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The COVID-19 Resilience of a Continental Welfare Regime - Nowcasting the Distributional Impact of the Crisis*

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Abstract

We evaluate the Covid-19 resilience of a Continental welfare regime by nowcasting the implications of the shock and its associated policy responses on the distribution of household incomes. Our approach relies on a dynamic microsimulation approach that combines a household income generation model estimated on the latest EU-SILC wave with novel nowcasting techniques to calibrate the simulations using external macro controls reflecting the macroeconomic climate during the crisis. We focus on Luxembourg, a country that introduced minor tweaks to the existing tax-benefit system which already contained instruments with a strong social insurance focus that gave certainty during the crisis. The income-support policy changes were effective in cushioning household incomes and mitigating an increase in income inequality in the early stages of the pandemic. The share of labour incomes dropped, but was compensated by an increase in benefits, reflecting the cushioning effect of the transfer system. Overall market incomes dropped and became more unequal. Their disequalizing evolution was, however, overpowered by an increase in tax-benefit redistribution. Net redistribution increased, driven by an increase in the generosity of benefits and larger access to benefits. These changes are mainly explained by the labour market shock, signalling the automatic stabilizers embedded in the pre-COVID system. The system was well-equipped ahead of the crisis to cushion household incomes against job losses. The methodology is scalable to other countries and well-designed to explore the impact of later stages in the COVID crisis, both economy-wide and sector-specific. The model is a real-time analysis and decision support tool to monitor the recovery, with high applicability for policymakers.

Keywords: COVID-19, nowcasting, microsimulation, income inequality, tax-benefit policy

JEL Codes: D31,H23,J21,J22,J31

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1 Introduction

The novel coronavirus, which was first identified in China in December 2019 and spread to Europe in February 2020, forced governments of many countries to undertake unprecedented measures directed at containing the pandemic. To limit the spread of the virus, in March 2020, most European countries introduced full or partial lockdowns involving travel restrictions, school and workplace closings, bans on public events, restrictions on gatherings, 'stay at home' requirements and other interventions limiting people's movements and social interactions (Hale et al., 2020).

These containment measures resulted in a wide range of adverse economic consequences in many countries. On the one hand, business closures and travel restrictions forced many companies to scale down their activities disrupting national and international supply chains, producing a steady decline in the aggregate supply (Figari and Fiorio, 2020; OECD, 2020). On the other hand, 'stay at home' policies, economic uncertainty, and higher risks of contracting the virus induced a decline in the consumption of certain goods and services, such as transportation, clothing, dining, or entertainment items (Chetty et al., 2020; Coffey et al., 2020; Coibion et al., 2020). Taken together, the aggregate supply and demand shocks led to a persistent recession (Eichenbaum et al., 2020), which by its scope is expected to outweigh the Great Recession of 2008. According to the Organization for Economic Co-operation and development (OECD), the decline in the level of output in many countries may reach between 20 and 25 percent (OECD, 2020).

An immediate question that arises is how the macroeconomic shock related to COVID-19 has affected the distribution of household equivalized disposable incomes at the onset of the virus outbreak. As businesses lose their revenue, they pass the incidence of the shock to their employees by reducing wages, decreasing working hours or even turning to dismissals (Salgado et al., 2014; Chetty et al., 2020). The implications of these negative labour market shocks for household incomes, however, remain unclear since they largely depend on the asymmetry of the crisis and the governmental responses to it. As highlighted by Celi et al. (2020), despite being "symmetric in its very nature", the Covid-19 shock is affecting European economies in a very asymmetric way.

Early research on the economic consequences of Covid-19 reveals that employment losses were the highest for workers employed in the industries or occupations, where the jobs could not be conducted remotely, such as the hospitality, retail, manufacturing, and entertainment sectors (Adams-Prassl et al., 2020; Angelucci et al., 2020; WorldBank, 2020). As a result, countries where such sectors are more prevalent experienced higher employment losses and drops in market incomes than their counterparts with smaller shares of these sectors.[1]

To compensate (at least partially) for income losses, the governments of many countries introduced complementary income support programs, such as short-term unemployment schemes, special leave schemes, and direct cash payments (see, among other, Brewer and Tasseva, 2020; Figari and Fiorio, 2020; Li et al., 2020b; O'Donoghue et al., 2020). While some countries had to introduce radically different policies from their existing systems (e.g. Ireland, UK, Italy, Australia) in order to cope with the COVID-19 crisis, other countries moved swiftly by minor changes in exiting policy instruments able to cope with the shock. Luxembourg is one such example. It is one of the richest countries in the world with well-established fiscal and social policy instruments and regulators, which showed themselves efficient in mitigating the impacts of previous crises on the economy in general and on welfare of individuals in particular (Dolls et al., 2012; Paulus and Tasseva, 2020). The presence of these instruments and the availability of financial resources create strong economic and legislative prerequisites for a fast policy response during the COVID-19 pandemic.

Our objective is to assess the impact of the COVID-19 crisis and the associated policy

[1] For example, at the pick of the first wave of the crisis, the decline in average market incomes in Italy was estimated at 32.7 percent (Figari and Fiorio, 2020) whereas in the UK the decline was around 22 percent (Brewer and Tasseva, 2020).

responses on the distribution of household incomes in Luxembourg in the first months following the lockdown (between April and June 2020). Apart from estimating the change in the entire distribution of household incomes, we disaggregate income into separate components and explore in which of them shifts were more or less equalizing/dis-equalizing. Given that the impact of the COVID-19 crisis appears to be highly asymmetrical affecting some sectors more than others (Adams-Prassl et al., 2020; Angelucci et al., 2020; Glover et al., 2020; WorldBank, 2020), the sectoral composition of the economy in Luxembourg allows us to capture a new angle in the heterogeneity of the shock.

The economy is dominated by the tertiary sector, where the financial sector constitutes the most important pillar of the economy, accounting for more than 25 percent of GDP per year (OECD, 2019). It also serves as an employer for the largest portion of the workforce (11.4%) with another 27.3% being involved in professional, scientific, and technical activities, working in education or public administration (above the EU-27 averages).[2] Employees in these sectors are more likely to be able to work from home as compared to other sectors (Adams-Prassl et al., 2020; Brynjolfsson et al., 2020; Dingel and Neiman, 2020) and the consumption of their services did not decrease much during the COVID-19 crisis (Chetty et al., 2020).[3] Therefore the impact of the COVID-19 crisis on individual employment, market and disposable incomes is expected to be smaller in Luxembourg as compared to other economies which rely heavily on sectors with limited possibilities for remote work (e.g. manufacturing) or close interpersonal contacts (e.g. hospitality and tourism).[4]

Luxembourg's fast reaction to the COVID-19 outbreak and its management of the crisis attracted international recognition. The first infected person in the country was registered on February 29.[5] On March 16, with 81 officially confirmed cases, the government introduced a full lockdown closing all educational facilities, non-essential shops and businesses, cancelling public events and restricting public gatherings.[6] Due to those measures, Luxembourg managed to avoid a severe outbreak of COVID-19 in spring and early summer with the situation somewhat worsening from the second half of July onwards. In addition to a quick reaction during the first wave of the COVID-19 outbreak, the government also introduced a large-scale testing strategy, which made Luxembourg the global leader in the number of COVID-19 tests performed per 1000 residents. One of the main objectives of this strategy was to provide the government with an up-to-date picture of the pandemic situation in order to enable a timely policy response.[7]

The main challenge in assessing the immediate impact of the COVID-19 pandemic on individuals' incomes and welfare lies in the availability of data. Large-scale representative surveys on income and living conditions, which are typically used for the distributional analysis, become available with a one- or two-year delay. When a sudden economic shock hits, these data become obsolete. Governments, however, need the knowledge of the real-time income situation of individuals at the moment of the crisis (Jenkins et al., 2012; Salgado et al., 2014; Chetty et al., 2020). We overcome this challenge by applying a nowcasting approach based on dynamic microsimulation using up-to-date official statistics on the shifts in sectoral employment

[2]These statistics are taken from //statistiques.public.lu/en/index.html.

[3]Around 52 percent of employees were exercising teleworking in the second quarter of 2020 (STATEC, 2020).

[4]The impact of the COVID-19 crisis on the financial and banking sectors, however, remains unclear. Giese and Haldane (2020) emphasize that during the current crisis banks serve as 'part of the solution, rather than part of the problem' as they used to be during the Great Recession. Demirguc-Kunt et al. (2020), however, argue that banking systems under significant stress during the COVID-19 crisis faced declines in their stock returns. OxfordEconomics (2020) also considers the possibility of an intensification of the financial crisis in the future if the recession deepens.

[5]See RTL Today - Man quarantined in CHL: First case of coronavirus confirmed in Luxembourg, Charleroi Airport increasing precautionary measures. Extracted from https://today.rtl.lu/news/luxembourg/a/1476925.html on December 3, 2020.

[6]See RTL Today - All bars and restaurants to close, 81 confirmed cases. Extracted from https://today.rtl.lu/news/luxembourg/a/1483941.html on December 3, 2020.

[7]Recent research has also shown that fiscal, macroeconomic, and health benefits of widespread COVID-19 testing programs far exceed their costs (Atkenson et al., 2020).

and tax-benefit policies. These are used to calibrate the simulations from a household income generation model (see Sologon et al. 2020) estimated on the latest available survey data from the European Union Statistics on Living Conditions (EU-SILC). Following the calibration approach of Li and O'Donoghue (2014), we align household incomes with the current macroeconomic situation, similarly to O'Donoghue et al. (2020). We then use this data to analyse the impact of the COVID-19 crisis on individual incomes and welfare in the period between the first and the second quarter of 2020.

Our paper contributes to an increasing literature on the economic consequences of the COVID-19 pandemic for the welfare of individuals and the households they live in. Among the studies on the distributional consequences of the crisis we mention Brewer and Gardiner (2020) and Brewer and Tasseva (2020) in the UK, Beirne et al. (2020) and O'Donoghue et al. (2020) in Ireland, Figari and Fiorio (2020) in Italy, and Li et al. (2020b) in Australia. In Italy and the UK, despite the presence of automatic stabilizers and the introduction of new policy instruments, the findings document an increase in inequality in household disposable incomes during the first months of the COVID-19 outbreak. In contrast, in Australia and Ireland, the introduction of income support programs in response to the crisis prevented a drop in household disposable incomes at the bottom of the distribution, which, in combination with the suppressed incomes at the top of the distribution, led to a decline in inequality. Based of the design of their tax-benefit systems, these countries belong to the Anglo-Saxon (Australia, Ireland, UK) and Mediterranean (Italy) welfare regimes. The former focuses on helping the poor whereas the latter puts the family at the centre of welfare provision leaving only a limited role for the state (Esping-Andersen, 1990; Ferrera, 1996). Luxembourg, in contrast, belongs to the Continental welfare regime, which relies on insurance-based income support programs aiming to secure individuals from income losses in the case of exogenous shocks (e.g. unemployment) or life events (e.g. retirement). The role of such programs is crucial in times of crises, when many individuals lose their jobs or are forced to reduce their working hours.

On the methodological side, we are proposing an infrastructures which is well-designed to explore the impact of later stages in the COVID crisis, both economy-wide and sector-specific. The model is a real-time analysis and decision support tool to monitor the recovery, with high applicability for policymakers. In addition, the infrastructure is scalable to other countries as it relies on a flexible income generation model, on comparative cross-national survey data and macro alignment statistics, and the pan-European tax-benefit model, EUROMOD, enhancing its applicability and policy relevance.

