 and its supportive policies on the production side for Flanders to Wallonia and Belgium as a whole, conditional on access to the relevant data for their respective recovery programs. Regional differences in COVID-19 outcomes, production patterns, and implemented policies can further provide external validity to our earlier results, while potentially

uncovering differences in outcomes due to the specificities of the individual regions. These micro-level dynamics are important inputs into the quantitative framework discussed in Section 5, allowing to better understand the impact of COVID-19 and its policies on inequality and heterogeneity at the micro level, and GDP growth, employment, and productivity at the macro level.

4. Policy responses to COVID-19 in Belgium

Policy toolbox and budgetary environment

Belgium, like many advanced economies, used a mix of budgetary and liquidity instruments to mitigate the economic crisis's impact on households and businesses. In 2020, these support policies amounted to 4.9% of GDP, split across budgetary measures (4% of GDP) and liquidity measures (0.9%) (OECD, 2023). Budgetary policies such as grants, short-time work schemes, and waivers on social security contributions or taxes, affect the government's budget balance in the year they are implemented. Liquidity measures such as guarantees, loans, and tax deferrals, on the other hand, imply contingent liabilities that may affect the government fiscal position in subsequent years, depending on the beneficiaries' financial health (Haroutunian et al, 2021).

Employment support measures

During the pandemic, unemployment rates increased sharply from 4.9% in the second quarter of 2020 to 6.5% in the next quarter (Statbel, 2024b). At the peak of the crisis, over 1.2 million employees – about 25% of the working population – were protected through the federal temporary unemployment scheme (Loyen et al., 2020), and 95% of them only entered the scheme in March 2020 as a direct result of the pandemic. This scheme generally allows employers to transfer the costs of wages related to their employees to the federal government in the face of 'force majeure', enabling firms to reduce costs and better overcome a period of involuntary inactivity.⁷ Its importance during the pandemic cannot be understated: it commanded the largest share of all spending in budgetary measures in Belgium, reaching 2.3% of GDP⁸

From March 13, 2020 onwards, the existing scheme was extended to include 'force majeure' due to COVID-19, to support businesses, to limit the increase in unemployment, and to retain purchasing power of households as a result of the crisis and sanitary restrictions and lockdowns.⁹ The extension included a larger scope of eligibility in terms of types of employees (such as services through service vouchers), simplified procedures for faster turnover, and an increase from 65% to 70% of gross daily wage (capped at a maximum), plus a supplement of 5.63 euro per day. Moreover, eligibility was possible even if circumstances allowed employees to work some days, or partly from home (Loyen et al., 2020).¹⁰

However, coverage varied significantly across sectors. The most supported sectors were retail and wholesale, accounting for over one third of the total number of temporary unemployed. At a broader level,

⁷ Independents, students, flexi-jobs, seasonal workers, or statutory public servants are not covered by this framework.

⁸ In contrast to other countries like the US, Belgium did not issue direct consumption vouchers to support aggregate demand.

⁹ The scheme has been adapted several times during the crisis. On July 1, 2022, the extensions and arrangements related to COVID-19 were abolished, and the scheme transformed into additional support measures related to the war in Ukraine and the resulting energy crisis. See [Eurofound](#) for more information.

¹⁰ There is sizable variation across EU Member States in terms of the depth, scope, and coverage of temporary unemployment schemes (Dias da Silva et al., 2020). Moreover, while other economies such as the US mostly only provided partial support to workers that got laid off (Alcalá Kovalski and Scheiner, 2020), US unemployment rates returned to pre-pandemic levels very quickly (Bureau of Labor Statistics, 2023).

services accounted for half of the number of workers. While 41% of temporary unemployed are female, they tend to stay longer in the temporary unemployment scheme than men. The vast majority of workers under this scheme earns less than 3,000 euro gross per month. The coverage was also very different from that during the 2008-2009 financial crisis: at its peak in early 2009, there were around 280,000 employees under this scheme, or roughly one fourth of those during COVID. Moreover, while the financial crisis affected mostly manufacturing and construction sectors, the impact during COVID was predominantly on services. Finally, partly because of the sectoral differences, the share of women under this scheme was only around 20% during the financial crisis, compared to 41% during COVID-19 (Loyen et al., 2020).

For self-employed individuals, there was the extension of the bridging right, a Belgian income support program, by widening the criteria for eligibility, extending the maximum period of support, and allowing the concurrent collection of other social benefits. In April 2020, the bridging right covered more than half of all self-employed workers.

