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COVID-19 and the Mortgage Market in Luxembourg

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Abstract: With a ratio of household debt to gross disposable income above 150%, households in Luxembourg are among the most indebted in Europe. A high level of debt exacerbates the sensitivity of household net worth to changes in house prices, which can increase the severity of economic downturns. In this note, we evaluate the implications of the COVID-19 crisis for the mortgage market in Luxembourg using data on the labour market and government interventions, as well as surveys of consumer finances (HFCS). Our conclusions are twofold. At the aggregate level, the Luxembourg mortgage market is relatively well placed to weather the shock, because a large share of residents work in sectors that are less affected by the crisis such as the financial or government sectors. However, our analysis of micro-level survey data suggests that some segments of the population may be financially vulnerable to the COVID-19 shock.

Keywords: COVID-19; household finance; real estate market; mortgage market

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1. Introduction

> The residential real estate sector of Luxembourg is a source of systemic risk to financial stability, which may have the potential for serious negative consequences for the real economy.
>
> ESRB, 22 September 2016.

How will the COVID-19 pandemic affect the mortgage market in Luxembourg? As underlined by the European Systemic Risk Board (ESRB) in a formal warning issued in 2016[1], the indebtedness of households in Luxembourg is high. High household leverage can amplify negative shocks and further worsen potential downturns. Since the COVID-19 pandemic is a large negative shock to the economy, it is important to understand how the pandemic could affect the mortgage market in Luxembourg. On this note, we use a broad range of databases to shed light on this question. We review key facts on the financial situation of households, on the mortgage market, and on the structure of the labour market. Then, we use data from the Household Finance and Consumption Survey (HFCS) to perform a stress test of household balance sheets. Our findings suggest that at the aggregate level, the structure of the labour market for households living in Luxembourg could help attenuate the COVID-19 shock, since households who have mortgages in Luxembourg mostly work in sectors that are less affected by the pandemic. However, at the micro level, the stress test reveals substantial differences in the financial situations across households, so that some households may be at risk of financial distress.

Similar to many countries around the world, Luxembourg has been affected by the COVID-19 pandemic. A first peak of 27 new daily infections per 100,000 inhabitants was reached in late March 2020.[2] Then, the number of new infections declined and remained broadly stable in the summer. In the fall, the country experienced an acceleration of infections which rose from 8 to 107 between October and November 2020. The situation in

neighbouring countries has been broadly similar to that of Luxembourg, with new daily cases per 100,000 inhabitants peaking respectively at 30, 80, and 130 and in Germany, France, and Belgium during the fall of 2020.

To limit the spread of the virus, the government put in place a number of restrictions on economic and social activities. In March 2020, schools, restaurants, and bars as well as non-essential retail trade and personal services were closed. A gradual easing of the measures took place in late April, with a partial reopening of schools and shops in May. Some restrictions remained in place through the summer, and the measures were tightened again in the fall as the number of infections surged.

The pandemic and the restrictions have had a substantial economic cost. The Luxembourg GDP fell by 7.6% year on year in the second quarter of 2020. The unemployment rate increased from 5.4% in February to 6.9% in May 2020. The high cost of the crisis has in turn increased the attention on potential vulnerabilities in the economy. With a ratio of household debt to disposable income above 150%, the high indebtedness of households is perhaps one of the main vulnerabilities of the Luxembourg economy. House prices in Luxembourg are among the highest in Europe and grow at an accelerating pace from 6% per year in 2017 to 14.5% per year in 2020. The growth in house prices has been associated with a growth in household debt, so that the debt to disposable income ratio of households in Luxembourg is now the third highest in the European Union.

High indebtedness of households can increase the cyclicality of the business cycle. As households increase their leverage, their net worth becomes more sensitive to changes in house prices. A small decline in house prices can then strongly reduce the net worth of households, who in turn cut back on consumption to rebuild their balance sheet (Mian et al. 2013). House prices are also tightly linked to credit conditions so that changes in credit markets can amplify negative shocks (Favilukis et al. 2017).

In this note, we explore the implications of the COVID-19 shock for the Luxembourg mortgage market. Given the specificity of Luxembourg as a small open economy with a large share of workers commuting from neighbouring countries, our approach deliberately takes a reduced form. We gather a number of stylized facts from a broad array of databases to provide a first assessment of the impacts of the COVID-19 crisis on the financial wealth of households and the mortgage market in Luxembourg. In the first part, we discuss a number of features of the labour market, the government measures taken to fight COVID-19 as well as data on the banking sector. In line with studies of other economies, we find that the pandemic had a strong asymmetric impact across sectors. While requests for partial unemployment benefits from sectors such as finance or business services were limited, they were requested for more than 80% of workers in hospitality and catering and in the construction sector, and for around 50% of workers in industry at the height of the first lockdown in March 2020.

Given the strong asymmetric impact of COVID-19 across industries, we study more specifically how jobs are distributed across sectors (economic branches) in Luxembourg. Relative to the European Union, sectors that are less exposed to the pandemic, such as finance, have a higher weight (11% compared to only 2% in the EU), while industrial jobs for instance represent a smaller share of domestic employment (8% in Luxembourg, 16% in the EU). To study further the impact on the mortgage market, we then decompose employment into domestic and national employment. Domestic employment includes all workers employed by firms based in Luxembourg and national public institutions (excluding workers from international institutions). National employment instead includes the workers who live in Luxembourg. The distinction is important, because the economy of Luxembourg relies heavily on foreign commuters. Of the 465,000 workers working in Luxembourg, 200,000 (43%) commute in and out of the country every day. The residence of the workers is also important, since the mortgage markets have remained, to a large extent, fragmented across national borders. A household buying a house in France or Germany is much more likely to take a mortgage from a French or German bank rather than from a

bank in Luxembourg. Therefore, to assess the risks for the Luxembourg mortgage market, we must understand in which sectors the households living in Luxembourg actually work.

Heavily affected sectors such as industry, wholesale and retail trade, transport, hospitality, and catering (Horesca) activities employ a large number of workers (142,000 or 31% of domestic employment), but only 39% of these workers live in Luxembourg[3]. In fact, public administrations, financial corporations, and international bodies account for almost 50% of national employment (i.e., workers living in Luxembourg). These sectors were less exposed to the COVID-19 shock, and thus, workers living in Luxembourg may be less likely to enter financial distress.

In the second part of the paper, we use survey data from the Household Finance and Consumption Survey (HFCS) to perform a stress test of households in Luxembourg. The anonymised survey data include the key balance sheet items of around 1500 households living in Luxembourg. While the average balance sheet of households in Luxembourg is strong, we show that there is substantial heterogeneity in savings, wealth, and income both across and within sectors of the economy. To assess the financial resilience of households, we compute a 'Free savings rate', which is defined as the cash flows generated by households after the payment of all expenses, taxes, and housing-related expenses such as mortgage reimbursements. We find that the average free-savings rate of homeowners with a mortgage is 9%. However, there are substantial differences in the free savings rate across sectors, from sectors such as ICT (information and communications technologies) having high savings, while households in the Horesca and Retail trade sector are more vulnerable to changes in income. Then, we perform a simple back of the envelope calculation. Based on figures on requests for partial unemployment benefits, we assume that a fraction of workers in each sector is hit by an income reduction of 20% to 40%. The 20% income reduction corresponds to the replacement rate offered by the partial unemployment scheme. The 40% income reduction corresponds to a more conservative scenario that could reflect for instance informal work, a reduction in variable income, or the time-limits on unemployment benefits. Our figures suggest that around 0.93–2.2% of homeowners with mortgages under full lockdown would become vulnerable with less than 3 months worth of liquid assets to cover their negative free savings cash flows.[4]

Overall, our results suggest that at the aggregate level, the Luxembourg mortgage market may be well placed to weather the COVID-19 shock. However, at the microeconomic level, there is substantial heterogeneity in the strength of household balance sheets.

The paper is structured as follows. In Section 2, we describe the sources and datasets that we analyse. Then, we provide in Section 3 stylized facts on the household indebtedness and the mortgage market in Luxembourg. In Section 4, we assess the extent of the COVID-19 shock and its impact on employment across sectors and on banks in Luxembourg. In Section 5, we perform stress tests to estimate the COVID-19 shock on household balance sheets. Section 6 concludes.

Related Literature

Our paper is related to several strands of the literature.

A first strand of the literature has used household survey data to perform stress tests of household balance sheets. Giordana and Ziegelmeyer (2019) perform a stress test of household finances in Luxembourg. They build on the previous work that explored the debt burden and financial vulnerability of households in Luxembourg (Giordana and Ziegelmeyer 2017). Other authors have used similar methodologies focusing on other countries such as Estonia (Meriküll and Room 2020), Italy (Faiella et al. 2021), Austria (Albacete and Fessler 2010), or the euro area (Ampudia et al. 2016). Our contribution with respect to these analyses is the combined focus on Luxembourg and on the COVID-19 shock. One element that is particularly important in our analysis is that the sector of employment of the households plays a central role. The consideration of the sectoral impact is key to understand the COVID-19 shock, and this aspect was previously overlooked by the literature.