2 Macroeconomic background

The first person infected with COVID-19 was registered in Luxembourg on February 29. Within the two subsequent weeks, the number of infected individuals increased to 81, raising concerns that the situation might get out of control. In response to those concerns, the government introduced a set of lock-down measures from March 16, closing all educational facilities and non-essential businesses, encouraging remote work whenever possible, restricting gatherings, and limiting national and international travel. The measures started being lifted from April 20, with the construction sector and all related businesses coming back to work first. The gradual exit plan lasted until mid-July, when most of the restrictions were abolished except of the ban for large public gatherings and maintenance of sanitary measures.

Following the lock-down measures introduced in Luxembourg and the developments of the COVID-19 pandemic around the world, Luxembourg's economy shrank by 7.8 percent in the second quarter of 2020 as compared to the analogous period in the previous year (Figure 1). This was the largest decline in the country's quarterly GDP growth rates over recent decades, exceeding the size of the GDP decline that took place during the Great Recession of 2008/2009.

Similarly to other countries, a drastic decline in GDP growth rates was accompanied by an

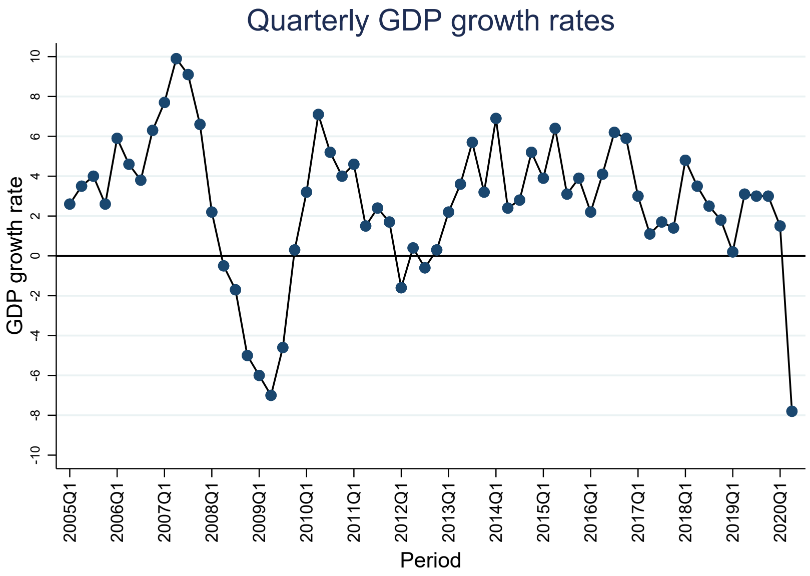


Figure 1: Percentage growth of GDP in market prices (one quarter compared to the same quarter in the previous year)
Note: Extracted from https://statistiques.public.lu/en/index.html on December 3, 2020.

increase in unemployment (Figure 2). The unemployment rate rose in Luxembourg between February and March, hit its highest level in April, and started slowly decreasing afterwards. By the end of September, however, it was still more than 1 percentage point higher as compared to the pre-crisis level.

In addition to the increase in the percentage of workers who lost their jobs, a substantial portion of employees were forced into short-term unemployment. Table 1 shows that almost 34 percent of employed individuals residing in Luxembourg were on short-term unemployment in April 2020. The number decreased following the gradual de-confinement and reached 9.5 percent in June. The highest shares of employees put on the short-term unemployment scheme in April 2020 were in the construction, hospitality, and wholesale and retail trade sectors (86.6, 83.9, and 52.9 percent accordingly). These are the sectors with typically limited possibilities for work from home (Dingel and Neiman, 2020), which were forced to shut down following the restrictions introduced in March. In contrast, there was no move to short-term unemployment in the public administration sector and it was extremely limited in other brunches of the service sector (i.e. financial services, education, health, and social work). Table 1 further shows that the activities of the majority of the sectors resumed in May and June, with the exception of the hospitality sector, where around 60.5 percent of employees were still on short-term unemployment in June.

Figure 2: Evolution of the monthly unemployment rate, all industries
Note: Extracted from https://statistiques.public.lu/en/index.html on December 3, 2020.

Table 1: Percentage of employees benefiting from the short-term unemployment scheme among the total number of employees residing in Luxembourg, by industry

Industry	Percentage of workers on short-term unemployment		
	April 2020	May 2020	June 2020
Agriculture, forestry, fishery	23.5	5.8	1.7
Manufacturing, mining, quarrying and turf production, electricity, gas and water supply	49.1	22.2	17.1
Construction	86.6	9.3	5.2
Wholesale and retail	52.9	26.9	17.8
Hotels and restaurants	83.9	70.3	60.5
Transport and communication	23.4	15.2	11.6
Financial intermediation	0.4	0.3	0.2
Real estate and business	31.2	15.5	10.8
Public administration and defence	0	0	0
Education	12.5	8.5	6.4
Health and social work	6.1	2.4	1.3
Other	29.3	22.9	18.2
Total	33.7	14.8	9.5

Note: Data provided by Statec.

Table 2: Policy instruments activated to stabilize the economic situation and cushion individual incomes

Policy instrument	Description	Beneficiaries
Economic Stabilization Program - March 18th		
Short-term unemployment scheme (chômage partiel en cas de force majeure)	The State takes over 80% of the remuneration costs of employees (permanent contracts, fixed-term contracts, apprenticeships) who had to temporary reduce their working hours, up to a maximum of 2.5 the social minimum wage for an unskilled worker (5354,975 Euros)	Startups/SME/large enterprises/non-for-profit organizations
Special family leave	The state overtakes 100% of the remuneration costs of employees who had to interrupt their work to guard children under 13 due to the closure of educational establishments	Employees/self-employed
Special sick leave	National Health Fund (CNS) overtakes 100% of the remuneration costs for individuals who got sick with COVID-19 from the first day of their illness	SME/self-employed, large enterprises
Néistart Lëtzebuerg/ Economic Recovery Plan - June until December 1st		
Progressive transition from chômage partiel en cas de force majeure to chômage partiel structurel	The objective is to continue supporting businesses previously benefiting from chômage partiel en cas de force majeure. The State takes over 80% of the remuneration costs of employees (permanent contracts, fixed-term contracts, apprenticeships) who had to temporary reduce their working hours, up to a maximum of 2.5x the social minimum wage. The government also introduced a simplified access for businesses operating in vulnerable sectors.	Businesses that benefited from chômage partiel en cas de force majeure
Extension of the special family leave	Equivalent to medical leave, replacing 100% of salary normally received for hours covered. The leave is provided to guard children (under 18) placed under quarantine or in isolation.	Employees/Self-employed/public officials
One-off 50 Euros voucher	A voucher for an overnight stay in a hotel or other accommodation in Luxembourg	Each resident older than 16 years and cross-border workers working in Luxembourg
Expensive life allowance (allocation de vie chère)	Doubling of the expensive life allowance, from a monthly amount of 110 Euros to a monthly amount of 220 Euros	Low-income households

Source: Compilation of rules from www.guichet.lu

In order to cushion the drops in labour incomes related to changes in employment the government introduced a set of new policy instruments, which were supposed to complement already existing tax-benefit system (Table 2). The largest, and probably the most influential, instrument for preserving formal employment in affected businesses was the short-term unemployment scheme. Within this scheme, the government overtakes 80 percent of the remuneration costs of those employees, who had to reduce their working hours, under the condition that employers will not formally dismiss them and allow to come back to work as soon as the economic situation improves.

For individuals that lost all their employment during the COVID-19 crisis a simplified procedure to access the normal unemployment benefit was put in place in order to reduces the frequency of physical contact[8]. The main differences between the two schemes are (EUROMOD, ming):

- different eligibility conditions (all employees are eligible for 'chômage partiel' which is not the case for the regular unemployment benefit scheme , where eligibility relies on the duration of employment prior to losing the job, country of residence, etc.);
- varying replacement rates depending on the family situation (the replacement rate for all employees under the 'chômage partiel' is 80%, subject to a maximum, while the regular unemployment benefit may be increased to 85% if the dependent children are present in the household), subject to the same maximum;
- delay in payment of up to 2 months for the regular unemployment scheme due to the application procedure which is not the case for beneficiaries of 'chômage partiel' (payment of 'chômage partiel' are processed through the employers payroll system).

Apart from the short-term unemployment, the government also introduced a special family leave scheme. Between March and May, employees who had to interrupt their work in order to guard children below 13 could have benefited from a 100% salary replacement. The leave was prolonged beyond May for those employees whose children did not receive a place in childcare / educational facilities due to additionally imposed sanitary restrictions or who had to go on quarantine due to children's COVID-19 exposure. In the case of contracting COVID-19 by employees or their children, the full coverage of salary costs was overtaken by the National Health Fund.

Between June and December 2020, the government also announced an increase in the special allowance for low-income households lifting it from 110 Euros to 220 Euros per month. Finally, all individuals of 16 years and older residing or working in Luxembourg received a 50 Euro voucher to be used for an overnight stay in a hotel or other accommodation in Luxembourg.

[8]They are required to fill in a form supplied by the Luxembourg National Employment Agency (ADEM) and ADEM will then contact them to complete the application (Application has to be submitted within 2 weeks following the change in the employment situation). There is no more need to go to ADEM in person. The payment is received at the earliest on the 11th working day following the date of submission and at latest on the third last working day of the following month + 2 to 3 days to receive the payment in the bank account. .

3 Method: nowcasting and its need in times of crisis

In order to understand how economic and policy changes affect individuals and households, household survey data is usually used. There is, however, a time lag between its collection and release for research purposes. In Europe, the main survey with information on the income situation of households is the European Statistics on Income and Living Conditions (EU-SILC). The most recent wave of this survey dates back to 2018 and contains incomes for 2017 (the income reference year is always the year preceding the data collection year). Hence, one can expect that data for 2021 with incomes for 2020 will be available only in 2023. In normal times, substantial changes may occur over a two-year period between the moment of data collection and its availability for researchers. In a crisis, changes in the income situation of households are often so significant that a time lag can make data relatively meaningless, especially for a timely policy response.

There are other more recent data sources that can assist in the analysis of changes in the welfare of individuals and their households, such as the Labour Force Survey (available on a quarterly basis with a six-week lag) or up-to-date register and price data (available on a monthly basis with a short lag). However, these datasets do not contain household income information. For example, the main objective of the Labour Force Survey is to document the employment situation of individuals and their labour market incomes. Administrative data often contains detailed information on individual incomes from different sources but it does not always cover all possible sources of income or allow linking individuals within households. Another limitation of administrative data is the lack of information on socio-economic characteristics of individuals and their households. Understanding these characteristics is important for the development of targeted policies, which can help to mitigate the impacts of the crisis on the most vulnerable groups.

We overcome this data gap by applying a “nowcasting” methodology based on microsimulation (O’Donoghue and Loughrey, 2014) using the most up-to-date data on employment, wage and price levels to calibrate a simulation model of household incomes, taxes and benefits following O’Donoghue et al. (2020) and O’Donoghue and Sologon (ming). This allows us to produce a "near real" time picture of the population and identify those that are most affected.

Most of the existing “nowcasting” methods are relatively crude, relying on price inflation factors and proportional changes of industry-specific employment rates combined with a tax-benefit model to explain the policy consequences (Navicke et al., 2014). This approach was applied in a handful of European countries to provide early scenario analysis assessing the impact of the COVID-19 crisis. This type of distributional transformation approach may sometimes bias the estimates if the impact of the shock is not uniformly distributed within the population. An alternative method, as adopted by Li et al. (2020b), is to combine several datasets via a semi-parametric re-weighting process to reflect the changes in the distribution. It follows the principle outlined in DiNardo et al. (1996) by adjusting the weights based on selected key covariates. Their approach, however, requires the availability of the actual labour market distribution both immediately before and after the shock, which is not available in the case of Luxembourg.

