N° 536-37 - 2022

Economie ET Statistique

Economics AND Statistics

Dossier thématique - Crise Covid

Les confinements et l'organisation interne des ménages

Effets de la crise sur les choix de localisation et sur les prix de l'immobilier résidentiel

Évolutions de l'emploi au niveau des territoires

Article

La dépendance protéique française

Thematic Section - The COVID Crisis

The Lockdowns and Intra-Household Organisation

Effects of the Crisis on Location Choices and on Residential Real-Estate Prices

Employment Trends at Territorial Level

Article

Protein Deficit in France

Insee

Economie ET Statistique

Economics AND Statistics

Directeur de la publication / Director of Publication:
Jean-Luc TAVERNIER
Rédactrice en chef / Editor in Chief:
Sophie PONTHIEUX
Responsable éditorial / Editorial Manager: Vincent TARDIF
Assistante éditoriale / Editorial Assistant: Véronique EGLOFF
Traductions / Translations: RWS Language Solutions
Chiltern Park, Chalfont St. Peter, Bucks, SL9 9FG, Royaume-Uni
Maquette PAO / CAP: LUMINESS
1, rue du Docteur-Sauvé, BP3, 53101 Mayenne, France
Impression / Printing: DUPLIPRINT
733 rue Saint Léonard, CS 3001, 53101 Mayenne, France

La revue est en accès libre sur le site **www.insee.fr**. Il est possible de s'abonner aux avis de parution sur le site. La revue peut être achetée sur le site **www.insee.fr**, rubrique « Services / Acheter nos publications ».

The journal is available in open access on the Insee website **www.insee.fr.** Publication alerts can be subscribed online. The printed version of the journal (in French) can be purchased on the Insee website **www.insee.fr**.

88, avenue Verdier - CS 70058 - 92541 Montrouge Cedex
Tél : +33 (0)1 87 69 50 00

Economie et Statistique / Economics and Statistics
Issue 536-37 – 2022

THEMATIC SECTION – THE COVID CRISIS

The Lockdowns and Housework

The Crisis and Residential Real-Estate

Employment Trends at Territorial Level

ARTICLE

Housework and Parenting during the Lockdowns in France: How Have Socio-Economic and Gender Inequalities Changed?

Ariane Pailhé*, Anne Solaz*, Lionel Wilner and the EpiCov team*****

Abstract – The lockdowns imposed during the COVID-19 pandemic had an unprecedented impact on people's time use. This article analyses the changes in time spent on household tasks and parenting by men and women during the lockdowns of the spring and autumn of 2020 in France, by social category, education, working arrangements and family configurations, using data from the major longitudinal EpiCov survey. The time spent on housework was high in the spring of 2020 and caring for children was particularly time consuming. This additional domestic and parental burden affected both women and men, but women continued to perform the majority of the housework, in spite of the similar working conditions between the sexes during this period. During the first lockdown, women at the top of the social hierarchy, who generally perform fewer household chores, spent far more time than usual on these tasks, thereby temporarily reducing social differences.

JEL: J22
Keywords: COVID-19, lockdown, housework, parenting time, gender, social class, inequality

**INED; **INSEE; ***Nathalie Bajos and Josiane Warszawski (scientific leads), Guillaume Bagein, François Beck, Emilie Counil, Florence Jusot, Nathalie Lydie, Claude Martin, Laurence Meyer, Ariane Pailhé, Philippe Raynaud, Alexandra Rouquette, Delphine Rahib, Patrick Sicard, Rémy Slama, Alexis Spire.* *This research was funded by the Agence nationale de la recherche ("Résilience COVID-19", reference ANR-21-COVR-0028-01).* Correspondence: *pailhe@ined.fr*

Received in November 2021, accepted in April 2022. Translated from 'Travail domestique et parental au fil des confinements en France : comment ont évolué les inégalités socio-économiques et de sexe ?'.