A second strand of the literature has analysed the implications of the COVID-19 pandemic for the real estate market. Studies on the interaction between COVID-19 and the real estate market have generally found a contrasted impact of the pandemic on the different types of properties. Gupta et al. (2021) find a "flattening of the curve" of real estate prices across geography. While center locations traded at a large premium relative to the periphery, the pandemic has reversed about 9% of the urban premium. In the case of Luxembourg, a study from Immotop (2020) stated that the announced median price increase for houses was higher for houses than for apartments during the first three quarters of 2020, whether in total or per m^2. Glumac et al. (2019) have shown a strong gradient of house prices, with houses close to the city center trading at higher prices relative to similar houses further in the periphery.

Another strand of the literature that is relevant to our study has focused on the impact of COVID-19 on stock prices. Understanding this relationship is important, as stocks can be owned by households, so that a decline in value would also affect their financial vulnerability. Narayan et al. (2022) study the relationship between COVID-19 and stock returns in Australia. Using a quantile regression framework, they show that the impact of COVID-19 was highly heterogeneous across sectors. In particular, stock prices in sectors such as health, information technology, and consumer staples increased relative to other sectors. This finding, consistent with similar studies in the U.S. (Mazur et al. 2021), is also in line with the observations for Luxembourg, both in terms of the usage of the partial unemployment scheme (Section 3) or the heterogeneity in the shocks that we use in the stress tests (Section 5).

The partial unemployment schemes that we describe in the paper are one of the many measures taken by governments to respond to the COVID-19 emergency. Koulischer et al. (2021) and Demyen (2022) analyse measures aimed at corporations, such as subsidies or loan guarantees. They find that such measures were useful to stabilise the economy and limit the potential damage of the COVID-19 shock on the economy. As we do not consider such measures, our analysis can be considered as a complement to these studies that focus more on the corporate support measures, while we focus on the household dimension. An important area of interaction between household and corporate finances is the labour market. Campa et al. (2021) study the impact of the COVID shock on the Swedish labour market. They document a highly heterogeneous impact across households, which suggests that the COVID shock increased the inequality across households. This finding is in line with our conclusion that some households in Luxembourg may be particularly at risk of financial vulnerability in the aftermath of the COVID-19 shock. On the aggregate side, Beine et al. (2020) study the impact of COVID-19 on the economy of Luxembourg. They find that the most severe lockdown measures could reduce Luxembourg's monthly output by 28 to 42% and that the COVID-19 crisis might lead to a permanent loss in output for Luxembourg.

A final strand of the literature that is relevant for our work has analyzed the design of the COVID-19 restrictions. The design of optimal policies has been studied by Janiak et al. (2021) in a Susceptible, Infectious, or Recovered (SIR) model. On the empirical front, Bourdin et al. (2022) study the drivers of the restrictiveness of health measures to tackle COVID-19. They argue that the number of patients in intensive care units is a key driver of the stringency of health measures, further highlighting the necessity of these measures to contain the virus despite their economic costs. Narayan et al. (2021) further study the impact of lockdowns on the economy. They show that lockdowns, travel bans, and economic stimulus packages all had a positive effect on the G7 stock markets. However, lockdowns were most effective in cushioning the effects of COVID-19. Our work complements their analysis by further documenting the impact of COVID-19 on the labour market of Luxembourg and on the financial fragility risks faced by households.

2. Data

To assess the extent and the impact of the COVID-19 shock, we gather a number of stylized facts from various databases. We first analyse the financial situation of households and the housing cost overburden before the sanitary crisis from the Survey on Income and Living Conditions (SILC) carried out by the STATEC and the Household Finance and Consumption Survey (HFCS) of the Central Bank in Luxembourg (BCL). HFCS collects information on household assets, liabilities, income, and consumption. We follow the evolution of COVID-19 cases in Luxembourg and in the neighbouring countries from the European Centre for Disease Prevention and Control and assess the impacts on the labour market. For the latter, we analysed the increase in the unemployment rate in Luxembourg and the requests for partial unemployment benefits by industry using data from the Comité de conjoncture and ADEM (Agence pour le développement de l'emploi). Given the strong asymmetric impact of COVID-19 across industries, we look at the jobs distribution across sectors in Luxembourg using data from the national accounts of STATEC and from the Labour Force Survey (LFS) to study more specifically workers who live in Luxembourg.

We evaluate the risks of the COVID-19 shock for the financial sector by assessing the balance sheet of the major retail banks in Luxembourg from Bankfocus and the evolution of mortgages and assets during the crisis from the ECB and BCL databases.

To evaluate the heterogeneous effects of COVID-19 across sectors, we analyse partial and full unemployment data from Luxembourg unemployment office ADEM and complement it with information of Social Security Office (IGSS—Inspection générale de la sécurité sociale). With these data, we compute the probability of losing a job or going into partial unemployment across sectors before the lockdown, under full lockdown, and under partial lockdown. Those measurements accurately reflect how the different industries have been affected by the stringent measures for preventing the COVID-19 outbreak.

We also use microdata from HFCS and SILC. HFCS provides insights into the economic behaviour and financial situation of households. Three waves are currently available for Luxembourg: Wave I in 2010, Wave II in 2014, and Wave III in 2018. However, the classification of ISCO (International Standard Classification of Occupations) in HFCS for Luxembourg is limited only to 1-digit major groups. It is limited when we want to map workers' seniority to their ability to work from home. Hence, we complement this analysis by using the data from SILC. SILC does not contain household wealth data, but it includes details on household 2-digit ISCO and NACE classification. In this paper, we use the latest data in SILC to analyse teleworking probability across sectors and the HFCS Wave III for computing Luxembourg Household Balance Sheet and perform our stress test under a heterogeneous shock of COVID-19.

3. The Mortgage Market before the COVID-19

We first review the financial and economic situation of households in Luxembourg before the COVID-19 shock. As shown in Figure 1, Households in Luxembourg earn on average twice as much as workers in the EU, according to the Eurostat Survey on Income and Living Conditions (EU SILC). This ratio is stable across the different quintiles of the distribution so that the relative inequality between the top and bottom quintiles is broadly similar in Luxembourg and the European Union. However, in absolute terms, there is a bigger gap between richer and poorer households in Luxembourg (around 40,000 € compared to 20,000 € on average in the EU).

According to the last Macroeconomic Imbalances Procedure of the European Commission, Luxembourg entered the COVID-19 crisis with no identified macroeconomic imbalances although with some risks related to increasing housing prices and household debt (European Commission 2020). As shown in Figure 2, the household debt to gross disposable income ratio was above 170% in 2018, which is the 3rd highest ratio in the EU after Denmark and the Netherlands, and it is well above the average in the euro area (94%).

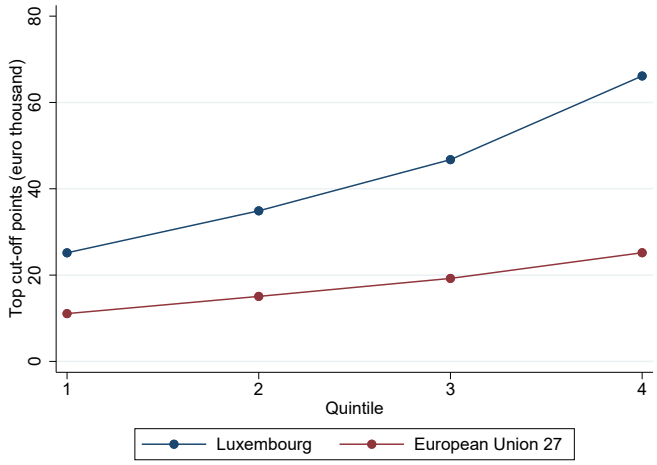


Figure 1. National equivalised income across quintiles for Luxembourg and European Union (27). *Note:* This figure shows the income of the top cut-off points of the first four quintiles of the income distribution in Luxembourg and the European Union. Figures are in thousand euros. Data source: Eurostat Survey on Income and Living Conditions, 2019.

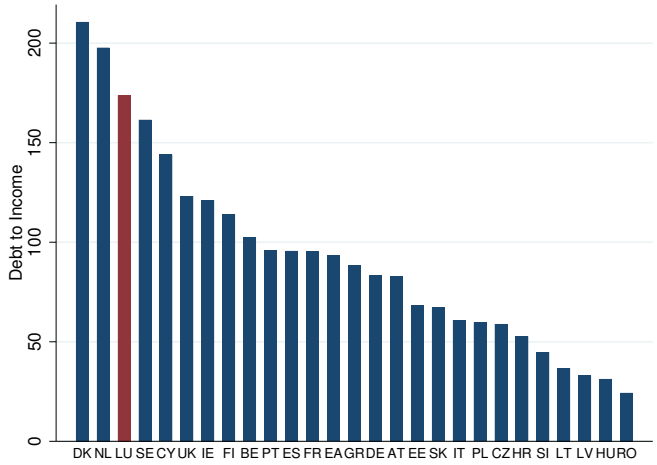


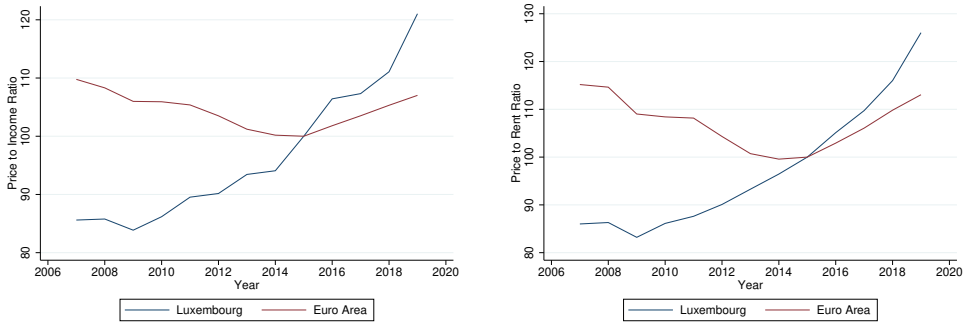
Figure 2. Household debt to disposable income in the European Union. Data source: Eurostat, 2018.