We propose a more nuanced approach that allows us to capture the heterogeneity of changes in the population by utilizing a dynamic income generation model to update the data (Bourguignon et al. (2001); Li and O’Donoghue, 2014). This approach relies on the generic household income generation model (IGM) developed by Sologon et al. (2020) to simulate the labour market situation and household market income distribution as a function of personal and household attributes and to generate counterfactual distributions under alternative scenarios. The IGM relies on a system of hierarchically structured, multiple equation models for detailed income sources, combining: a set of personal characteristics, parameters describing how the receipt and level of income sources vary with personal characteristics, and residuals linking model predictions to observed income sources. The nested parametric specifications mirror the typical logic observed in the labour economic study and allows us to incorporate changes in the system introduced by the policy shifts. Taxes and benefits are calculated using the EUROMOD microsimulation model (Sutherland and Figari, 2013).[9] In this paper, we extend the IGM to simulate counterfactual "near real-time"[10] income distributions as a function of more timely data in order to assess the distributional impact of COVID-19. In order to apply the dynamic nowcasting methodology, we require different data sources, which are discussed in detail in section 4: calibration data to index income growth; calibration data to align the labour market; and microdata on which to estimate and simulate.

Thus, underpinning our study is a set of calibration control totals reflecting the changes in the macro-economic climate in Luxembourg over the period of the outbreak, particularly in relation to the structure of the labour market. We build up the micro data to the present and we calibrate the IGM developed in Sologon et al. (2020) data to external control totals (macro trends). This assures that the IGM is describing the most current data. We introduce various shocks (e.g. factoring sector-specific impacts, differentiated by age and gender, fiscal responses) and create counterfactual distributions under alternative scenarios. We assume no second order behavioural responses to the crisis (e.g. no labour supply responses due to the fear to be contaminated at the work place or of the COVID-specific transfer policy interventions). We assume the changes in labour market participation are channelled through the shocks in the employment opportunities and wages rather than the presence of the virus per se.

The diagram in Figure 3 summarises the philosophy of the model. The ingredients of the method are:

- a household income generation model to describe the overall household income distribution and create counterfactual distributions;
- a nowcasting component to calibrate the simulation from the income generation model to external statistics with the objective to provide a "near real-time" picture of the distribution of income.

3.1 Income generation model

The income generation model follows the approach developed in Sologon et al. (2020).[11] Disposable income is formed of 5 broad components:

$$y_h = \underbrace{y_h^L + y_h^K + y_h^O}_{Market} + \underbrace{y_h^B - y_h^T}_{Non-market} \tag{1}$$

where

- y_h^L = gross labour income (including employee, self-employed incomes),
- y_h^K = household capital income (including capital, rental incomes),
- y_h^O= other household non-benefit pre-tax incomes (including private pension, private transfers, and other incomes),
- y_h^B = public benefits, and
- y_h^T= direct taxes and social insurance contribution.

[9] We have previously used the income generation model for cross-country analysis (Sologon et al., 2020) and for historical analysis in Lithuania (Černiauskas et al., 2020) and in Australia (Li et al., 2020a).

[10] As we align our simulation to the public release of the Labour Force Survey which occurs by quarters, we provide estimates with a lag of one quarter.

[11] Please refer to the source methodology in Sologon et al. (2020) for a detailed discussion of the income generation model.

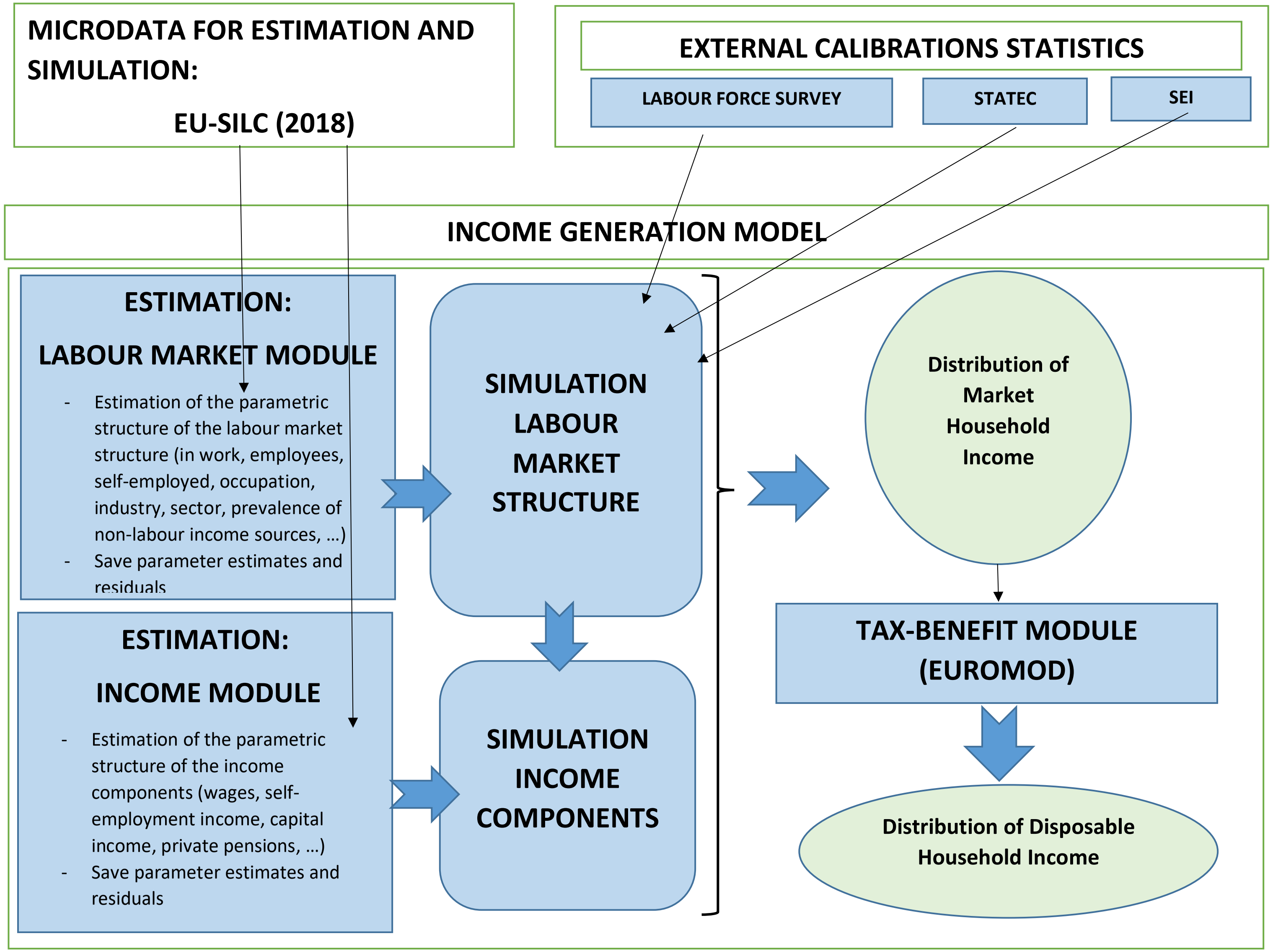


Figure 3: Summary chart of the nowcasting framework
Note: European Statistics on Income and Living Conditions (EU-SILC), National Statistical Office (STATEC), Survey on the Socio-Economic Impact of the COVID-19 Crisis (SEI)

We specify parametric relationships between observed individual and household characteristics and each income source. For each income source, we first estimate the prevalence of the income source, I_{hi}, equal to one if the individual receives the income source, and zero otherwise. For those receiving it, we estimate the level y_{hi}. For labour income, we first estimate a binary indicator equal to one if the individual is working, and zero otherwise. Then, for those individuals working, we estimate a model for being an employee versus a self-employed. For those in work, we model their occupation (8 categories, based on the ISCO-08 classification) and industry sector (primary, secondary, or tertiary). The remaining *non-benefit pre-tax income* are not modelled at such a granular level because too few households had such income. Formally, this is represented by:

$$y_h^L = \sum_{i=1}^{n_h} I_{hi}^{lab} \left(I_{hi}^{employed} y_{hi}^{employed} + I_{hi}^{selfemp} y_{hi}^{selfemp} \right) \tag{2}$$

$$y_h^K = \sum_{i=1}^{n_h} \left(I_{hi}^{inv} y_{hi}^{inv} + I_{hi}^{prop} y_{hi}^{prop} \right) \tag{3}$$

$$y_h^O = \sum_{i=1}^{n_h} I_{hi}^{Other} y_{hi}^{Other} \tag{4}$$

where: n_h is the size of household h; I_{hi}^{lab} is an indicator equal to one if individual hi is working; I_{hi}^S is an indicator equal to one if individual hi receives income from source S, y_{hi}^S is the level of income from source S, and $S \in$\{employed, selfemp, inv, prop, other\}.

To derive the estimates of the model parameters, each equation of the model is estimated independently using standard estimators. For the labour market structure and the presence of income sources, we estimate logistic and multinomial logistic models. For the distribution of wage income, we utilise individual characteristics conditional on the entire wage distribution (beyond the mean), assuming a Singh-Maddala distribution (see Biewen and Jenkins (2005) and Van Kerm (2013)), F:

$$F(w) = \mathrm{SM}(w; a(z), b(z), q(z)) = 1 - \left[1 + \left(\frac{w}{b(z)} \right)^{a(z)} \right]^{-q(z)} \tag{5}$$

conditional on a vector of characteristics z. $q(z)$ is a shape parameter for the 'upper tail', $a(z)$ is a shape parameter for the 'spread' affecting both tails of the distribution, and $b(z)$ is a scale parameter. a, b and q parameters depend log-linearly on individual characteristics. For the other income sources we estimate log-linear models. For the residual distribution, we apply the Juhn et al. (1993) approach extended to a more complex multivariate model.

These parametric relationships are reduced-form projections that describe the empirical associations between the household and individual characteristics and the income components. We use these estimated projections to simulate counterfactual distributions of disposable income under alternative scenarios.

Non-market income components resulting from public policy such as income taxes, social insurance contributions, social assistance benefits, social insurance benefits, and universal benefits are simulated using the EUROMOD tax-benefit microsimulation model for Luxembourg (see Sutherland and Figari, 2013). Since the model encompasses present and historic tax-benefit policies, EUROMOD allows a user to swap policies between different periods (see for e.g. Levy et al. (2007), Bargain and Callan (2010) and Bargain (2012)). Household benefits (y_h^B) are defined as the sum of household pension income, means-tested benefits and non-means tested benefits:

$$y_h^B = y_h^{pens} + y_h^{mtb} + y_h^{nmtb} \tag{6}$$

Direct taxes are defined as a combination of income taxes and social security contributions (ssc):

$$y_h^T = y_h^{tax} + \sum_{i=1}^{n_h} y_{hi}^{ssc} \tag{7}$$

All direct taxes and some of the benefits are modelled by EUROMOD. We use regression techniques to model the partially simulated and non-simulated variables as described in Sologon et al. (2020).

3.2 Simulating counterfactual distributions and nowcasting

We utilise the income generation model (IGM) to simulate counterfactual distributions and to undertake a decomposition of changes in the income distribution over time, between period t (before the crisis) and period $t+1$ (during the crisis). The IGM can be defined as:

$$Y = m(X, \Upsilon; \xi) \tag{8}$$

where:

- Y is household disposable income,
- X is a vector of exogenous characteristics,
- ξ is the vector of parameter values and
- Υ is a vector of residuals or unobserved heterogeneity terms.