There is evidence that prices started to rise early during the pandemic, even if not covered by official consumer price indices (Jaravel and O'Connell, 2020). This is because official price indices do not measure current prices increases, but an average of price movements in the near past (Eeckhout, 2023). In Belgium, consumers are partly protected against price hikes by a mechanism of automatic indexation of wages, replacement incomes, and most benefits. Such a mechanism might be either pro-poor or pro-rich, depending on the consumption patterns of rich and poor and on which goods and services exactly caused the price indices to rise (Jaravel, 2021).

Firm support measures

To aid firms in covering unmet costs, Belgium provided a variety of supports, including subsidies and tax reliefs (Belgian Court of Audit, 2021; OECD, 2023). Sector-specific support measures were also implemented, including for personal care, culture, education, service voucher companies, social action, sports, and tourism. Businesses were also offered tax and contribution relief that added up to 0.6% of GDP, primarily in the form of VAT and social security contribution reductions, alongside tax exemptions for regional grants and miscellaneous contribution exemptions.

Several measures were also implemented at a regional level. Some of these include the Corona Hinder Premie and subsequent variants in Flanders (Konings, Magerman and Van Esbroeck, 2023), as well as tax deferrals (Brussels and Flanders), waivers for utility payments (Wallonia and Flanders), guarantees on bank loans, and easier access to credit (Flanders) (OECD, 2020; EU Committee of the Regions, 2020).

Between April 24, 2020 and January 31, 2021, the Belgian government also issued moratoria on bankruptcies. Any enterprise that was financially healthy before March 18, 2020 (i.e. faced no liquidity issues up to that date), was temporarily protected from its creditors. Courts would not trigger defaults in this case, except for fraudulent failures. *Ex post*, the number of bankruptcies in 2020 and 2021 are the lowest since the financial crisis in 2008 (Konings, Magerman and Van Esbroeck, 2023). However, after lifting these measures, exits went up by 40% in 2022 and by another 10% in 2023. While these recent trends might be convoluted by the more recent shocks of the war in Ukraine and the energy crisis, the total effect of this policy remains unknown.

Liquidity measures were also used to support businesses, but to a lesser extent than the budgetary measures (OECD, 2023). A state-guarantee scheme for loans was designed to split the risk between the federal state and the financial sector. The state would bear part of the losses over the lender's portfolio: the bank would bear the first 3% of losses, half of the losses between 3% and 5% would be covered by the

state, and 80% would be covered for losses above 5% (Freshfields, 2020). Despite this, the adoption of this support measure was limited, indicating that banks felt confident enough in the financial stability of potential or existing borrowers to extend loans outside the scope of the guarantee scheme (Tielens and Piette, 2022).

The liquidity of firms was also supported by a corporate debt moratorium, which permitted borrowers to negotiate a six-month postponement of principal repayments with their institutional lenders, provided they met several criteria. These included having no outstanding debt or social security contribution arrears before the crisis and experiencing a significant loss in turnover due to the pandemic. State loans were also granted to firms, targeted primarily to airlines and other travel-related sectors especially hit by the pandemic.

Even though the COVID-19 pandemic had a similar impact on businesses throughout Belgium, the distribution of competencies between the federal and federated levels of government created a situation where the accessibility of support measures differed, depending on the geographical location or language community of the firms (OECD, 2023). For instance, the provision of direct and loan support to firms varied in terms of generosity, design, and implementation.

Global value chain policies

While the focus of the project is on the impact of regional and federal policies, we also discuss potential supra-national policies. These policies are not decided at the level of Belgian governments, but nevertheless can have a significant impact on production, trade, and consumption patterns in Belgium. Moreover, we will draw extensively from some of the toolboxes and datasets in this field, including some workhorse models, tools for welfare analysis, and input-output models and datasets.

The literature on global value chains has exploded thanks to the availability of various sources of input-output data and the development of structural frameworks. Many papers have analyzed supply chains from different points of view: offshoring decisions (Grossman and Rossi-Hansberg, 2008; Baldwin and Venables, 2013), trade flows and their value added component (Johnson and Noguera, 2012; Koopman et al., 2014), the positioning of countries and industries in global supply chains (Antràs and Chor, 2018; Alfaro et al., 2019) or their geography (Antràs and De Gortari, 2020).