High household leverage can increase the procyclicality of the business cycle (Mian et al. 2009). If households have a lot of debt and very high leverage, then their net worth becomes very sensitive to changes in house prices. If house prices decrease, this would lead to large negative impacts on the households' net worth. Zigrand (2020) highlighted that 85% of wealth is tied up in housing in Luxembourg, "No other country comes close to that. If house prices go down, the wealth of the nation will go down".

In its Financial Stability Review (2020), the ECB explained that "In some countries, high household indebtedness makes the housing market even more vulnerable. A number of euro area countries have both household debt to disposable income ratios at or above 100% and increasing signs of overvaluation. A marked rise in unemployment could have a negative impact on debt servicing capacity, which might contribute to a price correction in the RRE (residential real estate) market. Whether these risks to RRE prices materialise will depend to a large extent on how far unemployment rises and how far future household income drops when support schemes are scaled back" (ECB 2020).

Over the last decade, house prices have increased faster than the average income in Luxembourg, the price to income ratio raising from around 85% in 2008 to more than 120% in the end of 2019 (see Figure 3). The price to rent ratio—which measures how much it costs to own a house instead of renting it—has also grown steadily since 2010 (+40% points).

House prices have surged (+98% since 2008), while average rents rose 45% in the same period. The price to rent ratio can warn of an overheating in the housing market.



Price to income Price to rent

Figure 3. Price to income and price to rent ratios. Data source: OECD, 2019q3.

Despite the crisis, house prices in Luxembourg grew strongly in 2020 (+14% over one year in the 3rd quarter of 2020 in Luxembourg, +5% in the euro area). The supports for house prices are still there in Luxembourg: few offers, low risk for investing, and sustained demand supported by low interest rates. However, the decrease in consumer confidence and GDP, with tighter lending standards, and fading demand could lead to a slowdown in the euro area housing cycle.

With the sharp increase of price to income ratio, some households become overburdened by housing costs. Figure 4 shows that nearly 40% of low-income households in Luxembourg are overburdened by housing costs compared to 33% in the EU.

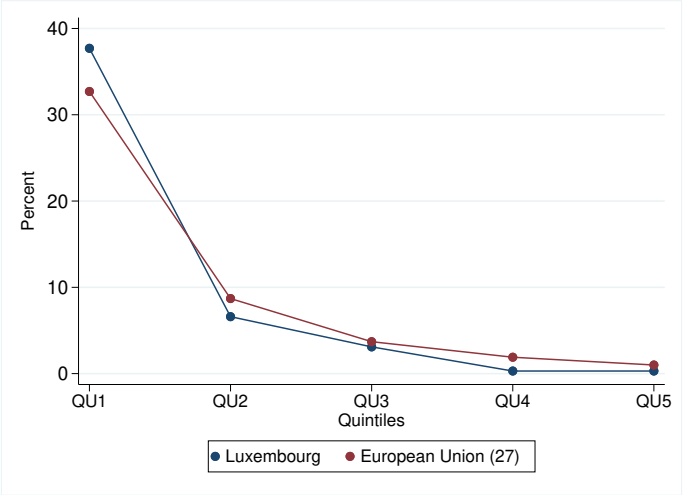


Figure 4. Housing cost overburden rate by income quintile for Luxembourg and the European Union (27). Data source: Eurostat Survey on Income and Living Conditions, 2019.

Table 1 gives the characteristics of households with mortgage outstanding in Luxembourg from the Households Finance and Consumption Survey (HFCS). The debt service to income ratio (DSTI) and loan to income ratio (LTI) vary significantly across the different income groups. The DSTI ratio—which measures how much households reimburse for their mortgage relative to how much they earn—varies from 15% for the 5th quintile to nearly 80% for the 1st quintile of households (with the lowest income). One should note that HFCS gives only a snapshot of households' situations. The banking sector's standard practice only grants mortgages to families with debt services not exceeding one-third of their total income. However, it mainly involves households' financial situations at the time of applying for a mortgage. Once given, a change in household's conditions does

not alter the granting decision already made (except when they cannot continue servicing the mortgages). We see a substantial variation in DSTI within households for the first income quintiles ranging from 0.1 to 7.5, with an average of 0.79 and a median of 0.45. It is understandable for those households that experience a shock in income, i.e., from prolonged unemployment or bankruptcy from independent activities, but we could not confirm those from the HFCS data, since it is not panel data.

Table 1. Household financial indicators by income groups.

Income Group	Pop. Share (%)	DSTI Mortgage	Loan to Income	Gross Income
Quintile 1	2.0	0.79	14.18	25,301
Quintile 2	3.4	0.24	3.64	48,305
Quintile 3	5.8	0.24	3.14	72,067
Quintile 4	7.7	0.19	2.76	108,514
Quintile 5	8.0	0.15	1.73	210,132

Authors' own calculation from HFCS survey data, Wave III (2018). We group household according to their total income quintiles and then subset only those who are homeowners with mortgages. Housing tenure status is based on the current status of a household's home main residence. The population share is respective to the whole population.

4. The COVID-19 Shock

Luxembourg was particularly hard hit by the COVID-19 shock in March 2020. While cases peaked at around 10 cases per 100,000 inhabitants in France during the first wave, the number of cases in Luxembourg peaked at 20,000. While cases subsequently fell in May, they peaked back in the fall of 2020, which was in line with cases in neigbouring Belgium, Germany, or France.

In March 2020, European countries were forced to adopt containment measures to slow and mitigate the spread of the coronavirus. This has meant shutting down many sectors of economic activity, either completely or partially. After a break in the summer, the second wave of infections has led to strengthened sanitary restrictions again (for details, see Table 2).

Table 2. Timeline of COVID-19 measures in Luxembourg in 2020.

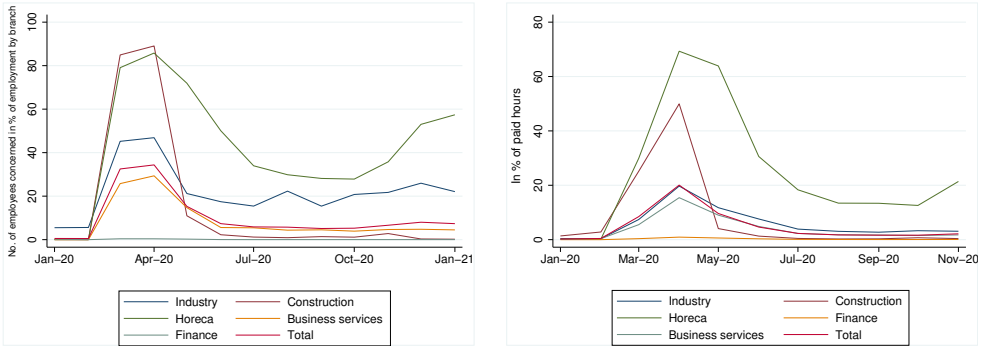
Date	Measures
Mar 16	Closure of schools, restaurants, and bars, non-essential retail trade, and personal services
Mar 23	Closure of construction sites and of passengers at Findel
Apr 20	Restarting of construction sites, DIY shops
May 4	Partial school reopening
May 11	Reopening of shops
May 25–29	Further reopening of schools, restaurants, passenger flights
Oct 30	Curfew (from 11 p.m.), new sanitary restrictions
Nov 26	Closure of restaurants and bars, cultural institutions, sport institutions
Dec 26	Curfew (from 9 p.m.), closure of schools, non-essential until 10 January

During the lockdown, the Luxembourg labour market suffered a rapid and substantial shock. Unemployment increased from 5.4% of the working population in February to 6.1% in March, especially following the closure of construction sites. New hires fell sharply with the containment (from 2500 in February to around 800 in April), causing unemployment to rise to 6.9% of the working population in May. Between February and June 2020, recruitments fell by 15%, in particular for young people (−21% for those under 25 and −20% for those aged 25 to 35) (STATEC 2020). At the same time, end of contracts fell even further (−19%), indicating a much lower turnover in the labour market than before the crisis.

With the relaxation of constraints, unemployment started to fall again (to 6.3% in October), but this trend has faded since the last quarter of 2020, and the rate is still around 1% above its pre-crisis level. The number of unemployed has particularly increased among men and young people from the construction industry and the hospitality and catering (Horesca) sector.

The COVID-19 shock on employment differs significantly across the economic sectors. On the one hand, those most affected by the health crisis (Horesca, commerce, industry, transport) lost some 2300 jobs between February and October 2020 (−1.6%, preliminary data). On the other hand, almost 4800 jobs (+2.3%) have been created over this period in the health and social action sectors, education, public administration, construction, social services, information and communication, and in the financial sector.

The partial unemployment scheme was the main measure for maintaining employment during the first containment and after. In April 2020, more than 13,000 companies had requested this state aid for more than 150,000 employees (see Figure 5). Without this aid, and by making the strong assumption that all the people concerned would have lost their jobs, unemployment would have doubled, and employment would no longer increase (−3.2% instead of +1.6% in October) (STATEC 2020).



