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How bad will the Covid-19 second wave be for Luxembourg's economy?

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on "Macroeconomic and epidemiological prospects for 2020-2021"

The Covid-19 second wave is hitting much of Europe. While this wave mostly affected young healthy people at its start, it is now spreading to older and more vulnerable segments of the population. It is thus with a weary sense of *déjà vu* that European citizens have been impacted by new packages of restrictions implemented to contain the virus and to prevent healthcare systems from being overwhelmed. Some countries entered a new (total or partial) lockdown allowing people to leave their home only to go to work (when teleworking is not feasible) or to buy essential goods and seek medical help, banning or limiting social gatherings, prescribing curfew, shutting non-essential activities, etc. In theory, such restrictions induce ambiguous effects on the economy as they directly curtail market transactions but also avoid panic-driven responses. Yet, lockdown measures implemented in March and April generated mechanical and sizeable cuts in output and plunged most economies into a temporary recession. History might be repeating itself in the coming weeks and the specter of a re-confinement hangs over Luxembourg's economy. In this policy brief, we combine recent tools developed at STATEC and LISER to assess the macroeconomic impact of the second wave, to shed light on the interactions between macroeconomic and epidemiological outcomes, and to compare the implications of moderately and highly coercive sanitary measures.

Combining tools: leading indicators, forecasting and epidemiological models

STATEC and LISER use complementary approaches to study the economic consequences of the current crisis. On the one hand, the economic modelling and forecasting unit of STATEC has long developed tools to analyze, monitor and forecast the situation of Luxembourg's economy and its international environment. Combining leading economic indicators, experts' views and surveys on businesses' and consumer's sentiments, the biannual *Note de Conjoncture* provides a dashboard of Luxembourg's economy and presents short-term prospects for GDP, employment, public finances and other important aggregates. While uncertainty about the impact of public health outcomes on the economy is difficult to factor in, STATEC relies on scenarios developed by *Oxford*

Economics to delineate *best-case* and *worst-case* macroeconomic scenarios for Luxembourg's GDP over the quarters of 2020 and 2021. The latter are elaborated with the help of its flagship macroeconomic model Modux.

On the other hand, LISER has coordinated the development of a model that links the economic and epidemiological aspects of the Covid-19 crisis. This effort was done within the *Task Force for the Coordination of the Public Research Sector in the Context of the Covid-19 Pandemic and was financially supported by the FNR under the Covid19 scheme*. It involved a group of economists and epidemiologists from LISER, STATEC and UL. The economic block of the model relies on an input-output structure sourced from STATEC data, enriched with supply-side constraints of different kinds.[1] The epidemiological block distinguishes between 3 population groups – students, active and retired people – and 304 labor force groups involving 19 industries, 4 countries of residence and 4 infection groups – susceptible, infected and symptomatic, infected and asymptomatic, and the recovered. The evolution of these stocks is governed by virus transmission rates on the job (or at school) and in the place of residence. The contamination process depends on workers' time spent at the workplace, at school and outside the labor market (*extensive margin*), as well as on place-specific transmission rates (*intensive margin*). The latter are influenced by prevention measures and by the number of contacts, which is endogenously governed by employment rates, parental leave status, teleworking practices, mass departures/returns during the holiday season and school attendance. This model has been recently refined and re-parameterized to match economic and epidemiological data available from January to (end of) October 2020 for Luxembourg and for the Greater Region. With a few parameters per sector only, the model almost perfectly replicates the evolution of the infection curve and the predictions made with its earlier version are very much in line with current data. Its economic outcomes are mostly governed by exogenous domestic and external demand shocks, which are derived from STATEC's most recent macroeconomic forecasts.[2]

Back to September 2020: A Spectrum of *Epidemionomic* Prospects

The outlook for the global economy has been uncertain since late summer. To put things in the context of September 2020, two opposing scenarios were considered by *Oxford Economics* and used by STATEC to delineate the spectrum of macroeconomic prospects for 2020 and 2021. The first two panels of Tab. 1 summarize STATEC predictions of quarterly GDP under these two scenarios, while the dashed curves in Fig. 1 illustrate the underlying trajectory of weekly *epidemionomic* outcomes generated by LISER's model.

The best-case scenario (labeled as '**NoSW**') assumes the absence of a second wave and a quick recovery of the international environment. It predicts that scientific advances will be such that restrictions can be completely lifted from 2020Q4. The effects of fear and uncertainty on final demand gradually disappear during 2020Q4 and 2021Q1.

[1] *Workers who are infected and detected cannot work, quarantined workers partly telework and are partly in sick leave, school activities impact employment through parental leaves, and containment measures reduce the permitted level of employment in some industries.*