The income generating process is a statistical representation of the structure of the presence and the level of market incomes (and its components), and the tax-benefit rules describing policy incomes. We apply this approach with the objective to understand how the distribution F of disposable income (Y), as well as any functional of interest $\theta(F)$ (such as inequality indices, quantiles) changed under the impact of a sudden crisis, such as the COVID-19 crisis. In particular, we are interested in isolating the COVID-19 policy response from the labour market shock in explaining changes in the distribution of disposable income during the peak of the crisis.

We proceed in two steps described below.

3.2.1 Nowcasting the distribution to t and $t+1$

The first step is to "nowcast" the most recent available survey data (period s) to reflect the situation in both periods of interest t and $t+1$. We follow the nowcasting methodology described in O'Donoghue and Sologon (2020, forthcoming) and applied in O'Donoghue et al. (2020). We first estimate the IGM for year s, saving the parameter estimates and the residuals from each model. We then simulate the changes in the distribution of disposable income by calibrating the labour market, income and tax-benefit transformations so as to reflect the components of the IGM of period t and $t+1$.

Below we outline the transformation in a general form and leave the exact variables on which the transformations are applied to the Appendix tables A–1, A–2 and A–3.

We perform three 'transformations':

1. The labour market structure transformation involves re-simulating the labour market structure and changing important characteristics of the labour market structure such as employment, occupation and industry sector and involves using the parameter estimates of period s and calibrating these simulations to the external labour market statistics. This results in a labour market structure aligned with the external statistics with respect to the in-work composition by age and gender, the composition of employment/self-employment

by gender, the occupation and industry structure by gender, the unemployment structure by gender. All individuals in the working age group will have an updated labour market status and updated labour market characteristics, captured by the new vector $\tilde{l}(\xi)$.

$$Y^l = m(X, \Upsilon; \tilde{l}(\xi)). \tag{9}$$

2. The returns transformation involves re-simulating and updating all income sources based on the new simulated labour market structure in the previous step. This results in an updated income vector for all individuals $\tilde{r}(\xi)$.

$$Y^{l,r} = m(X, \Upsilon; \tilde{l}(\xi); \tilde{r}(\xi)). \tag{10}$$

   At this step, we also apply the EUROMOD uprating factors for all the monetary variables to align them with the policy parameters of the respective year (to be applied in the next step). Factors include harmonized index of consumer prices, earnings, family benefits, health benefits, unemployment benefits, assistance benefits, disability benefits, old age benefits, survivor benefits and early retirement benefits. Similar swapping of tax-benefit policy rules and parameters were implemented for analysing trends in income distributions (see Bargain, 2012; Bargain and Callan, 2010; Herault and Azpitarte, 2016; Paulus and Tasseva, 2020) and cross-country differences (see Dardanoni and Lambert, 2002; Levy et al., 2007; Sologon et al., 2020).

3. The tax-benefit system transformation updates the tax-benefit rules to reflect the nowcasted period, simulated by EUROMOD, to produce an alternative parameter vector $\tilde{tb}(\xi)$. This involves using EUROMOD to apply the tax-benefit rules and parameters of the nowcasted period onto the market incomes and household characteristics updated in the previous steps.

$$Y^{l,r,tb} = m(X, \Upsilon; \tilde{l}(\xi); \tilde{r}(\xi); \tilde{tb}(\xi)) \tag{11}$$

These transformations result in the nowcasted outcomes before the crisis,$\tilde{Y}_t$, and during the crisis, $\tilde{Y}_{t+1}$:

$$Y_s \;=\; m(X, \Upsilon; \xi) -> \tilde{Y}_t = m(X, \Upsilon; \tilde{l}_t(\xi); \tilde{r}_t(\xi); \tilde{tb}_t(\xi)) \tag{12}$$

$$Y_s \;=\; m(X, \Upsilon; \xi) -> \tilde{Y}_{t+1} = m(X, \Upsilon; \tilde{l}_{t+1}(\xi); \tilde{r}_{t+1}(\xi); \tilde{tb}_{t+1}(\xi)) \tag{13}$$

The change in the distribution of disposable income under the impact of the crisis is assessed by taking the difference $\tilde{Y}_{t+1} - \tilde{Y}_t$, measured using distribution functional of interest, θ, such as the Gini index or the quantiles.

$$\Delta_\theta(F) = \theta(F_{t+1}) - \theta(F_t). \tag{14}$$

3.2.2 Simulating alternative scenarios to decompose the distributional changes between t and $t+1$

The change in the distribution can be decomposed with the help of counterfactual distributions. We are interested in separating the effect of the labour market shock from the effect of the policy response.

In order to identify the labour market shock we contrast the distribution at time t with the counterfactual distribution that would prevail if in period t we "import" the labour market shock of period $t+1$, keeping everything else the same. This is obtained by performing a labour market transformation of period t to reflect the labour market structure and the shock of period $t+1$ and resimulating incomes accordingly, while maintaining the uprating factor for monetary variables in line with the policy parameters at period t. The effect is represented formally by: $m(X, \Upsilon; \tilde{l}_{t+1}(\xi); \tilde{r}_t(\xi); \tilde{tb}_t(\xi)) - m(X, \Upsilon; \tilde{l}_t(\xi); \tilde{r}_t(\xi); \tilde{tb}_t(\xi))$. In essence, this is a counterfactual situation in which we have the COVID shock, but no COVID-specific policy intervention and the "old" system is allowed to buffer the shock via its automatic stabilizers.

In order to identify the distributional effects of the COVID-specific policy intervention, we contrast the distribution at time $t+1$ which incorporates the labour market shock and the COVID-specific policy response with the counterfactual distribution of no COVID-specific policy intervention: $m(X, \Upsilon; \tilde{l}_{t+1}(\xi); \tilde{r}_{t+1}(\xi); \tilde{tb}_{t+1}(\xi)) - m(X, \Upsilon; \tilde{l}_{t+1}(\xi); \tilde{r}_t(\xi); \tilde{tb}_t(\xi))$.

We can compute the impact on any distribution functional of interest, θ, such as the Gini index or the quantiles as follows:

$$\Delta_\theta(F) = (\theta(F_t^k) - \theta(F_t)) + (\theta(F_{t+1}) - \theta(F_t^k)) \tag{15}$$

where $\theta(F_t^k)$ is the distribution functional of interest in the scenario without a COVID-specific policy intervention. We come back to the specific decompositions at the beginning of Section 5, after discussing the data sources used in the estimations and simulations.

4 Data

As highlighted above, the application of the dynamic methodology requires two types of data: (i) microdata used for estimations and simulations, and (ii) calibration data used to align the microdata to macro trends reflecting changes in the labour market. The main source of the microdata is the 2018 wave of EU-SILC. The dataset contains detailed information on personal and household incomes, demographics and labour market characteristics of individuals, reflecting a nationally representative sample of the resident population. For our analysis, we have used the EUROMOD standardised datasets based on 2018 EU-SILC for Luxembourg, which are suitable for tax-benefit modelling.

Our analysis is underpinned by a set of calibration control totals reflecting the changes in Luxembourg's macroeconomic situation that occurred since the collection of the EU-SILC data in 2018 and up to the current COVID-19 crisis. We use the calibration control totals to calibrate the income generation model in order to align the information in EU-SILC with the current labour market situation. More precisely, we simulate the changes in the distribution of household incomes by calibrating the labour market, income and tax-benefit transformations so as to reflect the components of the IGM for the target periods. The data used for the calibration is drawn from three main sources:

- Labour Force Survey;
- Administrative data;
- Survey on the Socio-Economic Impact of the COVID-19 Crisis (SEI).

The Labour Force Survey (LFS) is published by Eurostat and is available on a quarterly basis. Given the asymmetric nature of the Covid-19 crisis, our labour market alignment is differentiated by age, gender, occupation and industry. For this purpose, we have extracted information on the employment rates by age, gender, occupation and industry for Q4 2019 (in order to ensure that our pre-crisis estimates do not capture any impact of the crisis) and Q2 2020. In the analysis, the pre-crisis period is referred to as Q1 whereas Q2 refers to April-June 2020.

For the alignment of short-term unemployment, we use the monthly statistics on the number of workers under the short-time unemployment scheme by industry, collected by the Luxembourg

National Employment Agency (ADEM) and provided by the Luxembourg National Statistical Office (STATEC):(i) April - to capture the peak of the crisis, and

(ii) average across Q2 - to capture also the recovery after the first COVID-19 wave.

As the data on the number of individuals under short-time unemployment does not differentiate between residents and cross-border workers, we utilized administrative statistics collected by the General Inspectorate of Social Security (IGSS) and provided by STATEC to compute the share of residents in total employment by industry. The share of resident workers in total employment was then applied to the number of workers under short-time unemployment. We thereby assume that the likelihood of falling under short-time unemployment does not differ between residents and cross-border workers employed within the same industry. IGSS data was also used to calibrate the number of retirees by gender, and the share of resident workers in the total workforce to reflect the situation in 2020.

To model the likelihood of individuals falling into short-time unemployment, we estimated a model utilizing the survey data on the Socio-Economic Impact of the COVID-19 Crisis (SEI) collected[12] during the pandemic. This model includes a range of demographic characteristics, such as age, household composition, marital status and education, but also information regarding the individual's occupation and industry of employment.

In order to assess the distributional impact of the COVID-19 crisis, we compare the nowcasted distribution of income in the first quarter of 2020 (Q1 - before the crisis) with the nowcasted distributions for (i) April (at the peak of the first wave) and (ii) Q2. The disposable income concept used is the equivalized household disposable income. We equivalize the standard EUROMOD definition of disposable income by dividing total household income by the square root of the household size (LIS equivalence scale). The population composition and the aligned labour marker structure based on the LFS, SEI and administrative statistics are shown in Table B–4.

5 Nowcasting results

We focus on the short-term impact of the crisis, between the start of 2020 (Q1, before the start of the COVID crisis) and the second quarter (Q2: April-June). The changes in the income distribution can be decomposed into two main parts, with one being the change induced by the labour market shock (part A) and the other due to the public policy response (part B):

$$\begin{aligned}\Delta_\theta(F^{Q_2}, F^{Q_1}) &= \theta(P^{Q_2}, LM^{Q_2}) - \theta(P^{Q_1}, LM^{Q_1}) = \\ &= \theta(P^{Q_1}, LM^{Q_2}) - \theta(P^{Q_1}, LM^{Q_1})\,\{partA\} \\ &\quad +\theta(P^{Q_2}, LM^{Q_2}) - \theta(P^{Q_1}, LM^{Q_2})\,\{partB\}\end{aligned} \tag{16}$$

Q1 referes to the situation at the start of 2020, before the COVID crisis: $\theta(P^{Q_1}, LM^{Q_1})$. This calibrates our simulations to the labour market situation at the beginning of the year using the LFS. P^{Q_1}refers to the tax-benefit rules in place in the beginning of 2020, before the introduction of any COVID-specific policy interventions.