Partial unemployment requests Paid hours not worked

Figure 5. Requests for partial unemployment and paid hours not worked in Luxembourg. Data sources: ADEM, Comité de conjoncture, IGSS, STATEC.

Nevertheless, "vulnerable sectors" such as hotels and catering, tourism, and events had already reduced their head count by about 2000 persons between February and May. Companies' job prospects, which were at their lowest point in April, are recovering only slowly across all sectors surveyed. Since November and the strengthening of sanitary measures, companies from the Horesca sector request again more partial unemployment benefits for their employees.

The paid non-working hours reported in Figure 5 give a picture of the effective use of the measure. In April 2020, 20% of all hours paid were for partial unemployment, while the requests granted concerned 34% of employees. Therefore, it seems that only 2/3 of the applications submitted actually led to partial unemployment. Working hours remained high in so-called "essential" branches as well as in teleworkable branches. In the 2nd quarter, 52% of resident employees teleworked, particularly in the financial sector (88%), education (80%), and jobs related to information and communication (77%).

Luxembourg is the only country in the euro area where total employment has slowed down but not declined in 2020. This is explained to a lesser extent by partial unemployment, but more importantly because the activity has decreased less in the sectors most exposed to the crisis and because some branches of services, traditionally very dynamic and with a significant weight in the GDP, were less affected by the crisis (the financial sector, for example).[5]

In Luxembourg, 32% of employees work in the financial sector or in public administrations, which are less affected by the lockdowns and sanitary measures, compared to only 25% in the EU (Figure 6). If we only look at the residents in Luxembourg (excluding

cross-border workers), 40% are employed in the financial sector or in a public institution (see Table 3).

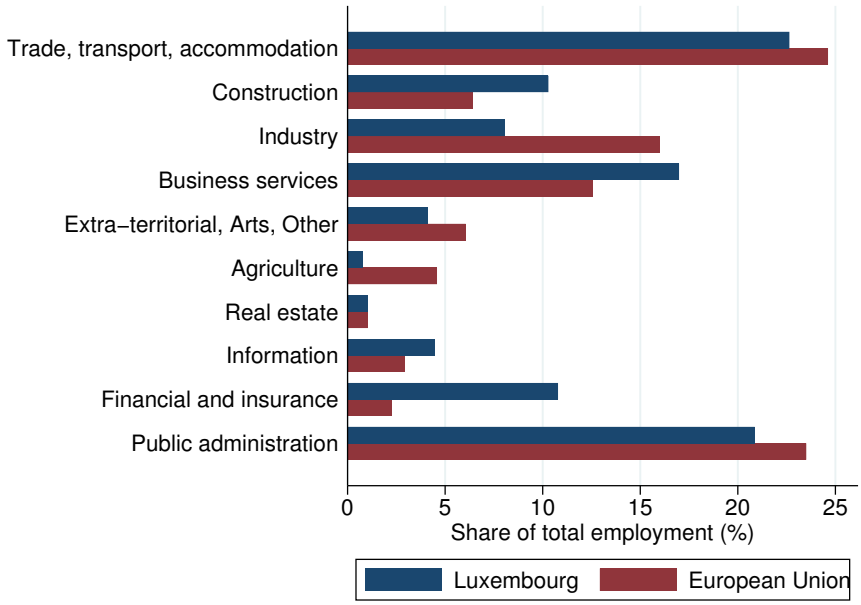


Figure 6. Domestic employment by sector, European Union and Luxembourg. Data source: Eurostat, Employment A*10 industry breakdowns, 2019.

Table 3. Employment in Luxembourg: national versus domestic.

Sector	Domestic	Share	National	Share	Share of Non-Residents
Wholesale and retail trade, transport, Horesca	105	23%	43	15%	59%
Construction	48	10%	16	6%	66%
Industry (except construction)	37	8%	13	4%	66%
Technical activities; admin. and support	80	17%	34	12%	57%
Agriculture, forestry, and fishing	4	1%	2	1%	50%
Real estate activities	5	1%	2	1%	56%
Information and communication	21	4%	12	4%	44%
Financial and insurance activities	50	11%	32	11%	37%
Public sector, education, human health	96	21%	83	29%	14%
Extra-territorial, arts, other service	19	4%	33	11%	-
Total	465	100%	287	100%	38%

Domestic employment refers to workers working for employers based in Luxembourg, including the private sector and national government institutions but excluding supra-national institutions. National employment is the sector of employment of workers that live in Luxembourg. It includes workers for supra-national governments living in Luxembourg. Data sources: STATEC (National accounts), EUROSTAT (Labour Force Survey), 2019. The employment number is measure in thousand persons.

As in past crises, cross-border commuters were more affected during the containment (−0.9% in the 2nd quarter, against −0.4% for national employment), but they also enjoyed most of the rebound in employment in the 3rd quarter (+1.6%, against +0.7% for nationals). Over the first eight months of 2020, 5700 jobs were created, half of which were occupied by residents and the other half by cross-border workers.

4.1. Probability of Teleworking across Sectors

The COVID-19 pandemic is most likely to have heterogeneous impacts across industries and occupations. In case of stringent social distancing measures, those who work in finance or the public sector can work from home, while those who work in the Horesca

sector are more likely to be in partial or full unemployment. The sectors related to social and cultural activities are also most likely to be unable to perform one's job due to low demand or forced closure from the government. Dingel and Neiman (2020) have measured the teleworking possibility for all occupations and found that only 37% of total jobs in the United States can be done at home. Using the teleworkability measured from Dingel and Neiman and mapping it to two-digit ISCO classification, we find that 52.6% of jobs in Luxembourg can be performed at home.

Workers in a profession with high probability of working from home also earn more on average. Figure 7 illustrates the likelihood of teleworking from household heads to their average household disposable income. There is a significant variant across sectors; however, the trend is upward and highly significant. ISCO classification reflects the seniority in management level, so it is understandable that a low management level typically earns less and has a low probability of working from home. However, the trend is similar even when we map it to the NACE sector. As we can see from Figure 8, those who work in finance or ICT sectors regardless of management level have a much higher probability of performing their jobs at home than those who work in Horesca or construction sectors.

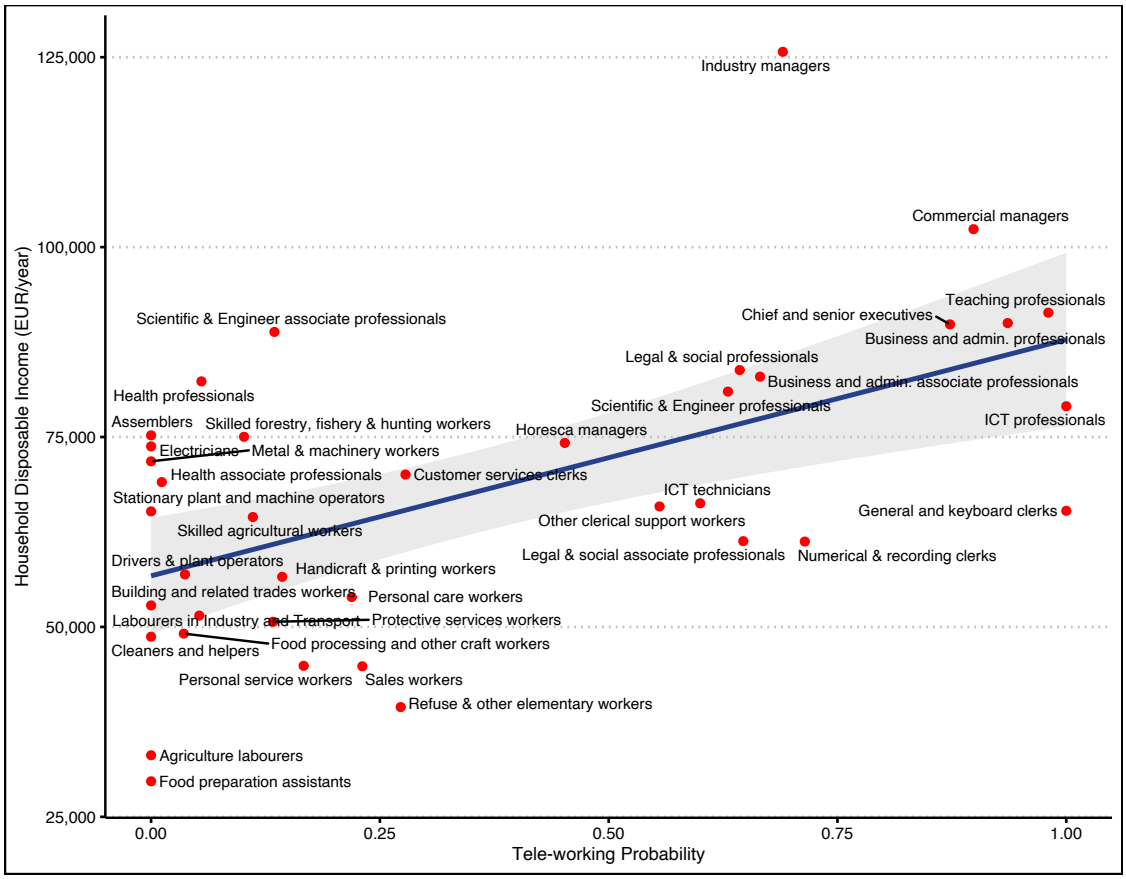


Figure 7. Probability of teleworking and disposable income in Luxembourg. Notes: Authors' own calculation based on SILC 2019 and Teleworkability Index from Dingel and Neiman (2020) mapping to each two-digit ISCO major group. The average household disposable income and the average probability of a job that can be done at home are weighted to representative of the whole population.