[2] *Forthcoming in the Note de Conjoncture of December 2020.*

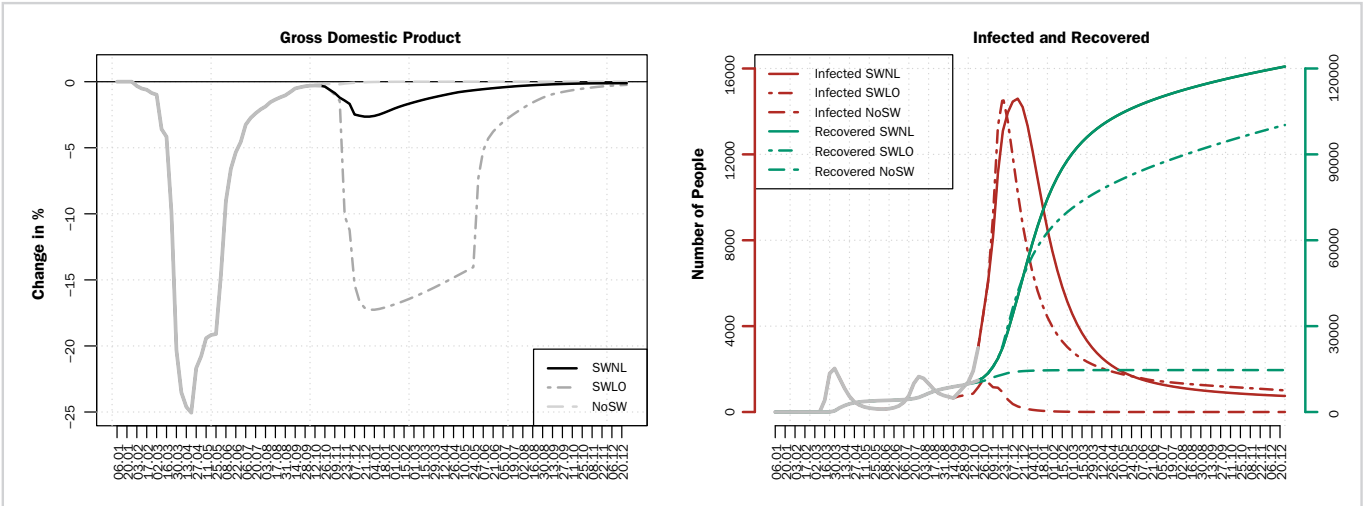
	2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Hypothetical "no Covid"	13206	13286	13365	13445	13526	13607	13689	13771
NoSW (no 2nd wave)	**12947**	**12016**	**12595**	12595	12658	12911	13169	13432
Index (Hyp=100)	**98.0**	**90.4**	**94.2**	93.7	93.6	94.9	96.2	97.5
Quart. growth rate (%)	**-1.4**	**-7.2**	**+4.8**	0.0	+0.5	+2.0	+2.0	+2.0
Annual GDP growth rate		-3.5				+4.0		
SWLO (2nd wave, 2nd lockdown)	**12947**	**12016**	**12593**	12089	11726	12195	12561	12938
Index (Hyp=100)	**98.0**	**90.4**	**94.2**	89.9	86.7	89.6	91.8	94.0
Quart. growth rate (%)	**-1.4**	**-7.2**	**+4.8**	-4.0	-3.0	+4.0	+3.0	+3.0
Annual GDP growth rate		-4.5				-0.5		
SWNL (2nd wave, no 2nd lockdown)	**12947**	**12016**	**12595**	12452	12430	12817	13132	13415
Index (Hyp=100)	**98.0**	**90.4**	**94.2**	92.6	91.9	94.2	95.9	97.4
Quart. growth rate (%)	**-1.4**	**-7.2**	**+4.8**	-1.1	-0.2	+3.1	+2.5	+2.1
Annual GDP growth rate		-3.8				+3.6		
SWHoR (1-m lockdown in HORESCA)	**12947**	**12016**	**12595**	12388	12430	12817	13132	13415
Index (Hyp=100)	**98.0**	**90.4**	**94.2**	92.1	91.9	94.2	95.9	97.4
Quart. growth rate (%)	**-1.4**	**-7.2**	**+4.8**	-1.6	+0.3	+3.1	+2.5	+2.1
Annual GDP growth rate		-3.9				+3.7		

Table 1:
Trajectory of Luxembourg GDP under four scenarios, 2020-2021 by quarter

Note : Numbers in bold characters are observations.
Source: STATEC (2020). Note de Conjoncture, forthcoming.

Figure 1:
Weekly path of epidemionomic outcomes under three scenarios

Note : The left panel reports the percentage of deviation in weekly GDP from the hypothetical "No-Covid" situation. The right panel reports the number of detected Covid-19 active cases (left scale) and the total number of recovered (right scale).



Using observed macroeconomic data for the first three quarters of 2020, STATEC estimates that this 'NoSW' scenario translates into annual GDP growth rates of -3.5% in 2020 and +4.0% in 2021 (top panel of Table 1), which basically means a fast recovery towards the no-Covid trend. The underlying epidemiological trajectory assumes that virus transmission rates decrease monotonically towards zero between September 2020 and May 2021, and that medical advancements make it possible for social distancing to fully relax without implying a rebound in the infection curve. The spread of the virus remain rampant until June 2021 with low intensity from January (see right panel of Fig. 1).

By contrast, the worst-case scenario (labeled as '**SWLO**') predicts a second wave requiring generalized lockdowns throughout Europe. In the case of Luxembourg, STATEC assumes a new confinement of longer duration (covering 6 months during 2020Q4 to 2021Q1) in the same industries as in March-April (i.e., construction, sales in non-essential businesses, services to households, food and accommodation) as well as in leisure, family and social life. This will be accompanied by a long-lasting decrease in final demand due to lockdowns abroad and to a degradation of the confidence of local and foreign actors. STATEC estimates that this 'SWLO' translates into annual GDP growth rates of -4.5% in 2020 and -0.5% in 2021, implying two years of negative real growth. The underlying *epidemionomic* trajectory (Fig. 1) suggests that GDP will be 15 to 17% below the 'No-Covid' hypothetical trend during the lockdown weeks and will slowly recover afterwards (left panel).[3] Assuming the lockdown had started on November 1st, the number of active Covid cases would have peaked peak at 14 500 by mid-November 2020, as it takes approximately 2 weeks for lockdown measures to become effective. This roughly corresponds to 100-120 admissions in intensive care units two weeks after the peak (i.e., by the end of November). The cumulated share of people who have ever been infected reaches 20% (i.e., 100 000 individuals) by the end of 2021 (right panel).

Somewhere in the Middle... If Moderately Coercive Measures Suffice

After a dip in new cases in July and August, Luxembourg is now reporting a higher number of cases than during the first peak. Hence, the second wave is here and the question is: how bad will it be? Luxembourg has hitherto avoided to strongly re-confine its economy. Besides testing, tracing and quarantining tools, the government decided to prohibit movements of people between 11PM and 6AM, to reinforce social distancing measures in restaurants, bars and cafés, to limit private gatherings and presence in shops, to promote medical teleconsultation, to forbid sports activities involving more than four people, etc. The effectiveness of these sanitary measures and their economic implications are highly uncertain as they strongly depend on the degree of adhesion of the population as well as on external factors such as the evolution of preventive measures and *epidemionomic* conditions in the neighboring regions.