Progress on the theoretical side on quantitative general equilibrium models of trade, reviewed by Costinot and Rodriguez-Clare (2014), made it possible to analyze the effects of trade liberalization on several macroeconomic outcomes, such as welfare (Caliendo and Parro, 2015), labor market dynamics (Caliendo et al., 2019), and inequality (Galle et al., 2023). After several negative global economic events, the focus of the academic literature has shifted from examining the benefits of supply chains to examining the potential risks and vulnerabilities. Eppinger et al. (2021) use a quantitative trade model to evaluate the impact of de-linking from global supply chains by simulating a trade shock. Similarly, Bonadio et al. (2021) examine the propagation of supply shocks caused by the COVID-19 pandemic along supply chains.

A key component of industrial policies are 'place-based' policies. Going back to at least Marshall (1890), ephemeral externalities drive the location and organization of production and consumption. Since Krugman (1991), the role of agglomeration economies in creating disparities among regions has been intensely discussed. However, these models were hard to take the data due to multiplicity of equilibria and the absence of detailed regional information. The advent of new quantitative trade models (among others, based on the work of Eaton and Kortum, 2002) allowed research in economic geography to test new models with the newly available data. Recent studies in this field estimate the impact of various shocks on the regional distribution of economic activity, e.g. productivity shocks (Caliendo et al., 2018), change in tax rates (Fajgelbaum et al.,

2019), investments in transport infrastructures (Fajgelbaum and Gaubert, 2020), environmental policies (Conte et al., 2022) and global warming (Cruz and Rossi-Hansberg, 2021).

The contributions of HAIOPOLICY

It is undeniable that the various support measures on both the worker and enterprise sides have avoided much worse during the crisis. However, even though there is some evidence on the impact of some of these policies, causal evidence on the full extent of their effectiveness and efficiency is lacking (OECD, 2023). Moreover, little is known about the balance between their budgetary costs and socio-economic benefits. Additionally, differences between the financial crisis of 2008-2009 and the COVID-19 pandemic in terms of size, demographics, gender and sectoral impacts point to the fact that each crisis can hit differently, and that it is dangerous to 'prepare for the last crisis'.

While there is recent work on several types of policy in production networks that allow for targeted intervention (Caliendo et al., 2018; Liu, 2019; Rubbo, 2023), these frameworks are often restricted to perfect competition. In this context, Konings and Magerman (2023) have simulated the impact of Vlaamse Veerkracht on output and labor outcomes. See e.g. Lashkaripour and Lugovskyy (2023) for a model to study optimal trade policy under monopolistic competition. Finally, while shielding both workers and firms from labor market imbalances and increasing firm survival in the short run, such policies do not target underlying structural issues related to the labor markets and might actually increase labor market frictions (see Section 2).

We will conduct extensive *ex post* econometric analyses of policies on both production and household sides, at the federal and regional levels where applicable. This work broadly extends our earlier work for VLAIO support measures for firms in Flanders to similar measures in the other regions and the federal level. For example, we will estimate causal effects of the job retention schemes (i.e., temporary unemployment scheme, bridging right scheme) on hours worked, unemployment, and income inequality on the household side, as well as on firm survival, growth, and productivity on the business side.

Furthermore, we will provide a basis for a discussion on temporary versus structural issues on both labor market and firm market sides. Available evidence suggests that short-time work policies are generally efficient in supporting employment in face of temporary shocks but may slowdown reallocation of workers towards more productive job matches (Giupponi et al, 2022). Whether this effect was significant is an open question and studying it involves knowing the current pre-crisis worker-firm match quality and the optimal one. By using the general equilibrium framework described in Section 5, this project also analyzes the potential long-run effects of these policies, i.e., their impact on labor misallocation, sectoral and aggregate productivity, output, and real income inequality.

5. A quantitative framework

Firms and micro-to-macro outcomes

Economists have long considered that shocks to individual firms do not matter for aggregate outcomes (Lucas, 1977). However, under the empirically relevant observation that the firm size distribution is highly skewed with many small firms and few large ones, idiosyncratic shocks to important firms do not average out in the aggregate but can contribute to booms and busts of the economy (Gabaix, 2011). This

phenomenon, known as 'granularity', challenges the predictions of conventional macro-economic models and forces us to study the micro level of production to understand macro-economic outcomes.¹¹

One of the mechanisms to explain this granularity is the notion that shocks can propagate through production networks. For example, significant reductions in one sector or firm (such as the 90% drop in sales in prolonged closed sectors like hospitality, accommodation, and the arts) can trigger losses in other sectors or firms through supply chain relationships and inter-sectoral dependencies, ultimately also cascading into aggregate losses.