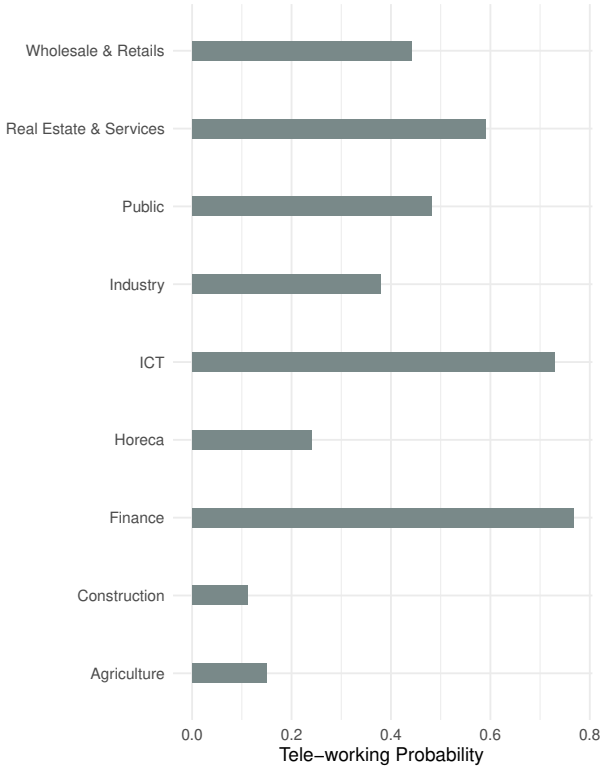


Figure 8. Probability of teleworking across sectors in Luxembourg. *Notes:* Authors' own calculation based on SILC 2019 and Teleworkability Index from Dingel and Neiman (2020) mapping to each NACE major group. The average average probability of a job that can be done at home are weighted to be representative of the whole population.

One should note that the feasibility of working from home is just one indicator for measuring the impact of the COVID-19 social distancing measures. Those whose professionals cannot work from home but are in essential industries might not be at a high risk of losing one's job than those who work in other sectors.

4.2. Mortgages and Banks in Luxembourg

Beyond the risks for households and the real economy, the COVID-19 shock and the high household indebtedness can create risks for the financial sector. The case of Luxembourg is specific given the role of the country as a financial center. This point is illustrated in Table 4, which shows the aggregate balance sheet of all banks (credit institutions) in Luxembourg. The total size of the balance sheet of banks is large, at more than €850 billion at the end of 2020. This represents around 3% of the size of banks in the euro area as a whole. Given the large size of banks' balance sheets relative to the size of the country and their specialisation in private banking, depositary banking, and corporate finance activities, mortgages account for a small fraction of banks' balance sheets in Luxembourg. Total mortgages outstanding stood at €39 billion at the end of 2020, which is equivalent to 5% of the assets of banks, against an average of 13% for banks in the euro area as a whole.

The total capital of the Luxembourg banking system is at €63.5 billion or 7% of assets. Thus, the ratio of capital to assets, also known as the leverage ratio, is comfortably above the 3% required by the Basel III regulations. Nevertheless, a major crisis on the local mortgage market could potentially reduce the capital of banks and affect their solvency. As of December 2020 (the last date available in Table 4), the COVID-19 crisis does not seem to have impacted substantially the balance sheets of banks in Luxembourg. Mortgages outstanding rose by a robust amount of €3.3 billion in 2020, which is higher than the increase in 2019 (+€2.5 billion). The amount of capital available to banks has also increased,

and so have deposits from households. As most households had little opportunity to consume while earning a stable income, they increased their savings. This improves the balance sheet of households but also provides a relatively stable and cheap source of funding for banks.

Table 4. Aggregate balance sheet of banks in Luxembourg.

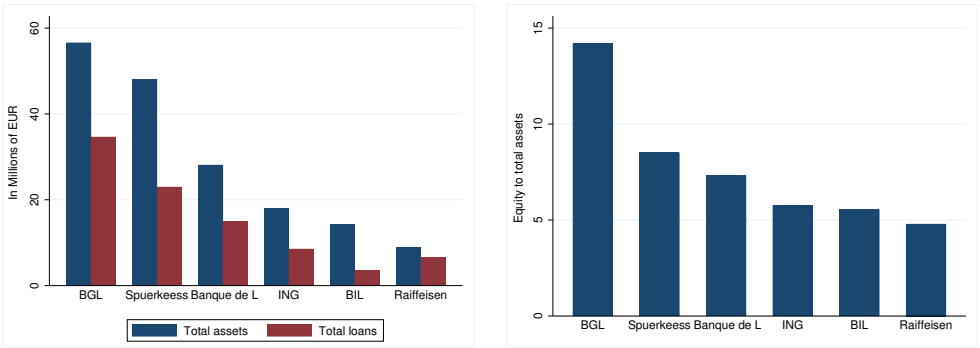
Item	Year		
	2018	2019	2020
Assets			
Mortgages	33,064	35,635	38,958
Corporate loans	112,087	117,607	107,082
Other assets	623,504	661,736	705,088
Total assets	768,655	814,978	851,128
Liabilities			
Capital	60,137	62,791	63,535
Household deposits	56,274	59,792	64,752
Non-househ. deposits	398,714	428,492	459,683
Other liabilities	253,530	263,903	263,158
Total liabilities	768,655	814,978	851,128

This table shows key items of the aggregate balance sheets of Monetary Financial Institutions (excluding the central bank) in Luxembourg. Sources: ECB, Luxembourg Central Bank. Mortgages: Loans for house purchase. Corporate loans: Loans to non-financial corporations. Household deposits are deposits from households, while other deposits are 'non-household deposits'. Figures in million euros and for December of each year.

Other prudential indicators suggest that the banking sector in Luxembourg is well capitalised, liquid, and has remained profitable despite the crisis and the low interest rates. According to the European Banking Authority[6], the average tier 1 capital ratio was 21% in June 2020 compared to 16% in the EU. Non-performing loans account for only 1% of total loans in Luxembourg (2% of non-performing loans in mortgages), while they represent 3% of total loans in the EU (3% of mortgages). The average return on equity remained stable at 6% in Luxembourg in June, while it fell in the EU from 5.7% in the end of 2019 to 0.5% in June 2020.

However, housing price developments, linked to the level of banks' exposure to mortgage credit and high household indebtedness, require continued monitoring. Between 2008 and 2020, the outstanding amounts of mortgages in Luxembourg have increased by 143%, while the average house price has doubled (+98%). The European Commission warned that for many consecutive years, real house prices have continued to grow at a relatively high rate and warrant close attention.[7] When we look at the aggregated balance sheet of all banks in Luxembourg (Table 4), only 5% of total assets (6% of total loans) are mortgages, but if we look only at the balance sheets of banks specialised in retail banking, mortgages account for 85% of total loans according to the last survey conducted by the ABBL and CSSF (ABBL and CSSF 2020).

The six major retail/universal banks in Luxembourg (namely the BGL, Spuerkeess, Banque de Luxembourg, ING, BIL, and Raiffeisen) held in their balance sheet 92% of long-term credits of households in Luxembourg at the end of 2019. As shown in Figure 9, these banks have a tier 1 ratio between 12 and 30% and a leverage ratio well above the minimum requirement. The high solvency ratios suggest that they could absorb potential losses on their mortgage portfolio in Luxembourg. The last alert mechanism reports of the European commission for Luxembourg state that even if household debt, which is mostly mortgage debt, has reached relatively high levels, reflecting the increase in house prices; see "Risks for financial stability are mitigated by the soundness of the banking sector"(European Commission 2019).



Balance sheets Leverage ratios

Figure 9. Balance sheets and leverage ratio of the 6 largest retail banks in Luxembourg. Data source: Bankfocus, 2019.

5. Household Stress Test

5.1. A Measure of Financial Distress

A standard way to measure households' debt burden in banking sectors is to calculate debt to income or loan value to income ratios. Those over-indebtedness indicators are undoubtedly valuable and vital to monitor, but they are insufficient. To better understand households' financial vulnerability and their probability of defaults, we need to consider all households' characteristics to determine their credit risks and repayment capability. Hence, the perfect datasets shall include all details about households' balance sheets (assets and liabilities) and their collaterals, loan repayment history, and information over the default rates. However, to our knowledge, such data types are not available in Luxembourg and at the European level. With this caveat, the Household Finance and Consumption Survey (HFCS) provide practical information and components for investigating households' financial distress. There are two main features that we think are suitable for our analysis of the HFCS survey. First, it provides detailed information on household balance sheets, including all details on assets and liabilities. Second, it contains both income and current loan repayment flows and information on consumption levels. Nevertheless, the HFCS also has some shortcomings. It does not contain any information on households' default rates. Hence, we need to construct an indicator to identify the likelihood of households defaulting on their debts.