Q2 refers to the second quarter of 2020 (April-June): $\theta(P^{Q_2}, LM^{Q_2})$. This calibrates our simulations to the labour market situation during the second quarter of 2020, covering April-June. The labour market shock in terms of short-term unemployment is aligned using the statistics collected by ADEM and provided by STATEC averaged across Q2. We applied the average shock across the three months. We assume that all people who fall into short-term unemployment reduce their hours by 100%. These people will retain the affiliation with their employer, but they

[12]SEI was collected by the Luxembourg Institute of Socio-Economic Research and the University of Luxembourg.

will fall under the COVID compensation scheme. This is the base scenario for Q2 and will provide lower bound estimates for Q2. Alternatively, we could also align the reduction of hours worked under the compensation scheme based on external statistics provided by STATEC; this would provide middle bound estimates for Q2.[13] P^{Q_2}refers to the tax-benefit rules in place during the crisis period, which include the policy rules from Q1 and the COVID-specific policy interventions described in Table 2. We use the policy rules implemented in Euromod, which cover mainly the short-term unemployment scheme. The special family and sick leave for COVID-related issues offer full-insurance, providing 100% replacement of lost income, and thus would not affect the distribution of disposable income.[14]

The scenario of "No COVID policy intervention" is obtained by applying the policy of Q1 to the labour market shock of Q2: $\theta(P^{Q_1}, LM^{Q_2})$. We assume that all subsidised jobs would be lost should there be no compensation scheme. This will serve as our counterfactual for no COVID policy intervention. Contrasting this counterfactual with the actual situation in Q1 (before the crisis), $\theta(P^{Q_1}, LM^{Q_1})$, we obtain the impact of the COVID labour market shock (Part A) on the distribution of income (be it the entire distribution or a particular index).

Contrasting Q2 with the counterfactual of Q2 under the "No COVID policy intervention" scenario, $\theta(P^{Q_2}, LM^{Q_2}) - \theta(P^{Q_1}, LM^{Q_2})$, we obtain the policy effect on the distributional changes before/during the crisis.

We also look at the effects at the peak of Q2 in April. The difference from Q2 is that the labour market shock in terms of short-term unemployment is aligned using the statistics provided by STATEC for April, instead of the average for Q2. The effects are of a higher magnitude, but in line with the average effects for Q2.

5.1 Distributional changes before and during the COVID crisis

Figure 4 presents the distribution of disposable income in three periods - before the COVID-19 outbreak, at the peak of its first wave (in April 2020), and during the first three months following the start of the pandemic (the average for April-June) - using the Pen's parade diagram. On this diagram, all individuals are lined up according to the size of their monthly income from the poorest ones (on the left) to the richest ones (on the right). Figure 4 shows that monthly incomes of the poorest 10 percent hardly exceed 2000 Euros per month whereas monthly incomes of the richest 10 percent are slightly above 6000 Euros per month. Figure 4 further shows that all individuals experienced a drop in disposable income after the outbreak of the COVID-19 crisis. Income losses were the largest in April, when the country entered a strict lockdown, and decreased in size following the lifting of the lockdown measures in May and June.

In order to reflect better the changes during the peak of the crisis and in Q2, we take the differences between the April and Q2 parades versus the Q1 parade. Figure 5 (a) reveals that, both at the peak of the crisis and after, the absolute losses in Euros in household equivalized disposable income were the smallest at the bottom of the distribution and the largest at the top. In Q2, on average, the disposable income of the poorest 10 percent dropped by less than 50 Euros per month whereas the income of the richest 10 percent decreased by 300 Euros per month. In relative terms (Figure 5(b)), the income losses across the distribution in both periods are U-shaped, indicating larger relative losses for the middle (between 20th and 70th percentiles), than for the bottom and the top of the distribution.

In order to relate these income drops to shifts in income inequality, in panel (c) of Figure 5 we also report the changes in the normalized distributions obtained by dividing the quantile values by the mean of the distribution. This allows us to see the changes in incomes that relate directly

[13] The results for this scenario are consistent with the results for Q2, but as expected are smaller in magnitude. We did not include them in the paper, but they can be provide upon request.

[14] Future work will try to model the infection rate and special family leave take-up taking into account industry differentials. This would not affect the distribution of disposable income, but the degree of benefit redistribution which would be higher.

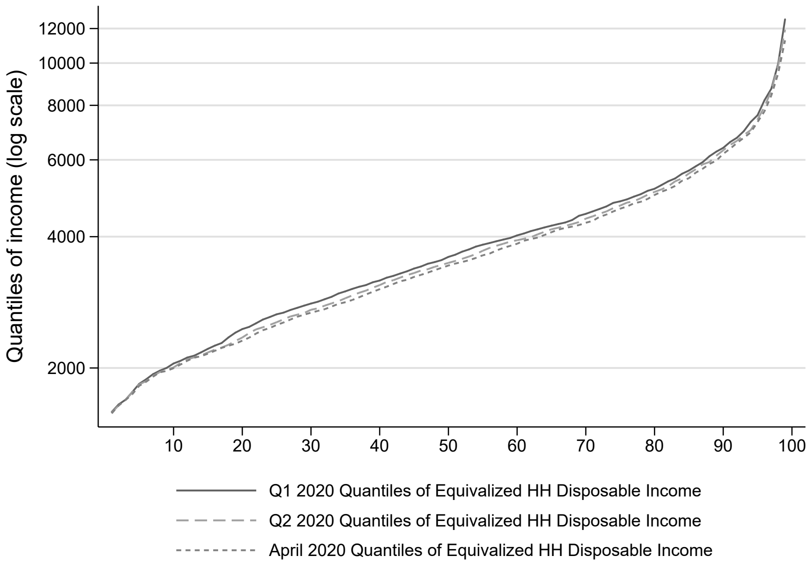


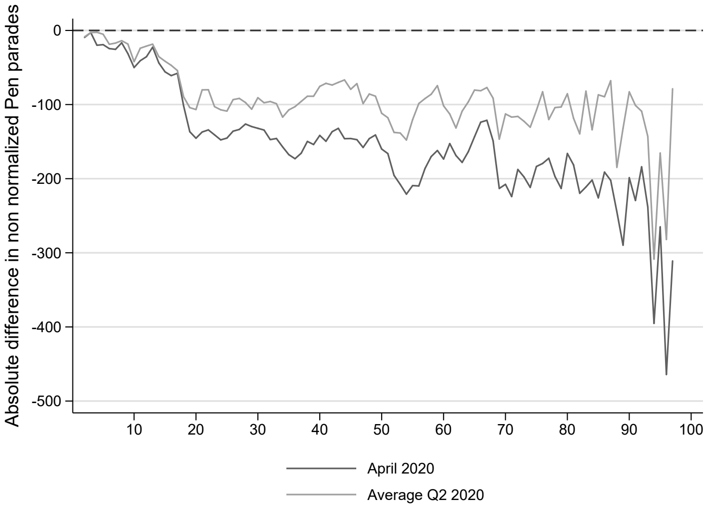
Figure 4: Pen Parades: 2020 Q1 vs 2020 April and Q2 nowcasted

to changes in income inequality. The fluctuations are small (between -0.02/+0.02), indicating minor (if any) changes in disposable income inequality, as will be shown later in Table 3. The U-shape is maintained: relative to the mean, the poorest 15% are in a better off position in Q2 than in Q1, whereas the middle became worse off and the top fluctuates around zero.

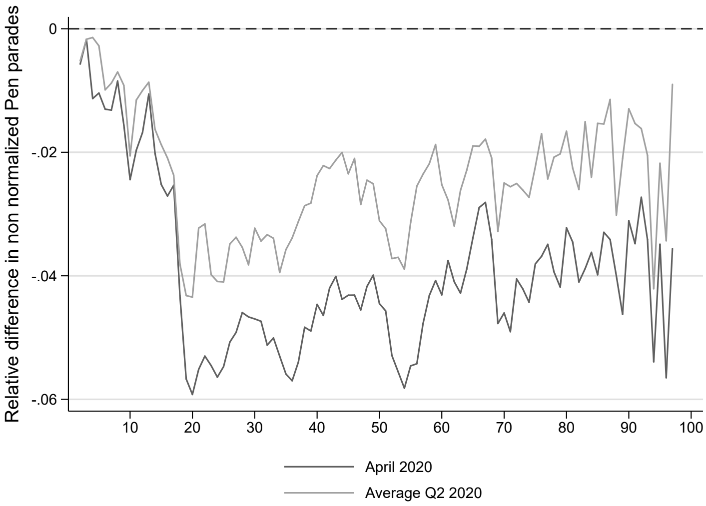
Table 3 summarizes changes in the distributions of household disposable income between the three nowcasted periods: 2020 Q1, April and Q2. The average household disposable income decreased by almost 160 Euros during April and by roughly 90 Euros during April-June as compared to the pre-crisis period. The decline in the median household equivalized income was of 160 Euros in April and of 111 Euros over Q2. The observed declines in individual incomes, however, have not translated into sizeable changes in income inequality. A standard measure of income inequality - the Gini coefficient - did not change at the pick of the crisis in April and increased by only 0.001 point in the subsequent months of Q2. The trends in alternative inequality measures - mean log deviation (GE0) and Theil index (GE1) - were very similar. Between Q1 and Q2, they increased by 0.001 and 0.002 points.

Table 3: Equivalized household disposable income in Q1 2020, April 2020 and Q2 2020 (monthly, in euros)

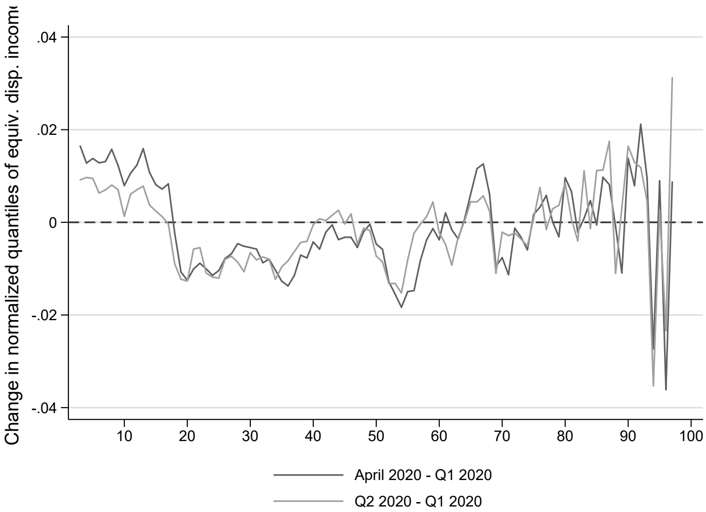
	Mean	Median	GE0	GE1	Gini
Q1 2020	4037.524	3594.930	0.113	0.120	0.260
April 2020	3878.205	3434.945	0.113	0.121	0.260
Q2 2020	3944.265	3483.183	0.114	0.122	0.261



(a) Absolute change in Euros



(b) Relative change (Q1 = reference)



(c) Change in pen parades divided by their respective means

Figure 5: Absolute, relative and normalized nowcasted changes: 2020 Q1 vs 2020 (April and average Q2)

5.2 Inequality decomposition by income source

We investigate next the factors which lie behind the stability of disposable income inequality despite the significant employment shocks at the beginning of the crisis. We evaluate the contribution of various income sources to the Gini coefficient following the decomposition procedure of Lerman and Yitzhaki (1985). This procedure foresees partitioning of the Gini coefficient in a set of components associated with contributions of various income sources, where the contribution of each income source is defined as a product of its share in total income (s), inequality measured with the Gini coefficient (g), and correlation with total income (r). Among income sources, we consider labour income, private pensions, capital and other market incomes, taxes, social security contributions, and public benefits (where we separate public pensions from the remaining public transfers, such as unemployment benefits, sickness benefits, family benefits, housing benefits, social assistance). The results of this decomposition exercise are presented in Table 4.