Let us first assume that these sanitary measures are sufficient to contain the virus. In the bottom panel of Tab. 1, we consider such a no-lockdown scenario (labeled as '**SWNL**') and

[3] *The macroeconomic trajectory depicted in the left panel of Fig. 1 does not perfectly correspond to the GDP data and prospects reported in Tab. 1. LISER's model has been parameterized to match the reported numbers as closely as possible.*

we rely on an optimistic parametric interpretation of the recent sanitary measures. More precisely, compared to early October and starting in November 2020, we assume a 50% decrease in contamination rates outside the labor market in the Greater Region, and an increase in teleworking (up to 50% of the April level).[4] We also assume a trajectory of final demand that is less optimistic than under 'NoSW' (-20% in 2020Q4 and 2021Q1, followed by a gradual recovery) due to consumers' fears and uncertainty.

This parametric interpretation of sanitary measures has been chosen to generate a decrease in the infection curve that is comparable to that of the lockdown scenario. The model predicts that the number of symptomatic active Covid cases will peak at 14 500 by mid-December (one month later compared with 'SWLO') and then fall until May 2021. Interestingly, the number of active cases was already greater than 10 000 on Nov. 10th. By the end of 2021, the cumulated share of people who have ever been infected will be around 25% (i.e., 120 000 individuals). The major difference with 'SWLO' relates to the macroeconomic implications of the containment measures. We estimate that this 'SWNL' scenario translates into annual growth rates of -3.8% in 2020 and +3.6% in 2021, which is way closer to the 'NoSW' scenario (-3.5% and +4.0%, respectively). Simulations in line with the robustness checks below suggest that about 3/4 of the growth differential with 'NoSW' in 2020Q4 is due to epidemiological effects: the labor force decreases by about 30 000 persons in December (14 500 infected and approximately the same number of quarantined people).[5] By contrast, the stock of active cases will be much smaller in 2021 and 4/5 of the growth differential in 2021Q1 is due to the deterioration of final demand.

Sensitivity to sanitary measures, collective adhesion and international environment

There is considerable uncertainty on whether moderately coercive sanitary measures will prove strong enough to contain the second wave and on the concomitant evolution of the international environment. The predictions of the 'SWNL' strongly depend on our parametric interpretation of existing measures. To quantify that uncertainty and to identify the key mechanisms at play, we start from the 'SWNL' and consider 8 variants (one variant at a time) implying (i) more or less ***teleworking*** (100% vs. 0% of the sectoral share of March-April), (ii) higher or lower ***adhesion to distancing*** measures in leisure, social and family life (contamination rates outside the labor market equal to 25% or 75% of those observed in early October), (iii) more or less ***testing/tracing*** (50% of participation in large-scale testing and 6 quarantined people per case vs. total absence of testing/tracing), (iv) more optimistic or pessimistic trajectory for ***exports*** (no shock

[4] *Our results show that measures affecting social life are key to curb the spread of the virus. The effectiveness of the lockdown is almost totally due to the constraints imposed outside the labor market. The reason is that trends in "on-the-job" contaminations are mostly governed by two sectors, public administration and education services, which were not economically impacted by the first lockdown. Yet, these results must be taken with caution as the lockdown is assumed to influence contaminations among workers only, while infected customers in the confined industries are counted as contaminations outside the labor market. In other words, the lockdown in industries with high exposure to risk (e.g., HORESCA) is likely to flatten the infection curve through the transmission rates in leisure and social life.*

[5] *Anecdotal evidence from the Inspection Sanitaire suggests that each infected case gives rise to 3 quarantined workers, among which 2 keep on working from home and 1 becomes inactive.*

vs. -40% in 2020Q4 and 2021Q1). These variants are considered as independent of each other, which means that we disregard the fact that variations in the infection curve can induce pressures on ICU admissions, panic or protest movements, which could translate into final demand responses. Figure 2 illustrates the *epidemionomic* consequences of these variants.

We first focus on adhesion to public health measures. Changes in teleworking practices have small effects on the infection curve. Within the context of our model, this is explained by the fact that highest transmission rates are now observed outside the labor market. Changes in social distancing have bigger effects, increasing the number of cases by 4 500 at the peak (low distancing) or decreasing it by 1 000 (high distancing). The low-distancing variant roughly translates into 140 admissions in intensive care units by the very end of the year, leading to a quasi-saturation of the ICU system. Changes in testing/tracing practices induces moderate epidemiological effects, increasing the number of cases by 2 500 at the peak (absence of large-scale testing and tracing) or decreasing by 1 500 (higher adhesion). In the normal disease course, these sanitary variants induce negligible effects on the economy (contrary to the deep-set trend in Covid cases), while annual GDP growth rates are sensitive to the evolution of the international environment. Turning our attention to export shocks, we find opposing results. The epidemiological consequences of output and employment shocks are negligible, which again results from the fact that transmission rates on the job are relatively well contained. By contrast, the economic trajectory for 2021 is sensitive to exports. For 2020, the effect is smaller as GDP levels for Q1 to Q3 are already given. In particular, the low-export variant translates into an annual growth rate of -3.9% in 2020 and 2.9% in 2021 (against -3.8% and +3.6% under 'SWNL'). Epidemiologically speaking, moderately coercive variants show that uncertainty about the spread of the virus remains large. A lockdown-type policy generates much more foreseeable epidemiological effects… at the cost of a big recession.