We follow the approach of Ampudia et al. (2016) and Albacete and Fessler (2010). We first construct a free cash flow (or financial margin) of each household as follows:

$$FCF_i = GI_i - T_i - DS_i - R_i - LE_i$$

FCF_i denotes the free cash flow of household i, GI_i is the gross income, T_i is the social contribution and tax liability, DS_i is the debt service, R_i is the rent for those households who are renters, and LE_i is the Living Expenses. Since the HFCS data for Luxembourg taken from ECB does not contain information on tax liability or net income, we apply the social contribution and marginal tax rate on income brackets provided by the public authority to estimate the net income and tax rates. Since taxes in Luxembourg are progressive, any shock to income levels also affects the liable tax rates and social contributions. We also adjust them accordingly in our stress test.

With the measure of FCF, we could quickly identify those households who could not make ends meet; however, not all households with negative cash flow will immediately fall into delinquency. Those households with a high level of saved cash or liquid assets can solve their debts by liquidating those assets. We assume that they can continue to service their debts and maintain their living expenses until the financial assets run out. Hence, we define financially distressed households as their financial resources to cover their expenses

and debt services for a certain amount of time. Formally, we can write the indicator for financial distress (FD_i) of household i as follows:

$$FD_i = \begin{cases} 0 & \text{if } FCF_i \geq 0 \text{ or } LIQ_i \geq n \times |FCF_i| \\ 1 & \text{if } FCF_i < 0 \text{ and } LIQ_i < n \times |FCF_i| \end{cases} \quad (1)$$

where n is the number of months in which the liquid assets LIQ_i can cover the negative cash flow FCF_i. In this paper, we choose n equal to three months for two main reasons. First, it matches the 90-day limit of conventionally defined non-performing loans. Second, we follow Giordana and Ziegelmeyer (2019) threshold of 3 months for Luxembourg, since it fits the aggregate levels of non-performing loans in bank lending sectors to households. Additionally, to establish the link between household situations at the microdata level to the aggregate level of banking sectors, we assign the probability of defaults as those who are under financially distressed situation and compute the exposure to defaults (EAD) as follows:

$$EAD_i = \frac{\sum_{i=1}^{N} FD_i \times D_i}{\sum_{i=1}^{N} D_i}$$

where D_i is the total debts of household i. EAD reflects the expected sum of debts held by financially distressed households relative to total household debts inside the economy (Luxembourg). Then, the share of losses given defaults (LGD) is defined as

$$LGD_i = \frac{\sum_{i=1}^{N} FD_i \times (D_i - A_i) \times I_{(D_i > A_i)}}{\sum_{i=1}^{N} D_i}$$

where A_i is the real estate assets level of household i, and $I_{(D_i > A_i)}$ is the indicator function receiving a value of 1 if the level of debts is higher than the level of assets. Following Giordana and Ziegelmeyer (2019), we use a 'hair-cut' price of 25% loss when households need to liquidate their real estate assets. The LGD reflects the potential loss of banks coming from the household sector.

5.2. Basic Statistics and Analysis on Household Financial Distress

5.2.1. Descriptive Statistics

To see how households cope with the COVID-19 shock, especially in the mortgage market, we first take a look at the current financial state of a typical Luxembourg household. The financial state of households can display how many resources households can tap into, in case of an income shock, and how resilient their financial condition is, while servicing mortgages. Typically, families hold enough liquid assets they can continue servicing their debt for a long time. Thus, these households are well-equipped to cope with a temporary shock on their income or housing market than those who hold little liquid assets. It is also the first component in our financial distress indicator.

Panel A of Table 5 shows summary statistics of the free cash flows, liquid assets, and liabilities of an average household in Luxembourg and those currently servicing their mortgages on their primary residence. As we can see, on average, homeowners with mortgages have a household size of 3, which is a little above the national average at 2.4. After extracting the social contribution and all other expenses, households currently paying mortgages are left with over €7500 per year on average as free cash flow, which accounts for approximately 9.1% of their gross income. This ratio at national average is a little bit higher at 12.6%.

Table 5. Summary statistics on free cash flows and liquid assets of households, and the share of households with insufficient liquid assets to cover their negative cash flows by indicated months.

Panel A: Statistics on free cash flows and liquid assets		
	All Households	Home-Owners (w. Mortgages)
Population Share	100%	27%
Avg. Household size	2.40	3.06
Free Cash Flow (FCF)	€8610	€7548
Liquid Assets		
Cash	€59,207	€54,349
Fin. Assets	€59,865	€62,740
Real Estate Assets	€713,588	€860,313
Liabilities	€104,188	€302,581

Panel B: Share of households with insufficient liquid assets to cover their negative cash flows by indicated numbers of month						
	No liquid assets	1	2	3	6	12
All Households	2.7%	8.3%	10.4%	12.4%	16.1%	20.7%
Homeowners with Mortgages	1.1%	5.6%	6.3%	7.8%	12.4%	17.8%
Households with negative CFC	5.8%	18.1%	22.7%	27.1%	35.3%	45.2%

Authors' own calculation from HFCS survey data, Wave III (2018). Housing tenure status is based on the current status of household's home main residence.

On the assets holding side, Luxembourg residents overall are wealthy with average total assets of almost €1 million, and current homeowners with mortgages are even more affluent. However, the majority of that wealth is in real estate. The share of real estate accounts for more than 80% of total household wealth. Hence, if a shock hits the real estate market, Luxembourg household wealth levels will be largely affected. The house prices have doubled since 2010 in Luxembourg, which considerably boosts the overall wealth of homeowners. In Table 5, the total liabilities (including mortgage debts) of homeowners with mortgages are just around €300,000 on average. This means that the current Loan to Value (LTV) is just around 34%. This LTV is significantly below the standard 80% LTV commonly practised in the banking sector. The housing market's appreciation favours existing homeowners, but it puts high pressure on the young generation and new buyers. New buyers will face higher housing burden and significant down payment barriers for becoming a homeowner.

Panel B of Table 5 further reports the share of households who exhaust their liquid assets after a specific amount of time covering their negative free cash flows. Among homeowners with mortgages, only 1.1% have no liquid assets at all, which is higher than the national average. We also report those statistics for all households with negative free cash flow: 5.8% among them keeps no liquid assets, almost one-fifth of them do not have enough cash to cover their debts for one whole month, and it increases 35% if it is for a half of a year. That figure reduces to only 12.4% if we consider all homeowners with mortgages (not just those who have negative cash flows).

5.2.2. Household Financial Distress across Sectors

Overall, we can see that homeowners in Luxembourg hold high liquid assets (including cash and financial assets), and the current LTV on their mortgages is low. However, how good are those indicators across sectors and household demographic characteristics? As shown in the previous section, a COVID-19 shock with stringent social distancing measures is more likely to affect those who work in a profession with a low level of teleworking probability. Those who work in sectors with low demand due to COVID-19, such as event management or cultural services, are also more likely to be affected by the current sanitary

shock. Hence, we also check for the free cash flow, financial distress, and other indicators across sectors. The summary statistics are reported in Table 6.

Table 6. CFC, FD, EAD, and LGD for different sectors and groups of households.

	Average CFC	Mean FD in %	EAD in % of Debt	LGD in % of Debt
All households	€8610	12.41	7.79	0.32
Homeowners with mortgages	€7548	7.79	6.79	0.15
By Selected Sector				
Construction	€−722	26.58	7.30	0.48
Finance	€19,729	0.00	0.00	0.00
Horesca	€847	29.86	48.03	0.79
Others	€7863	12.06	7.53	0.37
Public	€11,714	4.37	4.80	0.33
Retails	€5721	15.29	9.59	1.53
Services	€16,956	29.51	32.32	0.00

Authors' own calculation from HFCS survey data, Wave III (2018). Housing tenure status is based on the current status of household's home main residence. Sectors are referred to the reference person.

We extract the classification of occupations and employment sectors of households from the household heads.[8] We also set the occupation classification and employment sector of the household head to the household.[9] For employees, HFCS reports the classification of their firm's economic activities at one-character NACE. For those who are self-employed, not all of them have their own business; hence, there is no information regarding their NACE employment sector. We can only track the NACE employment sector for those who are self-employed and possess their own business.

There is significant variance in the free cash flow and share of financially distressed households across different sectors. The share of households under financial distress ranges from almost one-third of households in the Horesca and services sectors to less than 1% of those in the finance sector are under a similar situation. This snapshot shows that servicing mortgages likely places a considerable burden on households in the Horesca, construction, wholesales and retail sectors. In contrast, those in the public and finance sectors are more or less comfortable with the overall level of debt payments. The average free cash flow is low for the former groups, meaning they do not accumulate more liquid wealth and possibly borrow more to cover all the households' costs. In contrast, the latter group accumulates their liquid assets after servicing debt payments. Table 6 also reports the level of EAD and LGD for different sectors. The most vulnerable households also own some real estate, so the loss given defaults (LGD) is significantly lower than the EAD ratio. It means that even for households in the Horesca and construction sectors, less than 5% of those exposed debts (EAD) are potential losses.

A further decomposition analysis using logistic regression also confirms our observation. We run a logistic regression of financial distress with households' demographic characteristics and the employment sector[10]; the results are reported in Table 7. As expected, being unemployed or employed in the construction and Horesca sector increases the probability of defaults. Households whose household head has a higher level of education are also correlated to a lower probability of defaults. We also add a yearly dummy to control for all time-invariant events happening at the survey time. The yearly effects are both significant and positive for 2014 and 2018, implying an increase in the share of households with financial struggles compared to 2010.