Table 4: Household Equivalized Disposable Income Decomposition by Income Source (Euro) - Q1 vs. April and Q2

Country	Share (s)	Gini (g)	Correlation (r)	Concentration (c=g*r)	Relative Contribution (s*g*r/G)
Q1					
Labour Income	0.953	0.503	0.749	0.377	1.382
Private Pensions	0.000	0.998	0.293	0.293	0.000
Capital and other	0.031	0.942	0.613	0.578	0.069
Public Pensions	0.258	0.826	0.407	0.337	0.334
Benefits	0.103	0.652	-0.376	-0.245	-0.097
Taxes	-0.220	-0.658	-0.957	0.630	-0.534
SIC	-0.124	-0.398	-0.806	0.321	-0.154
Total		0.260			
April					
Labour Income	0.795	0.594	0.747	0.444	1.360
Private Pensions	0.000	0.998	0.344	0.343	0.000
Capital and other	0.032	0.942	0.628	0.592	0.074
Public Pensions	0.268	0.826	0.453	0.375	0.387
Benefits	0.240	0.623	-0.251	-0.156	-0.145
Taxes	-0.213	-0.665	-0.960	0.638	-0.522
SIC	-0.124	-0.405	-0.797	0.323	-0.153
Total		0.260			
Q2					
Labour Income	0.861	0.560	0.750	0.420	1.385
Private Pensions	0.000	0.998	0.324	0.323	0.000
Capital and other	0.032	0.942	0.615	0.580	0.071
Public Pensions	0.264	0.826	0.431	0.356	0.360
Benefits	0.184	0.650	-0.290	-0.189	-0.133
Taxes	-0.217	-0.663	-0.959	0.636	-0.529
SIC	-0.124	-0.404	-0.800	0.323	-0.154
Total		0.261			

Notes: Nowcasted distribution in Luxembourg for Q1, April and Q2(Euromod output) Labour Income = Employment + Self-Employment; Capital Income = Investment + Property; Other Income = other + private transfers.

We find that labour income, pensions, capital and other incomes contribute positively to the level of income inequality in Luxembourg, whereas, benefits, taxes, and social security contributions have an equalising effect, offsetting more than 1/3 of the increase in the Gini associated with labour income, capital income, and both types of pensions. The composition of disposable income changed substantially over the crisis, whereas the level of inequality stayed roughly unchanged. We observed a decrease in the share of labour incomes compensated by an increase in the share of benefits, reflecting the cushioning effect of the transfer system. Consequently to the drop in labour incomes, the share of taxes also decreased. Labour income became more unequally distributed (the figures include zeros which resulted from job losses) and more concentrated at the top of the distribution of disposable income, whereas benefits became less concentrated (meaning more people along the distribution access benefits during the crisis. The equalizing contribution of benefits more than doubled in April and increased by 79 percent in Q2 as compared to the pre-crisis level reflecting a partial substitution of labour incomes with unemployment benefits.

Figure 6 provides further evidence on the changes in labour market and benefit incomes along the distribution of household disposable income. Looking at the evolution of labour market incomes first, one can see that they declined substantially in the first month of the crisis, with the decline being the smallest at the bottom and the top of the distribution and somewhat larger between the 20th and 60th percentiles. This reflects the trend in the distribution of disposable income depicted in Figure 4. As a compensation for the decline in market incomes, benefits increased in size along the entire distribution of household income. The size of the increase was proportional to the decline in labour incomes being the largest in the middle of the distribution. The trends look similar in April and in the second quarter of 2020 but the size of income changes are slightly larger at the pick of the crisis as compared to Q2 in general.

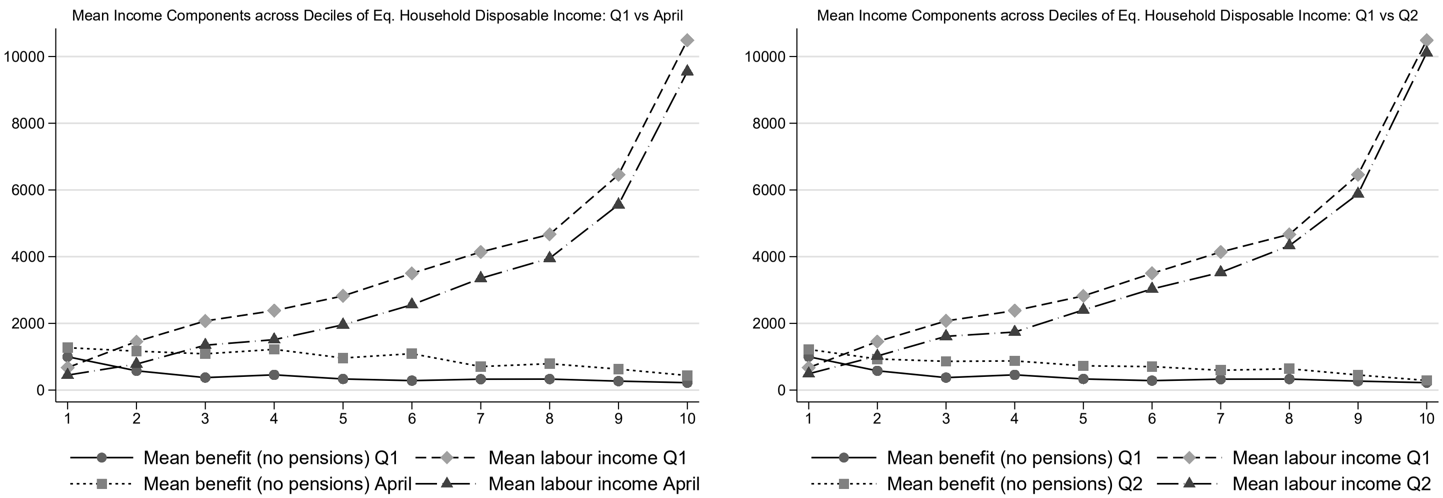


Figure 6: Mean income components by deciles of equivalized household disposable income: Q1(pre-COVID) vs April (left) and Q2 (right) nowcasted
Note: Both income components are in gross values.

5.3 Changes in redistribution during the crisis

In this section, we shed further light on the role of taxes and benefits in mitigating the impact of the crisis on the distribution of household disposable income in Luxembourg. We start by exploring the change in the Gini as we make the transition from gross income without benefits to gross income with benefits and then inspecting how it changes once we account for taxes and social security contributions. The difference in the Gini coefficients at each of these steps (the Reynolds-Smolensky index) reflects the redistributive impact of the respective public intervention (benefits, taxes, or social security contributions). In addition, for both taxes and benefits, we calculate the Kakwani index (Kakwani, 1977), which captures their progressivity/regressivity by taking the difference between the concentration coefficient of the given public intervention and the Gini coefficient before this intervention.

Table 5 presents these indices for the first and second quarters of 2020 and at the pick of the crisis in April. It shows that the Gini of the gross income before taxes and benefits increased from 0.484 in the first quarter of 2020 to 0.538 in the second quarter, with the largest increase taking place in April (0.571). However, as soon as we account for transfers received from the state, the increase in the Gini disappears in April and constitutes only 0.002 points in Q2 as compared to Q1. Thus starting from very unequal market distributions, adding benefits results in similar levels of inequality across quarters. Benefits became more generous as reflected in the average transfer rate which increased from 0.354 (Q1) to 0.482 (Q2). They also became less regressive implying that more people along the distribution received benefits in the second quarter as compared to the first one (not only the poorest). Overall, benefit redistribution increased substantially between the quarters.

Table 5: Progressivity and redistribution of taxes and benefits on household equivalized disposable income

	Q1	April	Q2	Ratio:April /Q1	Ratio:Q2 /Q1
Gini Gross Income	0.484	0.571	0.538	1.179	1.110
Gini Gross Income (incl. benefits)	0.328	0.328	0.330	1.000	1.005
Average transfer rate	0.354	0.591	0.482	1.669	1.361
Benefit Regressivity (K)	0.910	0.896	0.906	0.985	0.996
Benefit Redistribution (RS)	0.156	0.243	0.208	1.556	1.330
Gini (gross + benefits - income taxes)	0.268	0.268	0.270	1.001	1.007
Average tax rate	0.165	0.160	0.162	0.971	0.987
Tax Progressivity (K)	0.314	0.322	0.319	1.024	1.013
Tax Redistribution (RS)	0.061	0.060	0.061	0.991	0.999
Gini Disposable Income	0.260	0.260	0.261	1.001	1.006
Net Redistributive Effect	0.224	0.311	0.276	1.385	1.230

Notes: K = Kakwani; RS = Reynolds-Smolensky.

In contrast to benefits, the redistributive role of taxes remained almost unchanged. The average tax rate decreased, which is expected given the decrease in market incomes after the outbreak as compared to the period before. Due to its mechanical inverse relationship with average tax rate, we notice a slight increase in tax progressivity, which was too small to lead to a change in the redistributive impact of taxes.

Overall, Table 5 shows that net redistribution increased during the crisis and was driven mainly by the increase in benefit redistribution. Whether redistribution increased as a result of the introduction of new policy instruments described in Table 2 or of the labour market shock will be shown in the next section.

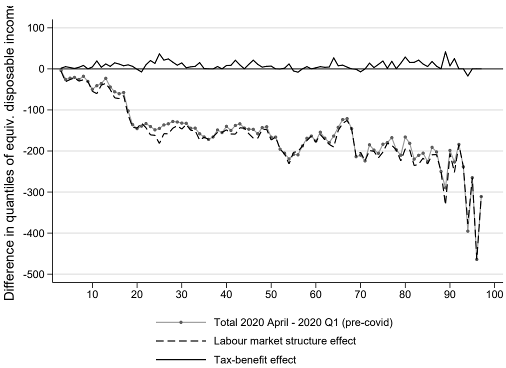
5.4 Contribution of the labour market shock and policy response to the changes in disposable incomes and inequality

In Figure 7, we identify the contribution of the labour market shock and of the policy intervention to the changes in the distribution of disposable income. The upper panels highlight the decomposition results for the absolute nowcasted changes in the quantiles of equivalised household disposable income, whereas the lower panels show the decomposition results for the relative changes in the quantiles (Q2-Q1)/Q1). To recap, the labour market shock effect is obtained by taking the difference between the counterfactual obtained by importing the COVID labour market shock of Q2 into Q1, when no special COVID policy was in place, and the initial Q1 situation. The effect of the COVID policy interventions (the delta between the tax-benefit rules applied after and before the crisis) is obtained by taking the difference between the distribution during the crisis and the counterfactual when the pre-crisis policy is applied to the shock (P2-P1)| COVID shock=1).

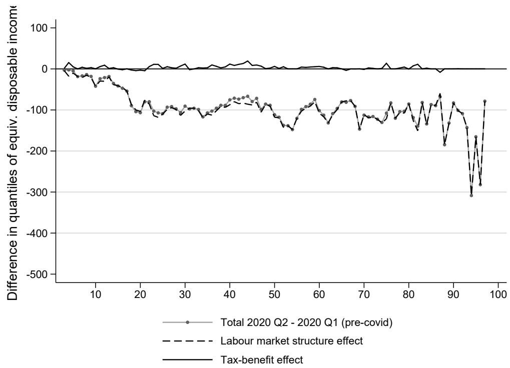
Most of the change in the distribution is explained by the labour market shock, which follows closely the observed change: assuming no COVID policy intervention, under the labour market shock, people lost income throughout the distribution. Both in absolute and relative terms, the bottom 20% lost less than the rest of the distribution. The scenario at the peak of the crisis (in April) shows a consistent story with the average scenario across Q2, only with a more pronounced effect.