Citation: Pailhé, A., Solaz, A. & Wilner, L. (2022). Housework and Parenting during the Lockdowns in France: How Have Socio-Economic and Gender Inequalities Changed? *Economie et Statistique / Economics and Statistics*, 536-37, 3–25 (First published online: July 2022). doi: 10.24187/ecostat.2022.536.2086

The lockdowns implemented during the COVID-19 pandemic had an unprecedented impact on the way that people spent their time. In France, working hours decreased or fell to zero for employees faced with job losses, a reduction in hours, or partial unemployment; for others, particularly those in front- and second-line jobs, they remained stable or increased (Barhoumi *et al.*, 2020; Jauneau & Vidalenc, 2020). The introduction of remote working allowed those who were able to continue working in this way to reclaim the time that they would usually spend commuting, but blurred the lines between the private and professional domains. The periods of lockdown and the introduction of the curfew limited the leisure activities that people could participate in outside the home, due to both the restrictions on movement and the closure of sports and cultural establishments. On the other hand, households were faced with increased demands in terms of household chores. Staying at home meant that more meals needed preparing and more shopping and cleaning had to be done (Craig & Churchill, 2021; Sevilla & Smith, 2020), while opportunities to outsource or delegate these tasks were limited by the closure of canteens and restaurants and the fact that many home help services were no longer available, particularly during the first lockdown in spring 2020. This increase in housework represents a break in the long-term trend, which has seen a gradual decline in housework for women in France (Champagne *et al.,* 2015), as is the case in other Western countries (Pailhé *et al.,* 2021; Kan *et al.,* 2011), brought about by the increase in employment among women, the development of household appliances and alternative products, and by a change in expectations and norms when it comes to housework.

During the first lockdown, the closure of nurseries, primary schools, secondary schools and extracurricular activities meant that parents of young and school-age children also had to look after them all day and provide more intensive support for their education (Thierry *et al.,* 2021). Regardless of their social environment, families prioritised the well-being of their children in accordance with good parenting standards (CAFC, 2021). This increased investment in activities with children seems to continue the trend observed in recent decades, for both women and men alike.

From the start of the first lockdown, the question arose as to how gender inequalities would change, in particular when it came to domestic and parental activities. Some saw the pandemic as a potential catalyst for gender convergence. By creating an exceptional situation in which the working conditions of partners became very similar, for example as a result of everybody working from home, the lockdown allowed for greater involvement of men in the private sphere, an area in which women usually invest more time. Therefore, for Alon *et al.* (2020) many fathers had to assume the primary responsibility for childcare, which may ultimately contribute to eroding the social norms that underlie the unequal division of domestic and parental work between women and men.

However, many quantitative surveys have instead shown that gender inequality has remained the same or even worsened over the course of the pandemic, and the findings appear to be linked to the context and type of activities (domestic or parental) carried out. All of the studies carried out in Western countries have shown a sharp increase in unpaid work, particularly among women (Craig & Churchill, 2021; Sevilla & Smith, 2020), with the extent of this varying depending on how strict the lockdown measures in place were and the duration and extent of school closures and disruption to lessons. The degree to which men were involved prior to the pandemic is also a key determining factor for the variations observed. In Anglo-Saxon countries, men significantly increased their involvement in domestic tasks (Petts *et al.,* 2021; Shafer *et al.,* 2020; Hupkau & Petrongolo, 2020). In southern European countries, their involvement was limited, particularly when compared with the very significant increase in housework for women (Farré *et al.,* 2022; Del Bocca *et al.,* 2020). Men in particular contributed more than usual to parenting, whether it be in Anglo-Saxon countries (Sevilla & Smith, 2020; Andrew *et al.* 2020; Petts *et al.*, 2021), continental Europe (Kreyenfeld & Zinn, 2021; Hipp & Bünning, 2020) or southern Europe (Biroli *et al.*, 2021). The gender gap has even narrowed in Australia (Craig & Churchill, 2021; Craig, 2020) and Canada (Shafer *et al.,* 2020). In Germany, the more even split of childcare observed at the start of the pandemic (Kreyenfeld & Zinn, 2021) subsequently reduced (Boll *et al.,* 2021). In southern Europe and the UK, women took on the majority of the increased childcare burden (Farré *et al.,* 2022; Del Bocca *et al.,* 2020), which brought about a widening of the gender gap (Hupkau & Petrongolo, 2020). These studies looked in particular at the impact of the change in working conditions on participation in housework during the pandemic. A small number of studies analysed the social differences and, once