Table 7. Logit coefficients of being under financial distress.

	Dependent Variable: Being under Financial Distress					
	(Model 1)		(Model 2)		(Model 3)	
	coef.	(s.e.)	coef.	(s.e.)	coef.	(s.e.)
Constant	−4.215 ***	(0.799)	−4.814 ***	(0.865)	−2.428 *	(1.396)
Labor Status: Employed/Others [ref. categories]						
Being Unemployed	0.264	(0.291)	0.246	(0.294)		
*Employment Sector *: Public Sector [ref. categories]*						
Employment Sector *: Horesca			0.844 *	(0.441)	1.072 **	(0.458)
Employment Sector *: Construction			1.143 ***	(0.403)	1.389 ***	(0.422)
Employment Sector *: Retails			0.584	(0.468)	0.721	(0.480)
Employment Sector *: Services			0.371	(0.502)	0.510	(0.512)
Employment Sector *: Finance			−1.881 **	(0.785)	−1.746 **	(0.791)
Employment Sector *: Others			0.564 *	(0.333)	0.377	(0.351)
*Gender *: female [ref. category]*						
Gender *: male	0.001	(0.135)	−0.052	(0.140)	−0.074	(0.198)
Age	0.002	(0.029)	0.005	(0.029)	−0.129 **	(0.059)
Age^2	−0.00001	(0.0003)	−0.00005	(0.0003)	0.002 **	(0.001)
*Birth Country *: Luxembourg [ref. category]*						
Birth Country *: OEA	0.253	(0.159)	0.169	(0.164)	−0.222	(0.235)
Birth Country *: OEU	0.188	(0.456)	0.219	(0.461)	−0.163	(0.650)
Birth Country *: Others	1.013 ***	(0.197)	0.900 ***	(0.204)	0.831 ***	(0.262)
*Household Size *: 1 member [ref. category]*						
Household Size *: 2 members	−0.215	(0.195)	−0.206	(0.196)	−0.066	(0.295)
Household Size *: 3 members	−0.259	(0.226)	−0.235	(0.228)	−0.002	(0.308)
Household Size *: 4 members	0.025	(0.221)	0.053	(0.224)	0.460	(0.288)
Household Size *: 5+ members	0.389	(0.248)	0.356	(0.250)	0.495	(0.337)
*Marital Status *: couple/widowed [ref. category]*						
Marital Status *: single	0.484 ***	(0.180)	0.540 ***	(0.183)	0.531 **	(0.242)
Marital Status *: divorced	0.699 ***	(0.187)	0.756 ***	(0.189)	1.016 ***	(0.264)
*Education Level *: Low (ISCED = 0, 1, 2) [ref. category]*						
Education Level *: Middle (ISCED = 3, 4)	−0.414 ***	(0.155)	−0.372 **	(0.157)	−0.392 *	(0.221)
Education Level *: High (ISCED = 5, 6)	−1.282 ***	(0.191)	−0.998 ***	(0.197)	−0.854 ***	(0.259)
Total Net Wealth [in Euro 100,000]	−0.136 ***	(0.019)	−0.131 ***	(0.020)	−0.157 ***	(0.030)
Total $Net\ Wealth^2$ [in Euro 100,000]	0.0001 ***	(0.00001)	0.0001 ***	(0.00001)	0.0002 ***	(0.0001)
Year Dummy: 2010 [ref. category]						
Year Dummy for 2014	2.426 ***	(0.352)	2.406 ***	(0.353)	2.563 ***	(0.525)
Year Dummy for 2018	2.643 ***	(0.351)	2.618 ***	(0.352)	2.686 ***	(0.523)
Observations	4161		4161		2470	
Sample	Full Sample		Full Sample		Employed Sample	

Calculations are based on the HFCS in Luxembourg Waves I, II, and III. Personal characteristics indicated by asterisks refer to the household head (reference person). One should note that the consumption components in the first wave of HFCS lack expenses on services, utilities, and travel; hence, it is advised to be cautious. We also run some robustness with only second and third waves, which does not significantly alter our results. The matching with other national surveys such as the Household Budget Survey are recommended to improve the accuracy of living expenses, but it is outside of the scope of this paper. The significant levels are indicated as * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

In conclusion, homeowners' overall financial situation with mortgages is heterogeneous across sectors and across different income groups within each sector. The COVID-19 crisis has had heterogeneous impacts across sectors, with a bigger impact on those sectors that require or deal with social contacts. Those sectors, namely Horesca and wholesale and retail, also show a large share of households with a low level of free savings rates, making them even more susceptible to the COVID-19 shock. In the next subsection, we perform a stress test of COVID-19 shocks on households with current mortgages and see how resilient or vulnerable they are.

5.3. COVID-19 Shock Simulation

To perform a COVID-19 stress test, we first need to investigate how the COVID-19 crisis affects the households' financial situations. There are two possible channels: the first is through an income shock due to job losses. As we can see from Section 2, the partial and full unemployment rates increase right after the first complete lockdown in March 2020 in Luxembourg. These are the first-order impacts. The second possible channel is via changes

in real-estate markets. If households expect an income shock and cannot honour their mortgage payment, there might be an increase in housing sales, and housing prices drop. Those drops in housing prices would further impact the LTV of banks' balance sheets and risk factors, and they subsequently would tighten the credit lines. However, if households and firms expect a short-lived COVID-19 shock, then the second channel impact might be relatively small. The second channel is of second-order implications, and it could be mitigated by an increase in demand for housing due to frequent home office use from the higher-income quartiles group. A second possible mitigation force of the second channel is also from the cross-border workers. They might consider relocating to Luxembourg due to tax reasons if the home-office trend continues to rise in the future. As those second channels are second-order and require a full-fledged model to specify, we first perform the first channel's stress test.

To compute the probability of losing a job due to the health crisis, we studied the evolution of job seekers by occupation relative to the employment in each sector. Since the two indicators are based on different classifications (ROME classification for job seekers and NACE for employment), we merged classes in eight large and distinct economic branches to compute the unemployment rate by type of activity to match the classification in HFCS. The share of workers requesting partial unemployment benefits relative to total workers is illustrated in Figure 10. We include the numbers before the lockdown in January 2020, when the economy was under full lockdown in April 2020, and when it was in partial lockdown in October 2020.

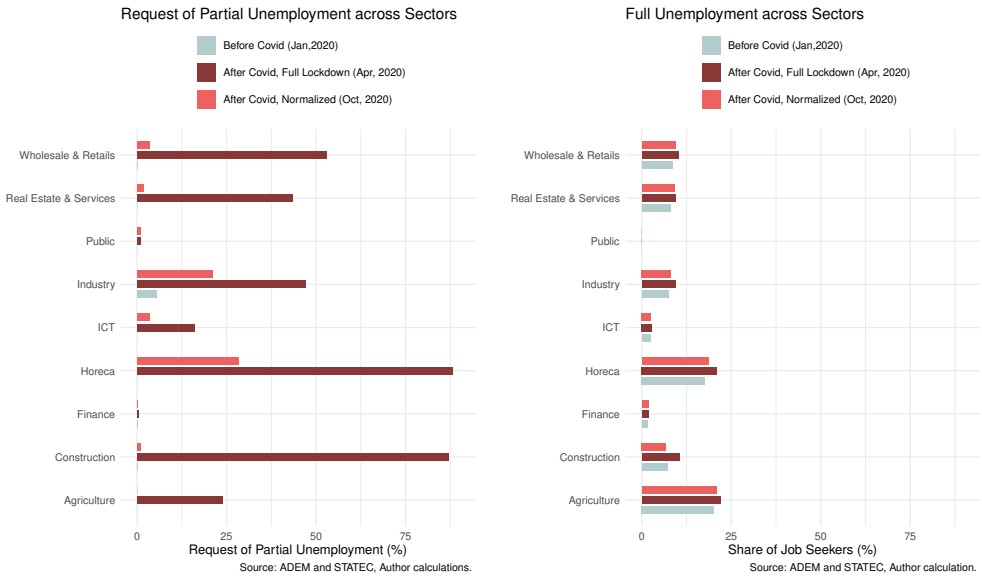


Figure 10. Unemployment level by occupation. *Notes:* Authors' own calculations. The data for requests for partial unemployment benefits are from ADEM and STATEC with actual recording of each sector. The data for full-unemployment are approximated from the records of registered job-seekers from ADEM with ROME Occupation Classification (for more details, see http://rome.adem.public.lu/index_metier.html, accessed on 15 December 2020). Then, we apply a simple mapping from ROME to NACE for easier comparison. It is noted that one category of ROME can match to more than one category of NACE, and vice versa, so we re-group some NACE sectors into large groups to facilitate the matching.

As we can see in the left graph of Figure 10, the requests for partial unemployment benefits from the Horesca and construction sectors jump from less than 1% to 80% under full lockdown in April 2020. Once the economy started to open up and entered a second lockdown in October, the construction sector returned to a smaller share of workers requesting partial unemployment benefits, while the Horesca and industry sectors were still at more than 25% of workers under partial unemployment scheme. Thanks to the partial

unemployment scheme in place, Luxembourg avoided a significant increase in the full unemployment rate. There is just a slight increase of less than 2% in the full unemployment rate in the whole country in April, and it had gone down from 7% in April to 6% in October 2020. Sector-wise, it is expected that the share of job-seekers increased mostly in the Horesca, industry, and construction sectors under full lockdown, as shown in the right panel of Figure 10. Under partial lockdown in October 2020, the construction sector's unemployment rate returned to the level before the lockdown, while the unemployment rate in the industry and the Horesca sectors remained higher than those before the lockdown.