Last minute change: a new lockdown on HORESCA and family contacts

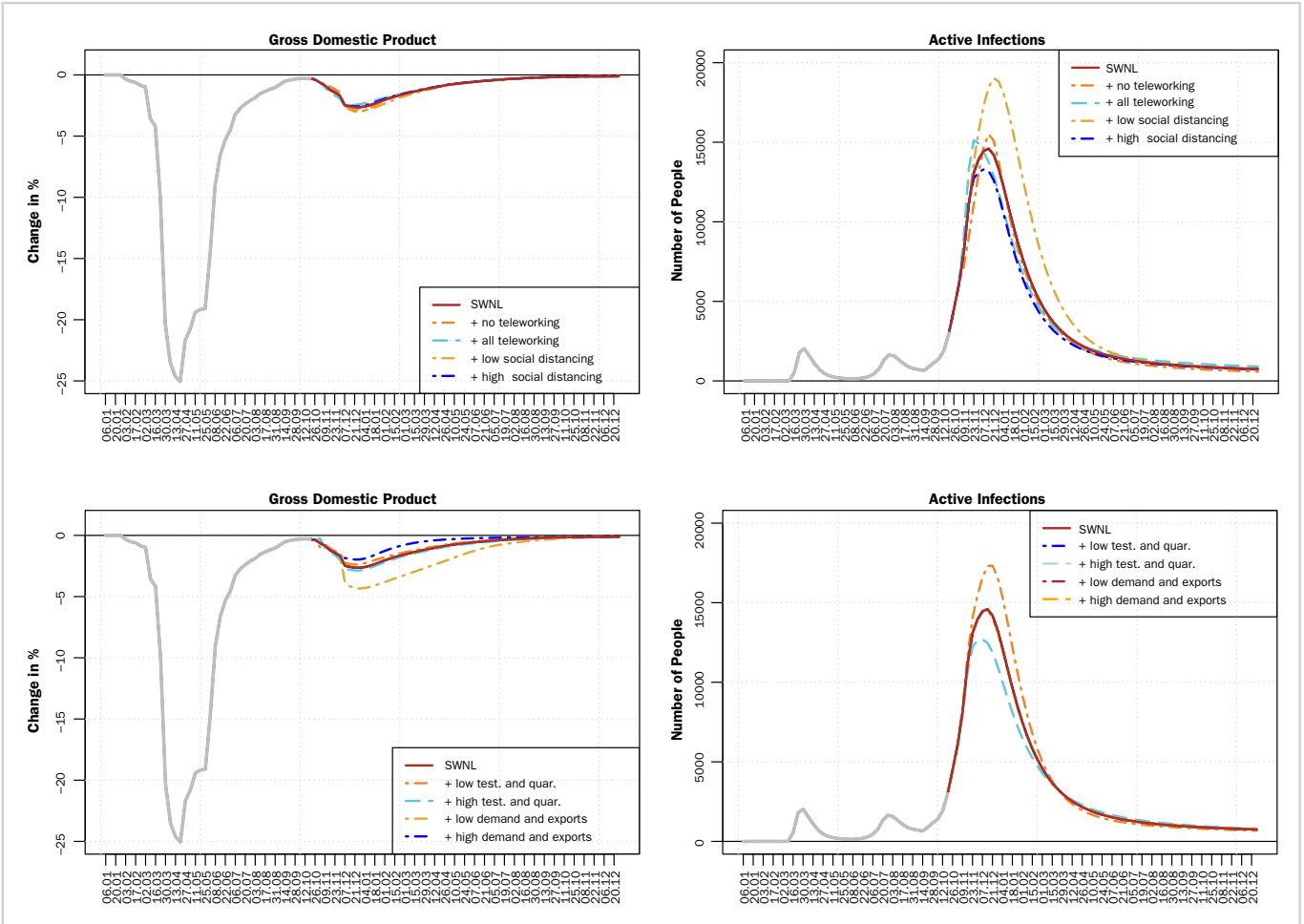
In line with our SWNL scenario, the evolution of the number of daily infections has not shown major improvement since the beginning of November. Although a large-scale lockdown has not been tabled for discussion, Luxembourg is clearly preparing for a partial lockdown which potentially consists of limiting family contacts and closing its *cafés* and restaurants, cinemas, theaters, swimming pools and sport centers. The measure could be implemented during the week of November 26 if the number of new infections does not quickly drop to a maximum of 500 per day. Considering a full lockdown of HORESCA for a period of one month (note that the average occupancy rate in hotels is already low, in the range of 15 to 25% according to recent newspaper article), the *epidemionomic* model predicts that closing HORESCA would "directly" affect the number of contaminations "on-the-job" in HORESCA and in the economically related sectors. This could lead to a drop of 800 in the stock of active cases at the peak of mid-December (i.e., a drop of 7 to 10 in ICU admissions two weeks later). This would also reduce the number of social contacts and flatten the infection curve through the transmission rates in leisure and social life. This is all the more true as the

frequentation of *cafés* and restaurants by non-Luxembourgish neighbors has increased for the last few weeks – due to higher restrictions abroad. Hence, combined with potential limits on family contacts, new lockdown measures are likely to generate "indirect" effects that could translate in a drop of 1 000 cases at the peak if we refer to our optimistic social distancing scenarios described in Fig. 2. This means a total effect of 1 800 cases at the peak of mid-December or alternatively, a drop of 15 to 20 ICU admissions two weeks later.

Economically speaking, taking into account the input-output links between sectors, a lockdown of one-month in the HORESCA sector would decrease GDP in 2020Q4 by 0.5 percentage points. The annual GDP would then decrease by 0.1 percentage point in 2020. As shown in Table 1, the annual growth rate would reach -3.9% (instead of -3.8% in the SWNL scenario). Would the lockdown be maintained in January 2021, the 2021 annual growth rate would also be impacted and would decrease by 0.1 percentage point… and if it had to be maintained throughout 2021Q1 (i.e., an unlikely duration of 4 months), the annual growth rate in 2021 would reach 3.3% (instead of 3.6% in SWNL). Excluding such extreme scenarios, a one-month lockdown in HORESCA has limited impact on the national economy, despite increasing the already huge annual income loss in this sector (from 25 to 30%).

Figure 2: Sensitivity of the SWNL scenario to epidemionomic variants

Note : The left panel reports the percentage of deviation in weekly GDP from the hypothetical "No-Covid" situation. The right panel reports the number of detected Covid-19 active cases (left scale) and the total number of recovered (right scale).