again, the results were contrasted depending on the context. In Spain, for example, female graduates saw the amount of time that they spent on unpaid work increase more than any other group (Farré *et al.,* 2022), while, in Germany, it was the men and women with a lower level of education who spent more time caring for children (Kreyenfeld & Zinn, 2021).

In France, in the initial surveys performed on small or non-representative samples, women stated that, during the pandemic, housework and parenting in particular increased (Champeaux & Marchetta, 2021). On average, the time that women devoted to housework and parenting during the first lockdown remained higher than that of men (Safi *et al.,* 2020), but housework was shared a little more evenly between partners than before the pandemic (Boring & Moroni, 2021), particularly in the case of couples where the man was not working or was working from home (Dominguez-Folgueras, 2021).

This article aims to further explore these initial findings using data from the large longitudinal and representative EpiCov survey (Box 1). We will analyse the differences in time spent on household and parenting tasks by men and women during the 2020 spring and autumn lockdowns (Box 2) and in particular the differences based on socio-professional category, income, qualifications, working arrangements and family configuration.

Following a brief recap of the main theories concerning housework, in section 2, we will describe the data and method used. In the third section, we will describe the changes observed with regard to employment and working hours during the first two lockdowns, followed by the descriptive and then multivariate findings concerning the amount of time spent on household tasks, and finally those for the time spent on parenting tasks.

1. Three Main Theories on Housework

The unprecedented experience of lockdown provided an opportunity to better understand the determinants of household and parental work and the mechanisms for its distribution between the genders. Three broad explanations are usually put forward. The first relates to available time: time spent on household tasks is inversely proportional to time spent at work for both women and men alike and therefore largely depends on their working hours (Presser, 1994; Blair & Lichter, 1991; Bianchi *et al.*, 2000; Gershuny *et al.,* 2005). The health crisis has severely disrupted the time that people have available. In France, the average number of hours worked decreased by around 35% during the first lockdown when compared with the same period of the previous year (Jauneau & Vidalenc, 2020); it can therefore be expected that both men and women who did not work during lockdown will have spent more time on housework. This has been observed by many studies: the increase in the burden of household and parenting work is linked to occupational changes during lockdown (Adams-Prassl *et al.*, 2020; Sevilla & Smith, 2020; Zoch *et al.*, 2021; Dominguez-Folgueras, 2021). However, the empirical results differ for the two genders: the time spent by men on childcare and household chores during the pandemic was more dependent on their working conditions than was the case for women (Andrew *et al.,* 2020; Sevilla & Smith, 2020; Hank & Steinbach, 2021), which is at odds with traditional findings, which show that the amount of time spent by women on housework stretches more around time spent on paid work than is the case for men. This means that, before the pandemic, women were more likely than men to increase the amount of time spent on housework, for example during periods of unemployment (van der Lippe *et al.,* 2018). In this sense, lockdown was an unprecedented situation that could help us to understand how time spent on household chores varies depending on paid work. Indeed, it presented an exogenous and unanticipated shock to the working hours of both men and women alike, something that the analysis can take advantage of, seeing as this change to working hours is not *a priori* linked to gender roles,[1] whereas changes in the working hours of men and women are usually shaped in advance by norms and earlier decisions concerning the gender-based division of work. The constraints of working hours are usually endogenous for everyone, so it is difficult to assess their role.