We introduce two levels of income replacement rates, of 60% and of 80% of the original gross income.[11] Afterwards, social contributions and income taxes are recomputed for each household. To keep the analysis simple and straightforward with as fewer assumptions as possible, we preserve the levels of expenditures of households.

We report the change in the share of vulnerable homeowners with mortgages across sectors in Figure 11. We consider both scenarios in full lockdown (left panel) and in partial lockdown (right panel). As we can see, under the complete lockdown, more than 15% of households in the Horesca sector, and around 8% of households in construction will fall into vulnerable situations. While under a no-lockdown scenario, the construction sector recovers quickly to the before-COVID level. The Horesca sectors' position is nevertheless stagnating at an increase of more than 5% of families that could not service their mortgage payment for the next three months. The impact is milder but still there for the wholesale and retail and industry sectors. For this analysis, we use the level of liquid assets at the 2018 level, and the longer the sanitary crisis is, the more acute the vulnerable households' finance issues.

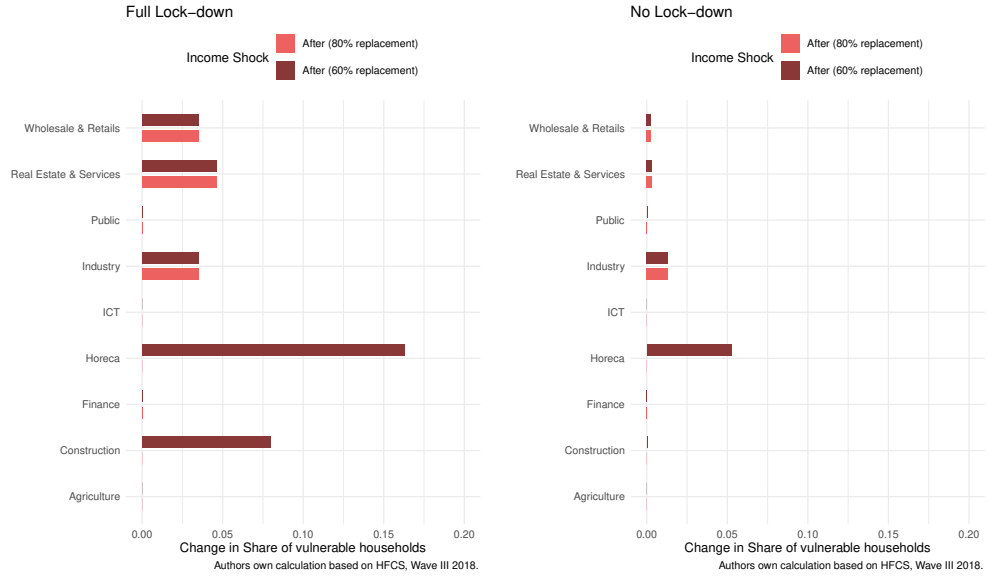


Figure 11. Change in share of financially distressed households due to COVID-19. *Notes:* Authors' own calculation based on HFCS Wave III under the assumption of an income shock due to COVID-19. We matched the probability of losing one's jobs based on the partial and full unemployment rates under full lockdown and partial lockdown scenarios. The share of vulnerable households strictly speaking includes those who are homeowners with mortgages and those whose heads are currently employed as employees (which is at more than 80% of total households with mortgages). The share is calculated over the number of homeowners within each sector.

To put the share of vulnerable families in perspective, we also plot the total number of mortgages and those in vulnerable situations across sectors in Figure 12. As we can see, the finance and public sectors are among the top two workplaces for homeowners with mortgages in Luxembourg. They also happen to be two secured sectors that are well-equipped to cope with the COVID-19-type crisis. The sanitary crisis hit unevenly those

who were already in a vulnerable situation. Almost half of those who work in the Horesca and the wholesale and retails sectors struggle to keep up with the mortgage payment with low free savings rates. However, the mortgage market's overall situation in Luxembourg is relatively safe, as most homeowners are either working in public or finance sectors.

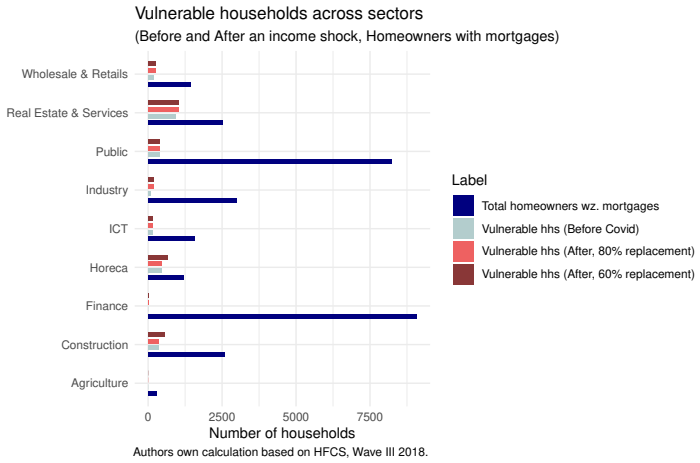


Figure 12. Number of financially distressed households. *Notes:* Authors' own calculation based on HFCS Wave III under the assumption of an income shock due to COVID-19. We matched the probability of losing one's jobs based on the partial and full unemployment rates under a full lockdown scenario. We consider only households with those who are homeowners with mortgages and those whose heads are currently employed as employees (which is at more than 80% of total households with mortgages). The figure shows the total number of homeowners with mortgages in each sector with the number of vulnerable households before and after a hypothetical income shock due to COVID-19.

6. Conclusions

Given the high level of household indebtedness and the risks that this raises for both households and the financial sector, it is important to understand how the pandemic could affect the local mortgage market.

In this paper, we use a broad range of data to explore this issue. We first provide an overview of the economy and the balance sheet of households before the COVID-19 shock. Then, we use data on the partial unemployment scheme to understand how the pandemic affected the labour market. We find that the impact has been strongly asymmetric, with sectors such as hospitality and catering, retail trade, or industry being strongly affected by the pandemic, while the finance and public sectors were less affected. When we decompose the employment of residents by sectors, we find that around 50% of residents work either in the financial or in the government sector. Since these sectors are likely to be less affected by the pandemic, the aggregate impact of the pandemic on the local mortgage market in Luxembourg is likely to be less severe relative to other countries.

Then, we perform a simple stress test of household balance sheets using disaggregated survey data. We find that although the balance sheets of households are strong on average, there exist substantial disparities in the individual situations. The balance sheets of households working in more vulnerable sectors such as Horesca also tend to be more fragile. As a consequence, the pandemic could lead to the financial distress of a number of households despite the supportive aggregate situation. These facts could support the case for targeted policy interventions aimed at supporting households that are most adversely affected by the COVID-19 shock.

While the different stylized facts can improve our understanding of the mortgage market and COVID-19 in Luxembourg, we do not claim that the relationships are causal. The stress test in particular is meant to illustrate the heterogeneity in financial situations across households. A conservative reading of our note would focus on the facts presented.

An interesting avenue for future research would be to further study the causality of these relationships using administrative data.

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Notes

1 Warning of the ESRB, 22 September 2016.

2 Seven day moving average. Source: ECDC data.

3 Respectively 34% in industry, 37% in trade, 41% in transportation and 51% in the Horesca in 2019.

4 We consider only families whose head is currently employed as employees (which is at more than 80% of total households with mortgages). The number for self-employees with no specific sectors classified would be slightly different depending on how COVID-19 impacts on their areas.

5 For more information about the economic impact of the COVID-19 crisis by branch of activity, see STATEC (2020, pp. 58–63).

6 European Banking Authority, Risk Dashboard, https://www.eba.europa.eu/risk-analysis-and-data/risk-dashboard (accessed on 15 October 2020).

7 In January 2021, new standards for mortgages have been defined in Luxembourg to avoid overburden and to prevent banks from lending too much money (CSSF 2020). Accordingly, the non-first-time buyers could only borrow 90% of the purchase price of the property (80% for buy-to-let investors).

8 Giordana and Ziegelmeyer (2019) use the demographic characteristics of the "financially knowledgeable person" (FKP) as an indicator for households' demographic characteristics (See Giordana and Ziegelmeyer 2019, p. 32). However, in the HFCS database, the FKP indicator (Question HA0100) is missing; hence, we assign the household's demographic characteristic to the household head or the reference person in the HFCS survey.

9 An alternative way is to assign a weight of 50% for households with two working members or one (the household head) retired, and the other spouse is still working.

10 We combined three waves to increase the total observations.

[11] We based our income replacement rates on the unemployment benefits provided by ADEM. In fact, those who are unemployed involuntarily and has been working in Luxembourg for at least 6 months get 80% of the average income and is capped at 2.5 times the social minimum wage. The maximal duration for unemployment benefits is for 12 months. For more details, see https://adem.public.lu/en/demandeurs-demploi/demander-indemnites-chomage/residents/salaries.html (accessed on 15 December 2020). It is noted that those who lost their jobs while in the probation period or under mutual agreement with a company are not qualified for unemployment benefits. We take the ranges of an income loss between 20% and 40% as a benchmark and for a simple illustration.

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