The effect of changes in the tax-benefit rules during the crisis fluctuates around zero across the distribution, which indicates that the system was well equipped ahead of the crisis to cushion household incomes against job losses. In essence, there is little difference in the policy functioning between the pre-existent unemployment benefit scheme and the short-term unemployment scheme introduced in response to the COVID-19 pandemic. The main difference lies in the speed with which individuals access cash-flow support under the two schemes and the additional eligibility conditions for the existing unemployment scheme. Under the new COVID scheme, people who fell into short-term unemployment could access benefits faster than via the standard unemployment scheme.

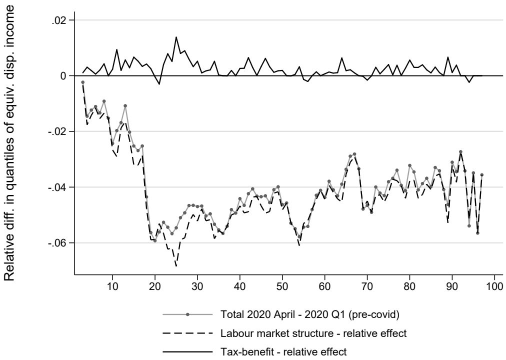
Comparing the absolute level of income replacement to the relative level of income replacement, it becomes clear that although individuals in the bottom half of the income distribution benefited from higher absolute levels of income replacement, the relative level of income replacement was similar for individuals throughout the distribution of incomes. A potential explanation for this pattern is that policy action may be more feasible politically if those affected perceive similar levels of relative income replacement.



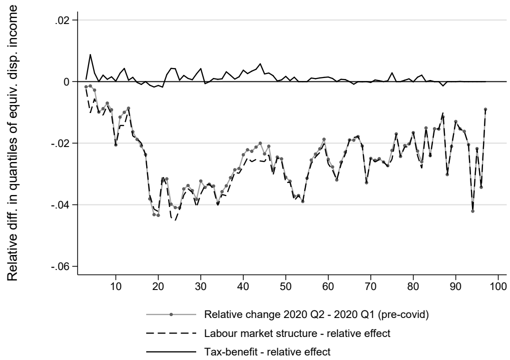
(a) Absolute decomposition: April



(b) Absolute decomposition: Q2



(c) Relative decomposition: April



(d) Relative decomposition: Q2

Figure 7: Contribution of the labour market shock and policy response to the change in income quantiles under the COVID crisis: April-Q1 (left); Q2-Q1 (right)

When we move from the detailed distribution to the decomposition of summary Gini index in Table 6, we find that under the labour market shock, the distribution of market incomes became more unequal (by 5.3 Gini points in Q2 and 8.7 Gini points in April), the effect however is cancelled by the tax benefit intervention. The Δ 0 effect of the changes in the tax-benefit rules judged against the COVID shock confirms that in policy design function the system did not change. The system was well-equipped before the crisis to handle a rapid shock, at least in the short run.

Net redistribution increased during the crisis and was mainly driven by an increase in the generosity of benefits and a decrease in the concentration of benefits across the distribution (more people accessed them). These changes are mainly explained by the labour market shock in Table 6, signalling the automatic stabilizers embedded in the existing system. The small effects due to changes in policy design confirm our previous finding that differences in policy design pre-during crisis are small.

Table 6: Decomposition of the change in Gini coefficients and in redistribution measures before (Q1) and during the COVID-19 crisis (April and Q2)

	Gini Disposable (1)	Gini Gross Income (2)	Net Redistr. (3)	Benefit Regressivity (4)	Avg. Benefit Rate (5)	Tax Progressivity (6)	Avg. Tax rate (7)
2020 Q1	0.260	0.484	0.224	0.910	0.354	0.315	0.165
Changes under COVID-19							
April - Q1	0.000	0.087	0.086	-0.013	0.237	0.008	-0.005
Contribution of the shock and policy response to the change April - Q1							
LMS	0.001	0.087	0.086	-0.011	0.234	0.007	-0.004
TB	-0.001	0.000	0.001	-0.002	0.003	0.000	-0.000
Changes under COVID-19							
Q2 - Q1	0.002	0.053	0.052	-0.003	0.128	0.004	-0.002
Contribution of the shock and policy response to the change Q2 - Q1							
LMS	0.002	0.053	0.051	-0.003	0.127	0.004	-0.002
TB	-0.000	0.000	0.000	-0.001	0.001	0.000	-0.000

Notes: LMS: labour market structure; TB: tax-benefit system.

5.5 International context

Where does Luxembourg stand among other countries in terms of its policy responses to the COVID-19 crisis and their ability to mitigate changes in individual welfare induced by the economic shock? Studies focusing on the impact of the Covid-19 pandemic on the distribution of household incomes are relatively scarce and cover only a limited number of countries. In what follows we reflect upon the role of tax-benefit systems and discretionary policy measures in cushioning income shocks in Luxembourg in comparison with the recent findings in Australia (Li et al., 2020b), Ireland (O'Donoghue et al., 2020), Italy (Figari and Fiorio, 2020) and the UK (Brewer and Gardiner, 2020; Brewer and Tasseva, 2020).

These countries differ in their sectoral composition of the economy, welfare systems and specific policy measures introduced in response to the COVID-19 crisis. With respect to the sectoral composition of the economy (Figure 8), Italy relies heavily on the wholesale and retail trade, transport, and hospitality sectors, which are followed by manufacturing. Ireland has a substantial share of GDP produced in manufacturing, with the information and communication sector in the second place. The UK has the largest share of GDP produced in the public sector, which is followed by wholesale, retail, trade, transport and the hospitality services. The Luxembourgish economy, in contrast, is dominated by the service sector with the largest share of the gross value added coming from the financial and insurance services, followed by the public sector. Given the asymmetry of the COVID-19 crisis, which affects industries differentially, the consequences of this crisis for individual employment and market incomes vary substantially across countries.

From a welfare perspective, all five countries have well-established tax-benefit systems, which, to a larger or smaller extent, are expected to cushion income losses during an economic shock. The design of these systems, however, differs substantially across the countries. Australia, Ireland and the UK belong to the Anglo-Saxon welfare regime, which puts an emphasis on the provision of means-tested benefit schemes aiming to reach those at the bottom of the income distribution (see Esping-Andersen, 1990). In these countries, traditional unemployment benefit schemes are limited in duration, have a relatively low generosity (the replacement rates fall between 50% and 60% for Ireland and the UK, and 40% for Australia - see Figure 9), and often rely on means-testing. Italy belongs to the Mediterranean welfare regime, where the provision of welfare is put mainly on families with a quite limited involvement of the state (for more details, see Ferrera, 1996). The main focus of the welfare provision organized by the government falls on pensions but it also supports incomes of individuals in need. As shown in Figure 9, the net benefit replacement rates are rather high in Italy, ranking it above the countries with Anglo-Saxon welfare systems. Luxembourg, in contrast, belongs to the Continental welfare regime, which relies heavily on the provision of insurance-based social benefits with high replacement rates. The unemployment scheme in Luxembourg provides a replacement of 80 to 85% of previous income during the first 12 months following the job loss (even higher when we consider also other benefits, such as housing). The country also provides relatively generous social assistance to those individuals who exhausted the possibility of receiving unemployment benefits, have limited incomes from other sources and can prove that they live in need.

As early research shows, the capacity of these welfare systems to cushion consequences of COVID-19 largely depend on their design. Brewer and Tasseva (2020), for example, show that UK automatic stabilizers have only a limited ability of cushioning income losses during a crisis, when a substantial portion of employees loses jobs or is forced to reduce the number of working hours. A similar finding is reported by Figari and Fiorio (2020), who conclude that the in-built features of the tax-benefit system in Italy were not sufficient to mitigate the economic shock induced by the COVID-19 crisis. As our results show, even without COVID-19 related policy responses, the Luxembourgish tax-benefit system would have absorbed the shock and buffer the income loses of the affected individuals and households. Given that the system does not target only those at the bottom of the distribution, but supports individual incomes proportionally throughout the distribution, the activation of the system prevented an increase in disposable income inequality despite the surge in market income inequality.

Finally, all countries introduced discretionary policy measures in response to the COVID-19 crisis. For example, all five countries introduced wage subsidies or analogous schemes aimed to protect employment contracts in order to allow individuals to remain employed or re-start work as soon as the situation improves. Albeit they somewhat differ in terms of eligibility criteria, the replacement rates within these schemes are relatively high: 80% of the remuneration costs in Italy, Luxembourg, and the UK (subject to a maximum cap in all three countries), a maximum rate of €410 per qualifying employee per week in Ireland, a flat rate of €460 per week (A$750) in Australia. As shown by Brewer and Tasseva (2020), Figari and Fiorio (2020), Li et al. (2020b), and O'Donoghue et al. (2020), wage subsidies played a crucial role in mitigating market income losses in Australia, Ireland, Italy, and the UK at the onset of the COVID-19 crisis. Australia has also temporarily doubled the unemployment benefit amount and broadened the eligibility criteria, leading to a substantial increase in welfare expenditure. In countries such as Australia and Ireland, these discretionary measures led to a slight decrease in inequality of disposable household incomes. While these countries introduced radically different policies from their existing systems, the COVID policies introduced in Luxembourg were minor modifications of existing policy instruments aimed to cushion the drops in individual incomes related to employment changes during the crisis. As our results indicate, in the absence of the COVID-induced policy response, the labour market shock would have been absorbed by the automatic stabilisers (i.e. the already existing system of taxes and benefits).

These results, however, should be interpreted with caution. As the crisis evolves, those who were forced into short-term unemployment might become unemployed and move to the classical unemployment scheme. This scheme will cushion their incomes with approximately the same replacement rate for another year but, then, those who fail to find new employment will exhaust the duration of unemployment benefits and will face the option of applying for social assistance, which is usually means-tested and involves stricter conditions. Additionally, it is also possible that the job market may experience major shifts as new work practices, such as work-from-home adopted amid the crisis, may render some pre-COVID positions obsolete, creating frictions in the labour market. While the increased welfare expenditure has been effective in stabilising the income distribution in many countries, it is not clear whether some of the generous measures are sustainable given that economy may take a few years to fully recover. The fiscal pressure along with the suppressed economic activities may force the government to either increase tax or reduce the generosity of the payments in the future, which may lead to a delayed increase in income inequality.

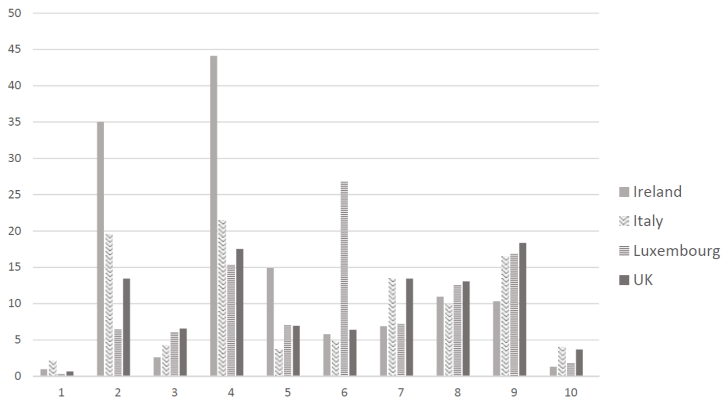


Figure 8: Gross value added by industry, selected European countries

Note: 1 - agriculture, forestry and fishing; 2 - manufacturing; 3 - construction; 4 - wholesale and retail trade, transport, accommodation, and food services; 5 - information and communication; 6 - financial and insurance activities; 7 - real estate activities; 8 - professional, scientific, and technical activities; administrative and support service activities; 9 - public administration, defence, education, human health and social work activities; 10 - arts, entertainment and recreation, other service activities.

Source: Eurostat (extracted on November 30).