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APPENDIX

This policy brief is Part of the MODVid project on "Modeling the macroeconomic and distributional effects of COVID-19 and restarting scenarios" funded by the Covid-19 funding scheme of the FNR. MODVid is coordinated by LISER and involves 20 researchers from the University of Luxembourg, STATEC and LISER. On the heels of RECOVid report, the new research project is comprised of four complementary and interdependent work packages (WP). Together they estimate the macroeconomic, distributional, and epidemiological effects of the crisis and of restarting scenarios in Luxembourg. The philosophy is to develop a set of evolving and interconnected modeling tools that aim to deliver outputs in the short and medium term. This work is part of WP1 dealing with the short-run health and macroeconomic effects of the crisis.

Recent Extension of the Epidemionomic Model

The structure of the model is described in Burzynski et al. (2020).[1] The economic block of the model relies on the input-output (I/O) tables of Luxembourg sourced from STATEC. The standard I/O model is enriched with supply-side constraints of different kinds. In the first version of the model, the epidemiological block distinguishes between 304 groups of working-age individuals involving 19 industries, 4 countries of residence and 4 infection groups (susceptible, infected and symptomatic, infected and asymptomatic, and the recovered). The evolution of these stocks is governed by virus transmission rates on the job and in the place of residence. The contamination process depends on workers' time spent at the workplace and outside the labor market (extensive margin), as well as on place-specific transmission rates (intensive margin). The new version of the model includes inactive people: students can be contaminated in school and in the place of residence, whereas elderlies have no professional life and can only be infected in the place of residence.

Re-Parameterization

The model has been recently re-parameterized to match economic and epidemiological data available from January to (end of) October 2020 for Luxembourg and for the Greater Region. In particular, with a few parameters per sector only, the model almost perfectly replicates the evolution of t he infection curve by sector, by age and in the total population (see Fig. A.1 below). The economic block has been recalibrated to match observed STATEC data for Q1, Q2 and forecasts for Q3 of 2020. From Q4 2020 till Q4 2021, two STATEC scenarios have been used to parameterize LISERs model, one with no second wave and one with a second wave. LISER has elaborated two alternative scenarios based on a second wave but with moderate sanitary measures only.

Detailed Results for the Three Main Scenarios

Fig. A2, A3, A4 and A5 show detailed results by week for the four main scenarios discussed in the policy brief: NoSW, SWLO, SWNL, and SWHoR respectively. The first panel gives the percentage of deviation from the counterfactual "No-Covid" GDP level. The second panel gives the number of active (detected) cases and cumulated number of recovered people per week. The third panel gives percentage of deviation in value added by sector. The fourth panel shows that share of active Covid cases by sector. The fifth panel gives the percentage of deviation in the workforce by sector and per week. The sixth panel gives the share of active Covid cases by country of residence.

[1] *Burzynski, M. & J. Machado & A. Aalto & M. Beine & J. Goncalves & T. Haas & F. Kemp & S. Magni& L. Mombaerts & P. Picard & D. Proverbio, & A. Skupin & F. Docquier (2020). COVID-19 Crisis Management in Luxembourg: Insights from an Epidemionomic Approach. LISER Working Paper Series 2020-08, LISER.*

Figure A1: Fitting the cumulated number of Covid cases by sector and by age group