A second group of explanations concerns the relative resources of each partner. According to economic theories of conjugal specialisation, the time spent by each partner on household chores depends on comparative advantages in professional and private spheres (Becker, 1985). In heterosexual couples, since, on average, men earn more than women, they devote more time to paid work, while women spend more time doing housework. More recent economic theories highlight the bargaining power between spouses, which is dependent on their respective resources (Chiappori, 1997; Behrman, 1997). According to sociological analyses based on

1. *Except with regard to the distribution by occupation and sector.*

the relative resources of partners, the distribution of unpaid work within couples reflects the power relationships in which the partner with the highest income (generally the man) or with the highest level of education tends to delegate housework to the other (Shelton & John, 1996). Although lockdown did not have any impact on relative levels of education, it did affect the relative economic resources of the partners in situations in which one partner unexpectedly lost their job or suffered a drop in income as a result of part-time working or a reduction in working hours. In addition, a higher level of education or higher salary within the household could provide one of the partners, and in particular the woman, who performs the vast majority of the housework, with the means to outsource some of that housework without having to negotiate with the other partner (Gupta, 2007). From that perspective, the near-impossibility of outsourcing housework during the first lockdown may have resulted in the renegotiation of the distribution of tasks to be performed based on relative resources among those households who usually rely on outsourcing (often the wealthiest).

The third perspective explains the gender disparities observed in the performance of housework as the result of the gender roles instilled in people from childhood, which are deeply internalised (Cunningham, 2001; Akerlof & Kranton, 2000). According to constructivist approaches to gender performance or "doing gender", these roles are reinforced by practices (Berk, 1985; Brines, 1994; West & Zimmerman, 1987): women display their gender identity through the household tasks they perform (West & Zimmerman, 1987; Brines, 1994). Couples may even compensate for an atypical situation from the point of view of gender (for example, households in which the woman is the main breadwinner) by adopting a traditional division of work (Brines, 1994). From this perspective, the pandemic would not be expected to bring about any significant change to the organisation of household tasks due to the deep-rooted nature of these gender practices.

2. Data and Method

2.1. Data

We make use of the data from the large longitudinal EpiCov survey, the sample for which is representative of the French population (Box 1), in which the same people were questioned in May and November 2020 with regard to the amount of time that they spend on household and parenting tasks. Our population of interest is that of working age people (20 to 65 years), whether they have a partner or not, who responded to the long questionnaire during the first wave, so 10,466 people (4,770 men and 5,696 women) and during the second wave, so 8,379 people (3,709 men and 4,670 women). Of the latter, 69% have a partner and 39% are parents of minor children (see Table A1 in the Appendix).

In the absence of reference data on the division of housework just before the pandemic,[2] we will compare the time spent on housework and parenting in May and November 2020. The impact on time was much less pronounced in the autumn than in the spring: in autumn, schools remained open, economic activity had largely resumed and with it, the amount of time spent doing paid work (Box 2); working full-time from home was also significantly less widespread and there were far more options for outsourcing housework. We are working on the assumption that this situation is fairly close to "normal". The comparison between May and November is therefore a way, albeit imperfect, to measure the impact of the first lockdown on time spent on household and parenting tasks. This may appear to be a strong assumption, as it is not impossible that the first lockdown had a learning effect and led to the reallocation of tasks, particularly for parents or new remote workers, which could have a lasting impact on the organisation of time within families. Without an identical measure of the amount of time spent on each task before lockdown, this is difficult to judge. This assumption of a sort of "return to normal" does appear credible, however. For example, a study carried out in the United Kingdom using data from the Understanding Society panel showed that the distribution of housework, which had become more equal during the spring lockdown, had returned to the pre-lockdown situation by September 2020 (Sánchez *et al.*, 2021). In addition, in the French context, other events affecting paid working hours in a significant and lasting manner, such as the 35-hour reform, only had a minimal impact on time spent performing housework (Pailhé *et al.*, 2019a) and long-term changes are generally extremely slow (Champagne *et al.*, 2015). The bias is also well-known: if the first lockdown allowed men to participate in the long-term, measuring the difference between the two periods underestimates their greater involvement during the first lockdown.