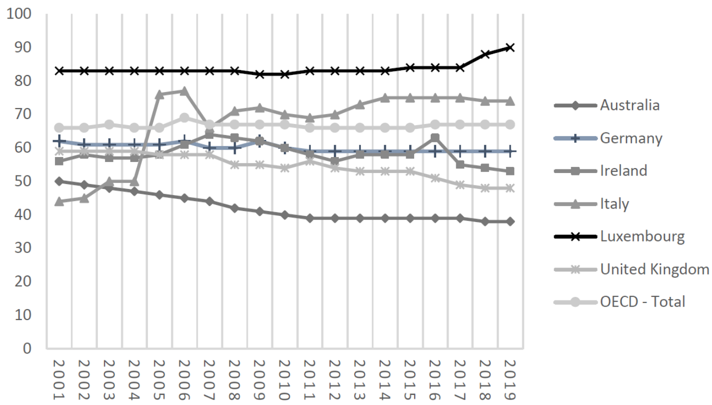


Figure 9: Net replacement rates in unemployment for a single person without children at 67% the average wage

Note: Figure based on OECD data, https://stats.oecd.org. The replacement rates include also social assistance and housing benefits.

6 Conclusion

COVID-19 has swept across the globe for most of 2020 disrupting social and economic activities in most countries. In the early months of the crisis, full or partial lockdown restrictions were put in place leading to job loses, which in turn shocked household incomes to varying degrees. The rapid economic changes and the lack of up-to-date data to understand these changes increased the relevance of using microsimulation tools to understand these changes and how the COVID-induced policy responses fared in cushioning household incomes. Our paper proposes a novel approach that combines microsimulation and nowcasting techniques to provide "near real-time" information to policymakers on the implications of economic shocks and associated policy responses on the distribution of household incomes, despite the unavoidable lags affecting the collection of survey data.

We contribute to the literature by applying this approach in order to bring evidence on the resilience during the COVID crisis of a typical Continental welfare regime, designed to be strong in times of crisis. Luxembourg introduced minor tweaks to an existing tax-benefit system with instruments with a strong social insurance focus that gave quite a certainty during the crisis. Other countries, with either an anti-poverty focus as in the case of the Anglo-Saxon welfare regime (e.g. Australia, the UK and Ireland), or countries with a social insurance regime focused on pensions such as the Mediterranean welfare regime (e.g. Italy) had to introduce radically different policies since their existing systems had a different functioning with a design that did not have the ability to cope with the COVID-19 crisis.

Our analysis shows how the crisis-induced income-support policy modifications of existing instruments of the tax-benefit system were effective in cushioning household income across the distribution and in mitigating an increase in income inequality in the early stages of the pandemic. We find evidence that disposable incomes dropped in absolute values throughout the distribution, more at the top than at the bottom. In relative terms, we find evidence of a U-shape relationship, with higher relative losses for the middle of the distribution compared to the top and bottom of the distribution. Relative to mean incomes, which dropped during the crisis, the poorest households improved their relative position compared to the households in the middle of the distribution, which lost relative to the mean. This resulted in a stable level of disposable income inequality in the early stages of the crisis, albeit resulting from a different composition of income sources: we observed a decrease in the share of labour incomes compensated by an increase in the share of benefits, reflecting the cushioning effect of the transfer system.

Under the impact of the labour market shock, labour incomes (and overall market incomes) dropped throughout the distribution and became more unequally distributed (by 5.3 Gini points in Q2 and 8.7 Gini points in April). The disequalizing evolution in labour incomes was overpowered by an increase in redistribution through the tax-benefit system.

We isolate the impact of the COVID-induced policy changes from the impact of the labour market shock to see how the pre-COVID policy rules would have fared against the shock in comparison with the COVID policy rules. We find evidence that the system was well-equipped ahead of the crisis to cushion household incomes against job losses as we find inconsequential distributional differences in the policy functioning of the two systems (before and during the crisis) assessed against the same labour market shock. The main difference between the pre-existent unemployment benefit and the short-term unemployment scheme re-activated during the pandemic lies in the speed with which individuals could access benefits under the two schemes and the additional eligibility conditions for the existing unemployment scheme: people falling into short-term unemployment could access benefits faster irrespective of the eligibility conditions of the standard unemployment scheme.

Net redistribution increased during the crisis and was mainly driven by an increase in the generosity of benefits and larger access to benefits. These changes are mainly explained by the labour market shock, signalling the automatic stabilizers embedded in the pre-COVID system.

On a methodological note, our approach could serve as a real-time analysis and decision support tool to monitor the recovery, with high applicability for policymakers. It is applicable to assessing the impact of later stages in the COVID crisis such as part of re-opening and long-term sustainability strategies. The methodology is well designed to explore these changes both for the whole economy and for specific sectors. Using the model, policymakers could explore a menu of policy combinations in terms of their impact on key welfare measures and fiscal costs. Furthermore, this approach could be linked to epidemiological models (e.g. Burzynski et al., 2020) which allow extending the scope of the analysis to adjacent dimensions, such as the roll-out of vaccines and recovery strategies. As the infrastructure relies on a flexible income generation model, on comparative cross-national data sources, and on the pan-European tax-benefit model, EUROMOD, it is scalable to other countries thereby enhancing its applicability and policy relevance.

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Appendix

A Models

Table A–1: Definition of income components and summary modelling information - part 1

Variable	Definition	Level	Treatment	Transformation	Model
y_h	total household disposable income	household	aggregate		–
y_h^L	gross labour income	household	aggregate		–
I_{hi}^{emp}, y_{hi}^{emp}	employee income (wage*hours)	individual	modelled	LM struct/Returns	logit, Singh-Maddala
I_{hi}^{se}, y_{hi}^{se}	self-employment income (receipt, amount)	individual	modelled	LM struct/Returns	logit, log-linear
y_h^K	capital income (investment, property)	household	aggregate		–
I_h^{inv}, y_h^{inv}	investment income (receipt, amount)	individual	modelled	LM struct/Returns	logit,log-linear
I_h^{prop}, y_h^{prop}	property income (receipt, amount)	individual	modelled	LM struct/Returns	logit,log-linear
I_h^{pripen}, y_h^{pripen}	private pensions (receipt, amount)	individual	modelled	LM struct/Returns	logit,log-linear
y_h^O	other non-benefit incomes (receipt, amount)	individual	aggregate, modelled	LM struct/Returns	logit, log-linear

Table A–2: Definition of income components and summary modelling information - part 2

Variable	Definition	Level	Treatment	Transformation	Model
y_h^B	public transfers	household	aggregate	TB	–
y_{hi}^{repl}	replacement income (pensions, unemployment)	individual	aggregate	TB	–
I_{hi}^{unemp}, y_{hi}^{unemp}	unemployment benefits (receipt, amount)	individual	aggregate, modelled	TB	logit,log-linear, EUROMOD
$I_{hi}^{partialunemp}$, $y_{hi}^{partialunemp}$	short-term unemployment - Covid benefit (receipt, amount)	individual	modelled	LM/TB	logit, EUROMOD
I_{hi}^{pens}, y_{hi}^{pens}	public (state, survival, occupational pensions) (receipt, amount)	individual	aggregate, modelled	TB	logit,log-linear, EUROMOD
$I_{hi}^{disability}$, $y_{hi}^{disability}$	disability (receipt and amount) sickness (receipt and amount)	individual	aggregate, modelled	TB	logit, log-linear, EUROMOD
$I_{hi}^{sickness}$, $y_{hi}^{sickness}$	sickness (receipt, amount)	individual	modelled	TB	logit, log-linear, EUROMOD
$I_h^{housing}$, $y_h^{housing}$	housing benefits (receipt, amount)	household	modelled	TB	logit, log-linear, EUROMOD
y_h^{sa}	social assistance	household	modelled	TB	EUROMOD
y_h^{osw}	other social welfare	household	modelled	TB	logit, log-linear, EUROMOD
y_h^{fb}	family benefits	household	modelled	TB	EUROMOD
y_h^{mb}	maternity benefit	household	modelled	TB	logit,log-linear, EUROMOD
y_h^{cb}	child benefit	household	modelled	TB	EUROMOD
t_h	taxes and social security contributions	household	aggregate, modelled	TB	EUROMOD

Table A–3: Demographic and labour market variables

Variable	Definition	Level	Treatment	Factor	Model
n_h	household size	household	observed	Demo	–
x_h	household-level demographic characteristics (number of children aged 0–3, 4–11 and 12–15) and individual characteristics of the household head (marital status, gender, age and age squared, university education)	household	observed	Demo	–
x_{hi}	individual-level characteristics: gender, age and age squared, university education, marital status, number of children in the household (aged 0–3, 4–11 and 12–15), citizenship, age*university, age squared*university	individual	observed	Demo	–
occ_{hi}	Occupation (1-digit ISCO); for working individuals only	individual	modelled	LM Struct	multinomial logit
ind_{hi}	Sector (primary, secondary or tertiary); for working individuals only	individual	modelled	LM Struct	multinomial logit
pub_{hi}	Public or private sector job; for employees only	individual	modelled	LM Struct	logit
$white_{hi}$	White collar vs. blue collar	individual	modelled	LM Struct	logit
$experience_{hi}$	Labour market experience	individual	observed	LM Struct	–
s_{hi}	Number of hours worked	individual	modelled	LM Struct	linear
w_{hi}	Average wage rate; for employees only	individual	modelled	Returns	Singh-Maddala

B Population and labour market structure

Table B–4: Population and labour market structures (shares of total population)

	Q1 2020	April 2020	Q2 2020
Demographic			
Tertiary Education	0.338	0.338	0.338
People 16-65	0.704	0.704	0.704
People >65	0.133	0.133	0.133
Child 0-3	0.042	0.042	0.042
Child 4-11	0.077	0.077	0.077
Child 12-15	0.044	0.044	0.044
Married	0.545	0.545	0.545
Citizen	0.541	0.541	0.541
Male	0.498	0.498	0.498
Labour market			
In-work	0.579	0.573	0.574
Employee/Self-Employed	0.908	0.898	0.897
Covid Partial Unemployment	.	0.285	0.173
Occupation			
Managers	0.059	0.070	0.069
Professionals	0.413	0.428	0.428
Associate Prof.	0.162	0.157	0.157
Clerks	0.074	0.074	0.074
Service	0.098	0.093	0.093
Craft	0.086	0.094	0.094
Plant	0.063	0.043	0.043
Unskilled	0.045	0.042	0.043
Industry			
Agriculture	0.016	0.016	0.016
Manufacturing...	0.046	0.049	0.049
Construction	0.079	0.084	0.084
Commerce	0.396	0.404	0.404
Transport	0.057	0.051	0.052
Public administration	0.114	0.122	0.122
Education/Health/Social	0.214	0.210	0.210
Other	0.079	0.063	0.063
Public/Private	0.061	0.059	0.059
Other market factors			
With private pensions	0.005	0.005	0.005
With capital income	0.350	0.350	0.350
With other income	0.013	0.013	0.013

Notes: The estimates are weighted. The shares for education refer to age-group 25-64; for married, sex to age >= 16; for in-work to ages 15 to 80; for employees, occupation, industry and sector to those in work aged [16, 80); for citizen to the entire sample. The shares for private pensions refer to ages >= 45, for capital age>= 16. The aligned shares for inwork, employees, occupation, industry and sector include people in partial unemployment due to COVID as the LFS considers their status as employed. In order to capture the labour market shock, the shares in temporary unemployment reflect the proportion of those employed aged [16,80) who fell into partial unemployment. Wholesale and retail, Hotels and restaurants, Communication, Financial intermediation, and Real estate and business were grouped into Commerce.

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