In a class of models with perfect competition and no frictions, firm size, expressed as its Domar weight (defined as sales revenues over GDP, see Domar, 1961; Hulten, 1978; Gabaix, 2011; Acemoglu et al., 2012; Carvalho, 2014; Carvalho and Tahbaz-Salehi, 2019; Carvalho et al., 2021a), is the relevant statistic to evaluate the firm's importance in aggregate outcomes. However, this simple sufficient statistic breaks down with frictions (Bigio and La'O, 2020), when considering the impact of shocks up to second order (Baqae and Farhi, 2019), and more generally in economies with imperfect competition (Baqae and Farhi, 2020). These results also fail in open economies (di Giovanni et al., 2014, 2017; Baqae and Farhi, 2024). Moreover, local shocks can have intra-regional, inter-regional, and international spillovers (Bernon, Magerman and Palazzolo, 2024). Fortunately, it turns out that in these alternative specifications, objects like the Leontief inverse (the inverse of the unit matrix minus the input-output coefficient matrix, see Leontief, 1936), and the Domar weights remain key building blocks to study micro-to-macro behavior and exposure to shocks (Baqae and Farhi, 2020; Bernon, Magerman and Palazzolo, 2024).

Firms, competitiveness and level playing fields

Large firms often have a dominant market position, and these 'superstar' firms are becoming increasingly dominant, leading to higher market concentration and a lower labor share of value-added (Autor et al., 2020), even in Belgium (Dhyne et al., 2022; Amity et al., 2023a, b). Evidence suggests that these phenomena are taking place in the manufacturing and wholesale and retail sectors in Belgium, which constitute approximately half of Belgian GDP (Abraham and Bormans, 2020). In addition, locally dominant firms (not necessarily the largest ones) explain a significant portion of macroeconomic fluctuations (Jannati et al., 2020). These recent insights demonstrate why it is important to know which firms and sectors are facing shocks and which of them are benefitting from any recovery or support program as this will define any possible spillover effects propagating through the economy (Allen and Arkolakis, 2014, Caliendo and Parro, 2015; Flynn et al., 2022).

These findings are in line with results on increasing inequality across firms (De Loecker et al., 2020). In the US, aggregate markups are increasing over time, and market shares are reallocated towards higher-markup firms. Often, these firms also have market power on the input side (markdowns), pushing down prices for labor (wages) and inputs below the competitive levels (Morlacco, 2020; Rubens, 2023; Brooks et al., 2021).

These correlated observations endanger the adage of a "level playing field" of competition that the European Commission envisions and mitigate the rewards for workers below their marginal product of labor, while raising production and consumption prices above competitive levels. Therefore, there might be room for welfare-improving policies targeting the production side of the economy. For example, Liu (2019) studies

¹¹ It is not necessarily the size of the shocks that affect aggregate outcomes, but the skewness of the firm size distribution. In other words, even small shocks can have large outcomes.

the role industrial policy plays in production networks with distortions and finds that subsidizing upstream sectors can lead to positive aggregate effects on the economy.

The contributions of HAIOPOLICY

Despite a growing body of research on the impact of economic shocks on the production outcomes at both micro- and macro-economic levels, very little is known about the complex interaction between demand shocks (Section 2) and supply shocks (Section 3) on economic outcomes.¹² Nothing is known about the quantitative impact for Belgium. Moreover, households are not only consumers, but they also provide inputs into the production of the economy. Both supply and demand shocks can thus affect production and consumption in complex ways, which have not been considered up to now in this class of quantitative general equilibrium models.

One of the main goals of this project is to construct a quantitative framework of how large shocks such as COVID-19 can affect production and consumption outcomes as described above. The framework will contain heterogeneous agents on both the production and consumption sides, multiple sectors and regions, labor market frictions, imperfect competition, and a toolbox of potential policies to evaluate at both the micro and macro levels. The framework will allow for spillovers between production and consumption. For example, industry closures trigger a drop in labor demand. Even with massive support measures such as the temporary unemployment scheme, (real) wages drop and disposable income goes down. These effects can be highly heterogeneous across sectors, types of firms, types of workers, and their regional and socio-demographic characteristics. Moreover, these effects are not confined to the initial sectors or firms but can cascade throughout the economy via supply linkages and sectoral dependencies. These in turn, imply that a shock in one remote part of the production side of the economy can have significant effects on another part at the consumption side, which can trigger effects again in different parts of the production side of the economy, as saving and consumption patterns change, and so on.