2. *The most recent French Time Use survey (*enquête Emploi du temps*) dated 2009-2010.*

Box 1 – **The EpiCov survey**

EpiCov (*Epidémiologie et Conditions de vie liées au Covid-19* – Epidemiology and Living Conditions associated with COVID-19), a representative survey conducted by INSERM and the DREES (the statistics and research directorate of the ministry of health and social affairs) with the assistance of INSEE and *Santé publique France* (the French Health Authority) surveyed people aged 15 and over via the internet or telephone in mainland France, Martinique, Guadeloupe and Réunion in order to monitor the dynamics of the pandemic, living conditions and exposure to the virus (for a detailed description, see Warszawski *et al*., 2021). The same people participated in the survey at several points during the pandemic. Around 135,000 people responded during the first wave (of the 371,000 people drawn at random based on tax data), which took place between 2 May and 2 June 2020, the period between the strict lockdown and the first phase of opening up (see Box 2). Around 110,000 people participated in the second wave of the survey between 26 October and 30 November 2020 and 85,000 people responded to the third wave during the summer of 2021.

Only the first two waves of the survey are used here. The questionnaire included questions concerning the amount of time spent performing household chores, which were addressed to a randomly drawn sub-sample of respondents (around 10% of respondents, so 13,500 people):

Over the last seven days, how much time, on average, have you spent on common household chores (cooking, shopping, cleaning, laundry) each day?

Over the last seven days, how much time, on average, have you spent looking after your children or grandchildren under the age of 18?

In order to facilitate the response, seven response options were offered: 0 minutes; less than 30 minutes; more than 30 minutes but less than 1 hour; more than 1 hour but less than 2 hours; more than 2 hours but less than 4 hours; more than 4 hours but less than 6 hours; 6 or more hours.

Box 2 – **The measures of restriction during the first two lockdowns**

The first strict population lockdown was in place from 17 March to 11 May 2020 across the whole of the French territory. All activities deemed to be non-essential were shut down and people were asked to work from home wherever possible. Schools, nurseries and leisure and social facilities were closed and people were only permitted to leave the house to go to work, to go shopping, for health reasons or due to a family emergency and to exercise alone for no more than an hour and within a maximum radius of one kilometre from home. From 11 May, businesses reopened, as did primary and secondary schools, albeit very gradually. By 2 June, movement was no longer restricted within mainland France and bars and restaurants reopened.

The second lockdown, in place from 30 October to 15 December 2020 in mainland France, was less strict than the first. Remote working once again became the rule, but the list of essential activities was longer and many industries were permitted to continue trading. Nurseries and schools remained open. Movement was once again limited, as was the case in spring. From 28 November, people were permitted to travel within a radius of 20 km from their home and for up to three hours. "Non-essential" businesses reopened, with the exception of bars and restaurants and cultural establishments. On 15 December, people were allowed to move around during the day, but a curfew was introduced between 8 pm (6 pm in 25 departments) and 6 am. On 16 January 2021, the curfew was brought forward to 6 pm, before being gradually relaxed. It was lifted on 20 June 2021.

2.2. Estimation Method

Given the specific nature of our variable of interest (time spent on housework and parenting is reported in seven bands), we estimate the regressions for each interval. The dependent variable y refers to the time spent on household chores, measured in hours per day and reported via seven bands in the EpiCov survey. If $A_0 = 0$, $A_1 = 0$, $A_2 = 0.5$, $A_3 = 1$, $A_4 = 2$, $A_5 = 4$, $A_6 = 6$ and $A_7 = 24 - T - C$, where C is the time spent parenting and T is the time spent doing paid work, with the values at the extreme ends of the ranges being referred to as "thresholds". An ordered probit model (or an interval regression, Greene & Hensher, 2010) at known thresholds (with those thresholds being observed) assumes that there is a link between the range j and a latent, non-observed variable y^* taking the form $y_i = j \Leftrightarrow A_{j-1} \leq y_i^* < A_j$ and that this latent variable follows a linear model of type $y_i^* = x_i'\beta + \varepsilon_i$.