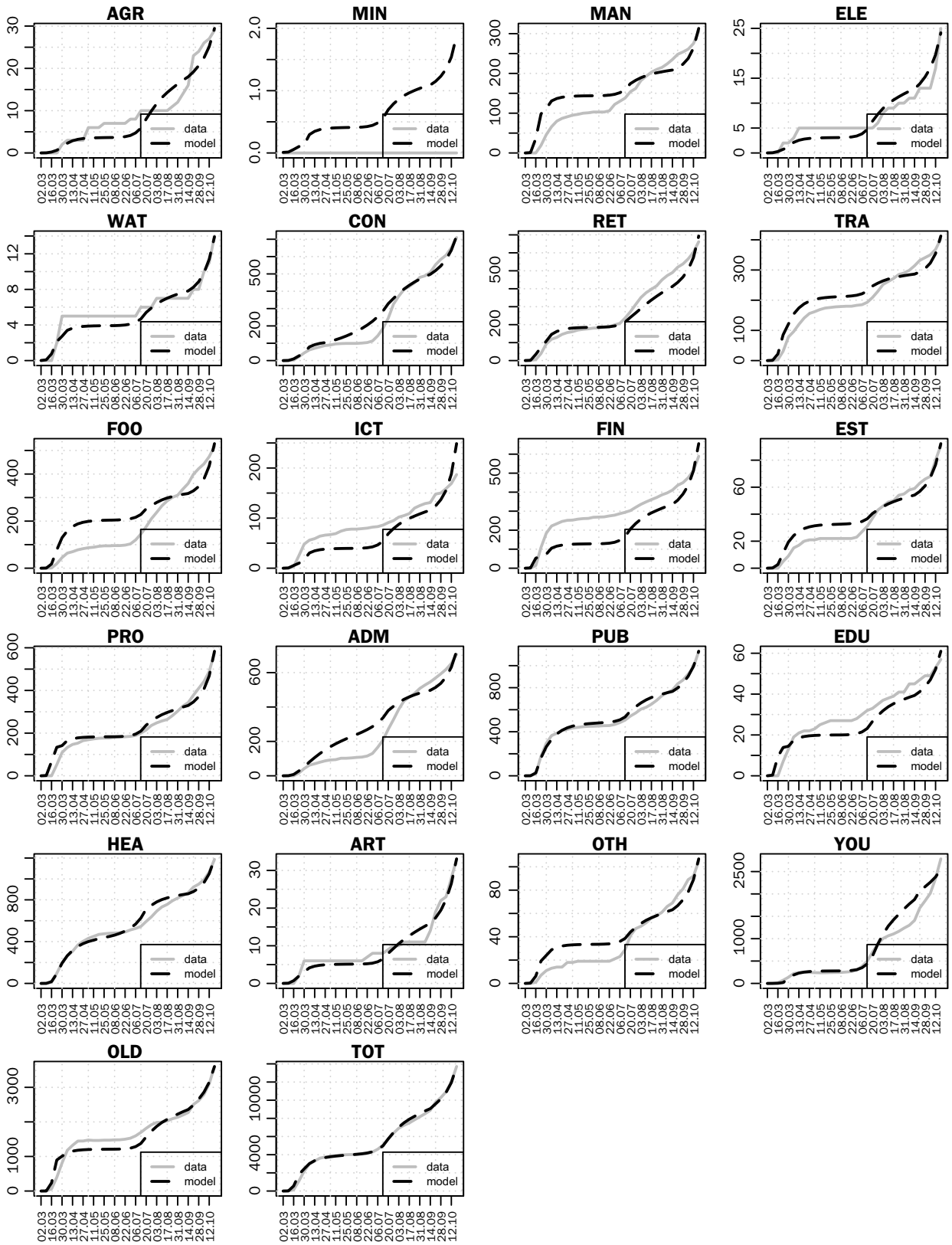
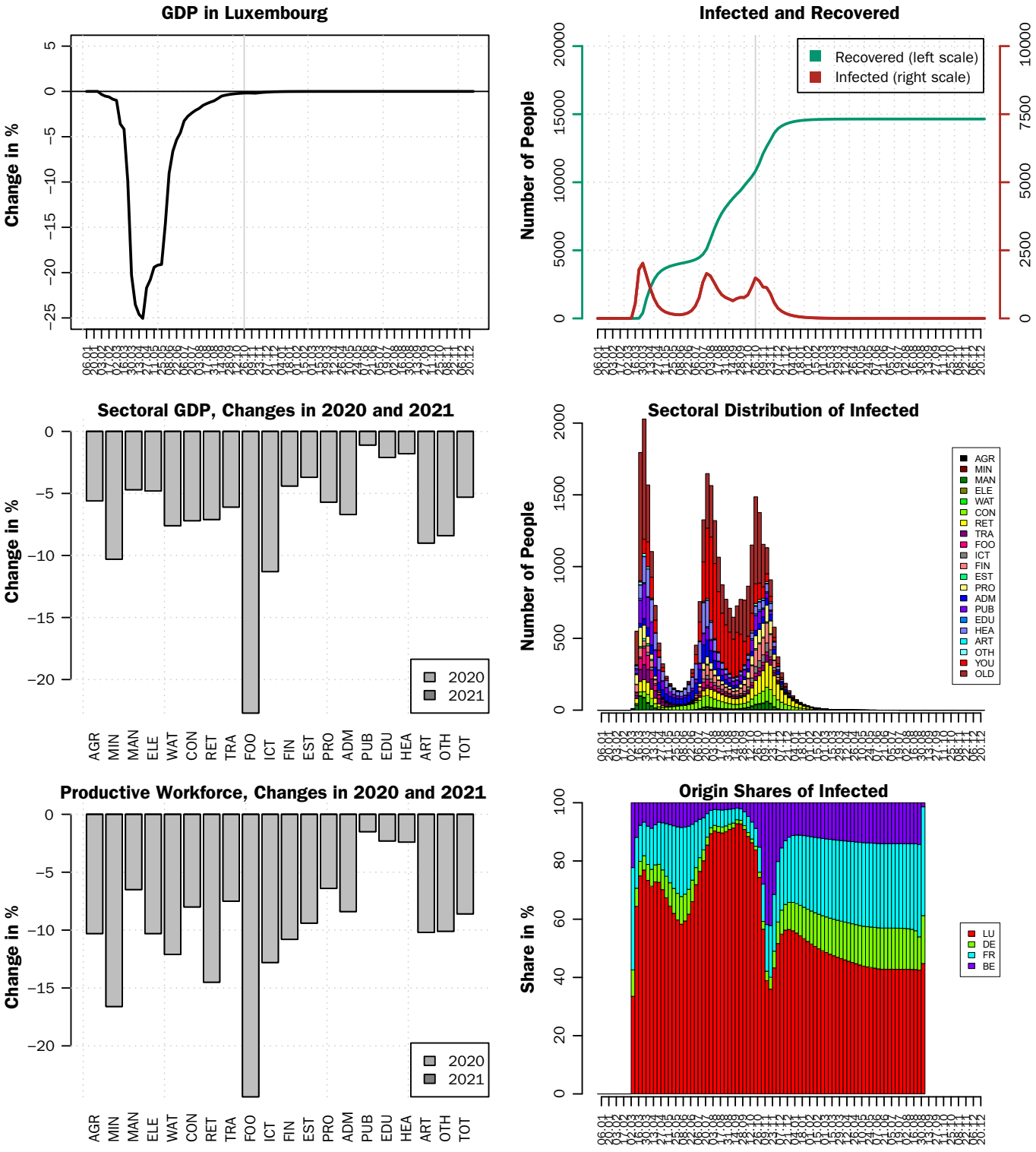
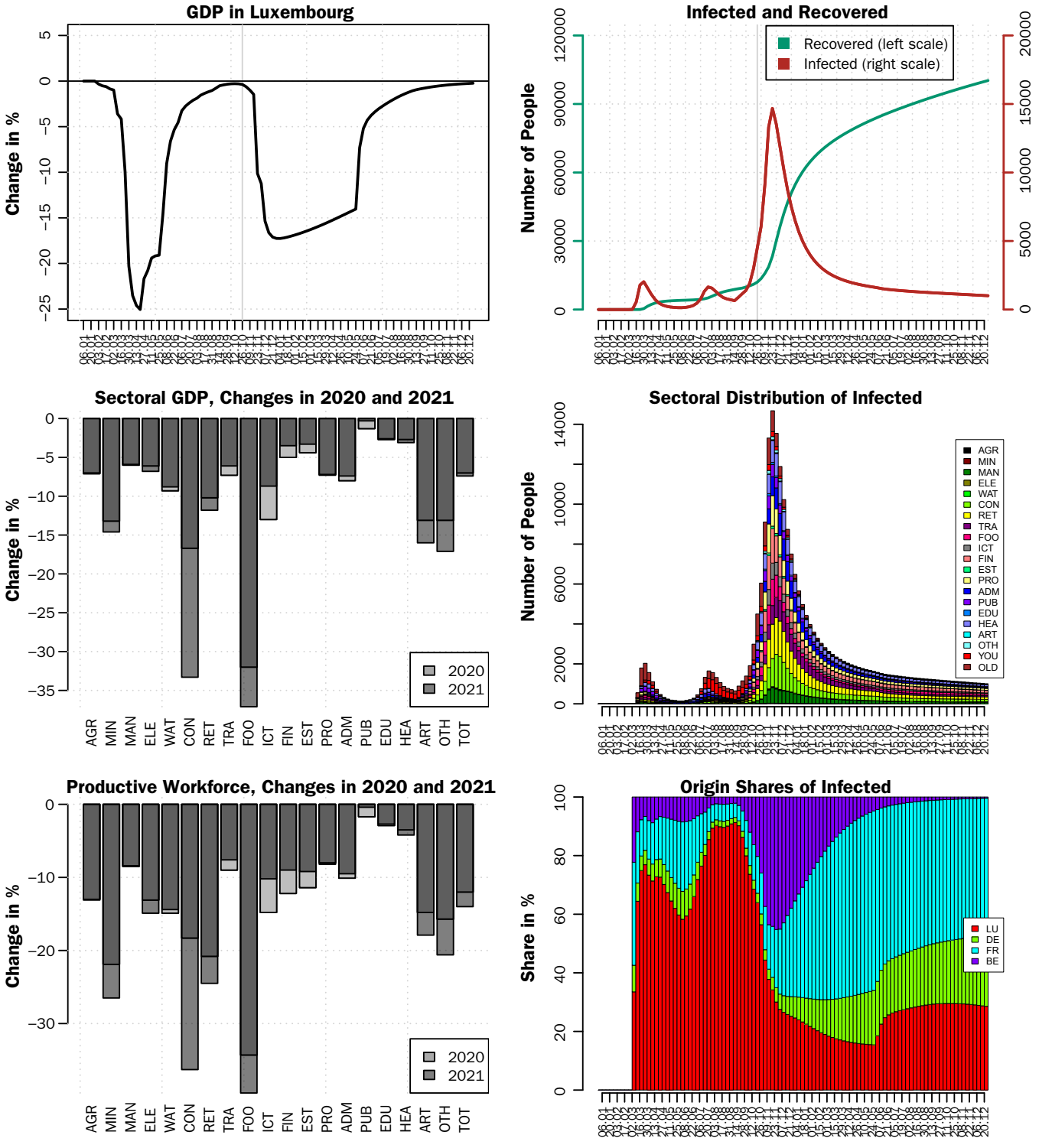