On the consumption side, this work builds on recent work on poor and wealthy hand-to-mouth consumers and their differences in the marginal propensity to consume (Kaplan et al., 2014; Cherchye et al., 2023). On the production side, we focus on the role of, and shocks to, supply chains (Baqae, 2018; Baqae and Farhi, 2019, 2020a,b; Bernard et al., 2022; Kikkawa et al., 2022).

This framework serves multiple purposes. First, it allows for a detailed and up to date quantitative model of the Belgian economy with its three Regions, and its exposure to shocks on both the production and consumption sides. The results of Section 2 and Section 3 serve as an input to calibrate this framework at a very detailed level. Second, the framework aims to model direct and indirect exposures to large shocks that can arrive through both the production and consumption sides, and, through input-output linkages, affect more distant parts of the economy, be it in terms of sectoral distance or geography. Third, this detailed framework allows to both (i) evaluate direct and indirect effects of COVID-19 and various related policies *ex post*, and (ii) *ex ante* simulate a battery of various potential policies, discussed in Section 4. Finally, it provides a benchmark for the optimality of potential policies (first best), or implementation of these policies under constraints (second or third best).

Building on a recent literature that measures unequal welfare gains from trade (Fajgelbaum and Khandelwal, 2016; Borusyak and Javelle, 2021), this project will also study the consumption inequality in

¹² See Baqae and Farhi (2021) for a Keynesian model applied to COVID-19.

Belgium stemming from heterogeneous price and quantity changes of imported products during and after the COVID-19 shock. Standard measures such as the Consumption Price Index (CPI) do not capture heterogeneity in socio-demographic prices that households face. One key innovation is to embed new price aggregators that allow to measure these differences (e.g. Fally, 2022; Atkin et al., 2024; Matsuyama and Ushchev, 2023). The observed changes in the patterns of trade (extensive margin) and levels of trade (intensive margin) may have resulted from the supply chains bottlenecks observed during and after COVID-19 crisis. These effects may be particularly important in Belgium, which is a very open economy.

6. Optimal policies

Taking stock

The combined output from the previous sections allows to develop evidence-based policy recommendations on how to protect vulnerable groups (both on the business and household sides of the economy), as well as reorganize our economies to become more resilient to similar future large and unanticipated shocks. Sections 2 and 3 contribute to an *ex post* causal analysis of COVID-19 and resulting policies, allowing to isolate, and quantitatively evaluate, the impact of the virus and issued emergency and recovery policies on many socio-economic outcomes, keeping everything else fixed. The framework of Section 5 allows to further study the direct and indirect effects of these policies through multiple layers of production and consumption heterogeneity. It also allows to simulate the socio-economic impact of various policies that might be implemented. Moreover, such a framework allows to evaluate the (non-)optimality of policies given some chosen policy objectives. That is the focus of this Section.

The impact of COVID-19 on socio-economic outcomes

Reports compiled or commanded by international institutions (e.g. Batista et al., 2021, Eurofund, 2023) as well as academic papers contain a substantial body of evidence on the socio-economic impact of COVID-19 and the policies to combat it (e.g. Almeida et al., 2021, Béland et al., 2021, Deaton, 2021, Ferreira et al., 2021, Stantcheva, 2022, Chetty et al., 2023). Some of the academic papers try to meticulously disentangle the policy effect from behavioral reactions to the spread of the virus (e.g. Kong and Prinz, 2020, Goolsbee and Syverson, 2020, Pangallo et al., 2023). Others concentrate on one particular dimension, such as consumption (Cox et al., 2020, Chen et al., 2021), labor market (Cassarico and Lattanzio, 2022), or income (Almeida et al., 2021), usually giving detailed evidence, but limited to particular case studies. On the contrary, Béland et al. (2021), Deaton (2021) and Ferreira et al. (2021) gather evidence from a large set of countries attempting to make some cross country comparisons.

There is little controversy about the fact that the health crisis hit richer countries more severely, irrespective of how health is measured (mortality or excess mortality rates, value of statistical life (years), quality adjusted life years, ...). The usual explanation is that the richer countries are more densely populated by groups especially vulnerable to the virus, and with a higher risk to develop more serious symptoms of the disease, such as older and obese people. There is less unanimity about which countries bore the highest income shock and rankings may depend on how the impact is measured. Ferreira et al. (2021), who collect data 145 countries, covering 96% of the world population, measure this impact by the additional number of years people live in poverty due to the income shock. Depending on whether one uses a common poverty line or a higher poverty line for richer countries, poorer countries face either a higher income shock, or there

is no relation with GDP per capita. Deaton (2021), covering 169 countries, on the contrary looks at (expected) loss in GDP per capita and find that richer countries faced not only a higher health impact but also faced a higher income shock.