The main variables of interest for studying the link between available time and time spent on housework are the work situation during lockdown and the amount of time spent on paid work. The time spent doing paid work is measured across the seven days preceding the survey. We construct a professional activity situation variable for each survey, for which the modalities are as follows: not working (in education, stay-at-home parent, retired, etc.), unemployed (job seeker), full or partial technical unemployment, working on site, working full-time from home, hybrid working and miscellaneous leave (special leave of absence, sick leave, holidays, etc.).

The socio-economic resources are measured by the highest level of education achieved, the standard of living decile of the household and the socio-professional category of a position[3] (we cannot study the impact of relative resources due to an absence of information on the partner's resources). The information on the standard of living of the household (income per consumption unit, in deciles) is taken from the 2018 tax files.[4]

The control variables are: age, family situation, whether the partner works outside of the home (as opposed to working full-time from home or not working), the survey period, the residential location variables (Île-de-France, other region within mainland France, overseas) and the type of accommodation (house or apartment).

The estimations were made on the basis of pooled data from the two waves, with interaction between the survey period (May vs November) and our variables of interest. Two specifications are estimated, one with working hours and the other with employment status. We routinely compare men's and women's hours, estimating the regressions for each gender. We provide a graphical representation of the predicted hours following these regressions (the results of the regressions performed for both waves together are presented in the Online Appendix, Table S-1 for time spent on housework and S-2 for time spent parenting).[5]

3. Results

3.1. Similar Situations and Comparable Working Hours between Men and Women during the First Lockdown

Employment and work rates for men and women have been becoming more comparable in recent decades. However, prior to the pandemic, in the 20-65 age bracket, women were more likely to be not working than men.[6] The proportion of unemployed people does not vary by gender. The recourse to remote working, which was not widespread before the crisis, was a little more common among men (9% reported working remotely) than among women (7.5%) prior to lockdown (Figure I).