Figure A2: Detailed results for scenario NoSW (hypothetical "no second wave scenario")



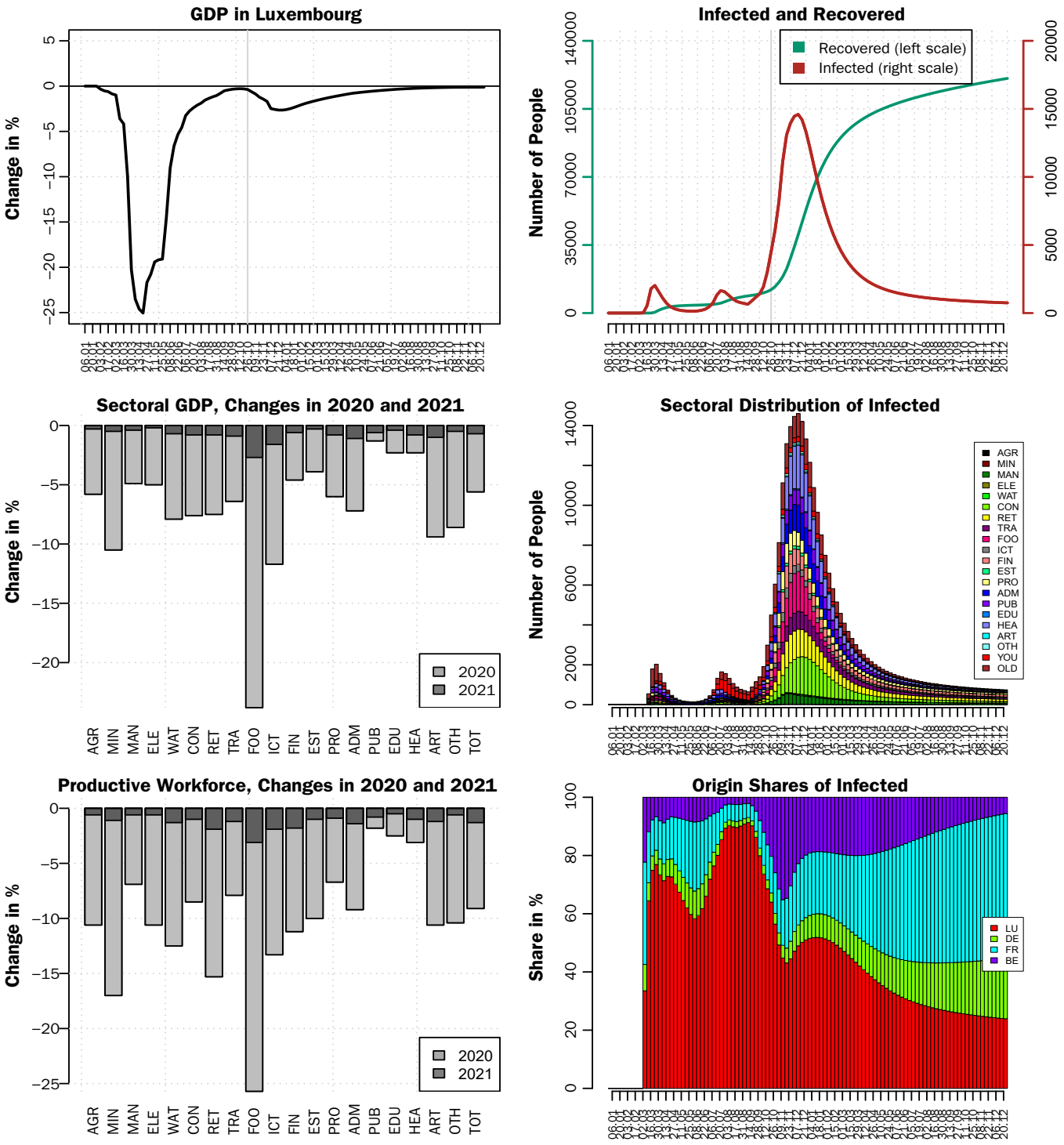
Note : The "Productive workforce" is defined as sectoral workforce (i.e. labor supply) from which detected active cases, workers in quarantine, and workers in chômage partiel (in periods of lockdown) and parental leave (if schools are closed) are deducted, hence the negative change.