The income shock is a consequence of different factors, such as health, non-pharmaceutical interventions to combat the health crisis (lockdowns, social distancing, ...) and government support to alleviate the consequences of the non-pharmaceutical interventions. Béland et al (2021) report a moderate increase in unemployment in all OECD countries plus China, except for Canada and the US, who are facing a spike in unemployment from 3.8% to 13%, and from 6.3% to 13%, respectively, in the second quarter of 2020. They warn though that standard definitions of unemployment are hard to maintain because of the massive intervention through job retention schemes in those countries. More generally, all of these studies warn about possible measurement errors in the data, e.g. developing countries having less reliable recording of COVID-19 casualties.

Most of the comparative studies lack information on within-country distribution of the shock, and sometimes data at the macro-level hide a lot of heterogeneity at the micro-level. Belgium is an interesting case, as it is one of the countries with largest health impact of the pandemic (both in terms of lost life years and mortality rates). However, Decoster et al. (2021) show that there was no excess mortality among the people aged 40 to 64. Among the elderly living in homes, there is no clear income gradient in mortality rates, neither in excess mortality rates. Reversely, there is a clear income gradient in mortality (lower mortality for richer people) among both the people aged 40 to 64 and those aged over 65 not living in homes. But as there is no excess mortality among the first group, the income gradient is not changed due to COVID-19. On the contrary, there is a clear income gradient in mortality rates for individuals aged 65 or more, and this income gradient has become steeper during the COVID-19 crisis.

Quantifying the socio-economic effects of a non-economic shock

The evaluation of non-pharmaceutical interventions such as lockdowns and social distancing and the accompanying government support measures, poses three challenges. First, while there is a large consensus that there is an impact of lockdowns and social distancing on the spread of the virus, there is less unanimity about how to quantify these effects, neither in terms of their health, nor in terms of the economic cost of the interventions. Even though this is a purely factual question, one cannot expect an easy consensus on the answer. Therefore, any analysis of these interventions should always explicitly state the assumptions driving the precise quantifications of these different dimensions.

Second, there is the normative trade-off between health and economic welfare. How much income or consumption one wants to give up in order to gain an additional improvement in health is the criterion in the light of which policies should be evaluated. Even though this is a normative question, and therefore its answer is to be determined by policymakers, economics can provide tools which allow to get better insights in the precise nature of this trade off. In that respect, Adler et al. (2020) argue that one should consider the distributional impact of both the health crisis and the policy interventions. An additional year of life (in good health) or an additional euro for the least well-off is worth more than the same improvement for the better-off.

Finally, not only politicians might have different opinions about how much an improvement in health may cost in economic terms, but also individuals have widely different opinions on this question. The contestation of the confinement rules among some groups of the population in some countries may testify of this divergent opinions. The easy reply may be that these people do not rightly consider the externalities their own choices

would cause, and that therefore public intervention under the form of mandatory restricting social contacts may be warranted from a purely public economic point of view. However, some studies document the psychological impact of social distancing (on the distress of working from home see e.g. Schifano et al., 2023, and more general on the lock down policies, Hamermesh, 2020).

Whether this should be considered in the evaluation of policy interventions is up for discussion, but an extension of the normative framework proposed by Adler et al. (2020) allows to take this dimension into account. They measure individual well-being as the amount of (yearly) income needed when living a fixed number of years in good health, so as to be equally well off as in the actual situation, a measure which is labeled 'equivalent income'.¹³ Societal well-being is then the level of equivalent income such that, if obtained by all individuals in society, would yield an equal amount of social welfare as the actual (unequal) distribution of equivalent incomes. Integrating the effect of social distancing is then, at least in theory, relatively straightforward, by considering the equivalent income to be that income needed to live a fixed number of years in good health and with a given reference level of social contacts, so that one would be equally well-off as in the actual situation.

The contributions of HAIOPOLICY

There are several ways to develop a framework to evaluate the efficiency, optimality, and/or fairness of suggested or implemented policies. However, this optimal policy implies a strong normative stance on how much policy makers and society as a whole value particular elements in their society. For example, how much do we balance productive and allocative efficiency with inequality? How much do we weigh the changes in outcomes of individual socio-demographic groups in response to a shock and/or policy? For this part, it is crucial that HAIOPOLICY develops a broad and deep discussion with the various stakeholders and policy makers.

¹³ This is not a factual question, but instead depends on an individual's relative intensity of preferences for health versus material welfare (income or consumption).

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