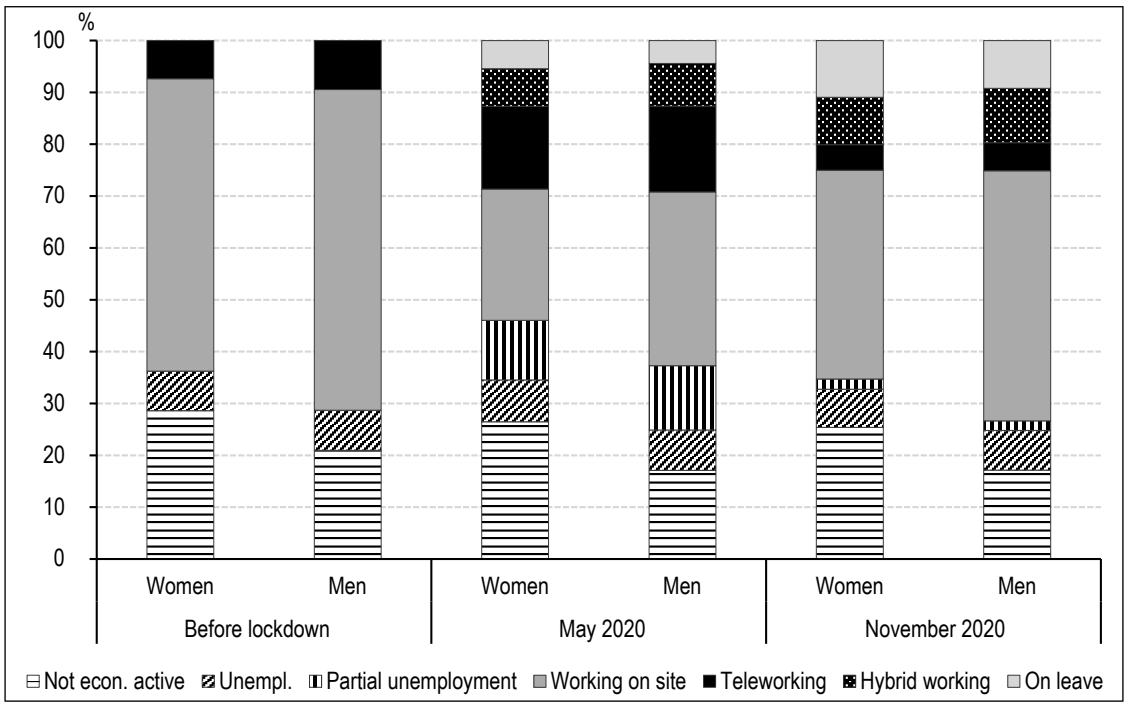
The spring 2020 lockdown made working conditions that were previously the exception much more common, such as technical unemployment or the possibility of working full-time from home. In May 2020, in the seven days preceding the first questionnaire, 12.4% of men and 11.5% of women (or 17.4% and 18.1% respectively of those actively employed prior to lockdown) were affected by full technical unemployment,[7] 16.6% of men and 16.0% of women of working age (or 21.5% and 24.1% respectively of those actively employed prior to lockdown) were working full-time from home and 33.5% of men and 25.3% of women (or 42.5% and 37.0% of those actively employed prior to lockdown) were working exclusively on site, a situation that has become less frequent, but is still more common among men than women.

During the second lockdown in autumn 2020, which was less strict, interruptions to economic activity were less frequent and there were more opportunities to work on site (48.8% of men and 40.9% of women, or 61.1% and 56.7% respectively of those actively employed before the health crisis and who work exclusively on-site). Full technical unemployment was significantly less common (2% of those actively employed before the health crisis). Full-time remote working also became less common, having been replaced by hybrid working, with employees alternating between working on-site some days and working from home on other days. We should also note the more frequent leaves, since the second wave of the survey was conducted in part during the All Saints' school holidays. Once again, we observed relatively few differences between the genders with regard to working conditions (except for among those who do not work).

Figure II shows the average time spent on paid work each day. Around 30% of men and 35% of women did not work or no longer worked at all during May 2020. The proportion of respondents who did not work during the seven days preceding the survey was smaller in autumn 2020 (21% and 25%, respectively), but remained high due to the school holidays. Average working hours had increased significantly in the autumn when compared with the figures for spring,[8] for both men and women alike. In November, more than 70% of men reported doing more than six hours of paid work per day (41% more than eight hours), compared with 55% in May 2020 (28% more than eight hours). Men are more likely

3. The detailed profession is filled in during the second wave of the survey.
4. The information regarding standard of living is missing for around 6% of respondents and the information regarding the socio-professional category is missing for around 8% of those surveyed. For these cases, we have created a "missing income" modality and a "missing social category" modality; indeed, removing these observations could result in bias within the sample if they are not randomly distributed across the population.
5. Link to the Online Appendix at the end of the article.
6. All of the differences between men and women were tested using a Student's test.
7. Those who reported having been in technical unemployment since the start of lockdown and who had not worked during the previous seven days were considered to be experiencing technical unemployment.
8. The time distributions differ significantly if a Kolmogorov–Smirnov test for equality of distribution is performed.

Figure I – **Occupational status of men and women aged between 20 and 65 before and during the periods of lockdown in spring and autumn 2020**



Notes: The question about the pre-lockdown period does not provide for a leave category.
Reading Note: In May 2020, 33.5% of men and 25.3% of women aged between 20 and 65 worked at their place of work during the previous seven days.
Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

to be working long hours of more than eight hours per day than women. It should be noted that the working hours of men and women were comparable during the first lockdown, as the distribution of working hours was fairly similar. The distributions differed more during the second lockdown, when both men and women had resumed their professional activities, with men often working longer hours than women.