Figure A3: Detailed results for scenario SWLO (A 6-month lockdown in 2020Q4 and 2021Q1)



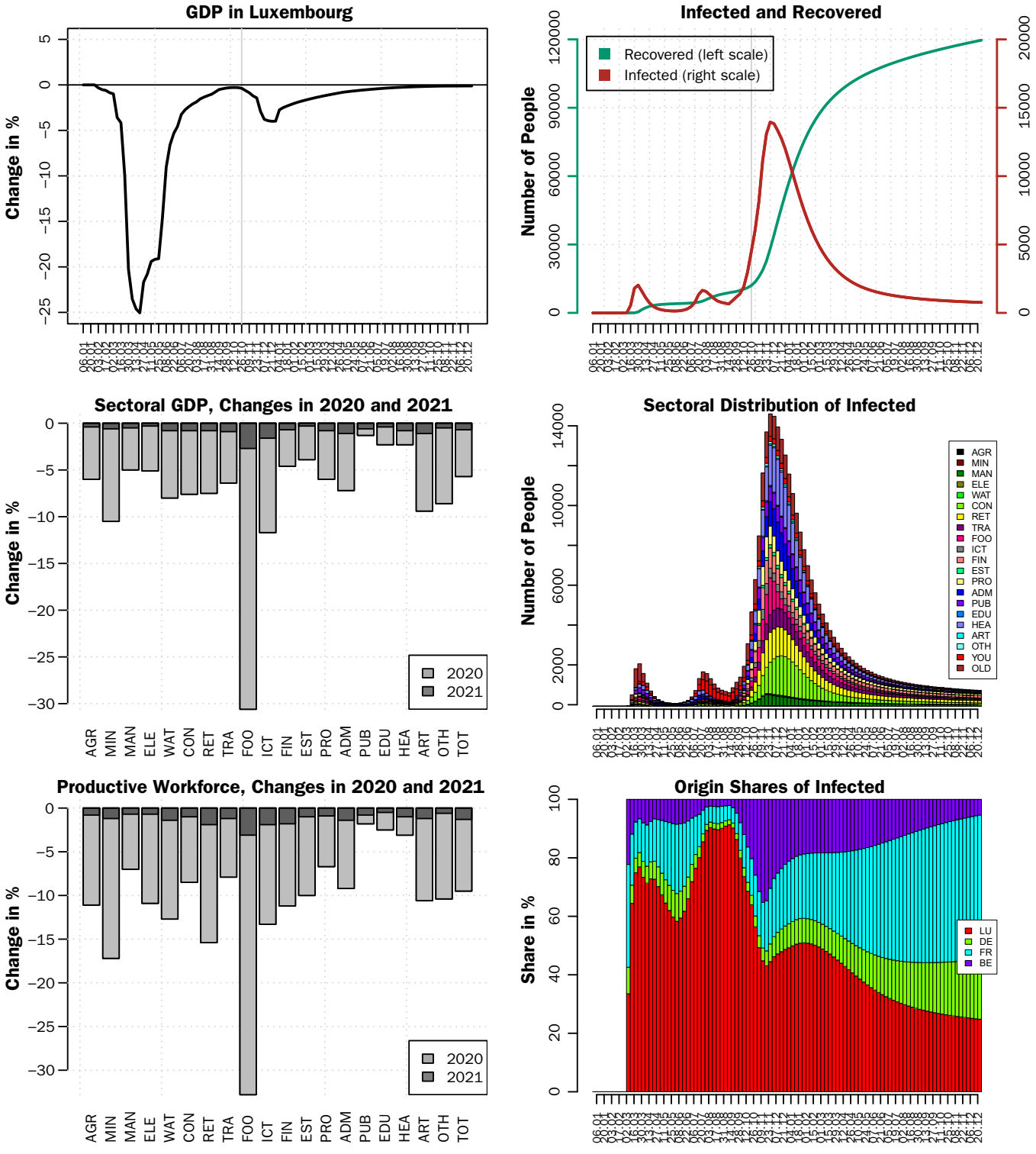
Note : The "Productive workforce" is defined as sectoral workforce (i.e. labor supply) from which detected active cases, workers in quarantine, and workers in chômage partiel (in periods of lockdown) and parental leave (if schools are closed) are deducted, hence the negative change.

Figure A4: Detailed results for scenario SWNL (No lockdown despite a second wave)



Note : The "Productive workforce" is defined as sectoral workforce (i.e. labor supply) from which detected active cases, workers in quarantine, and workers in chômage partiel (in periods of lockdown) and parental leave (if schools are closed) are deducted, hence the negative change.

Figure A5: Detailed results for scenario SWHor (1-month lockdown in HORESCA and family life)



Note : The "Productive workforce" is defined as sectoral workforce (i.e. labor supply) from which detected active cases, workers in quarantine, and workers in chômage partiel (in periods of lockdown) and parental leave (if schools are closed) are deducted, hence the negative change.