3.2. More Time Spent on Housework During the First Lockdown for both Men and Women

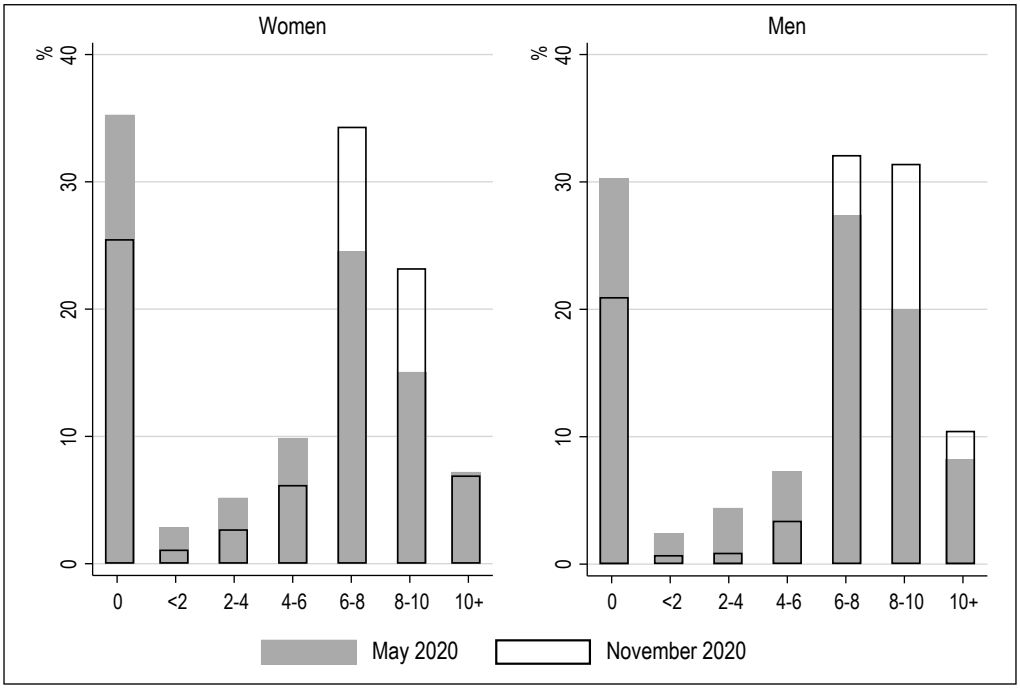
During the first lockdown, the amount of time spent on routine housework was high: 28% of men and 51% of women spent more than two hours per day on it, and almost one in five women even reported spending more than four hours a day on housework (Figure III). Parents spent particularly large amounts of time on household chores, with 58% of mothers and 32% of fathers devoting more than two hours per day to these tasks. That time reduced significantly[9] between May and November 2020. For example, 28% of men spent more than two hours per day doing housework in May compared with 23% in November, and the number of men spending less than one hour on housework per day in November increased significantly (45% compared with 40% in May). This is also the case for women, with short durations being more common during the second lockdown (23% compared with 16% during the first). The drop in time spent on housework between these two periods is smaller for women than for men: the proportion of those dedicating more than two hours per day fell from 51% to 44%.

3.3. The Amount of Time Spent on Housework Depends on the Work Situation

All else being equal, the time dedicated to household chores decreases in line with time spent on paid work for both men and women alike, regardless of the period in question (Figure IV). The availability in terms of time usually affects the amount of time spent on household chores. This is because those who work more hours are more productive (and spend less time than average on performing an identical task), are less exacting when it comes to the quality of housework and have the option to outsource housework (home help or purchase of substitute products such as ready meals), or because other unobserved characteristics are simultaneously linked to the two types of time. In both May and November 2020,

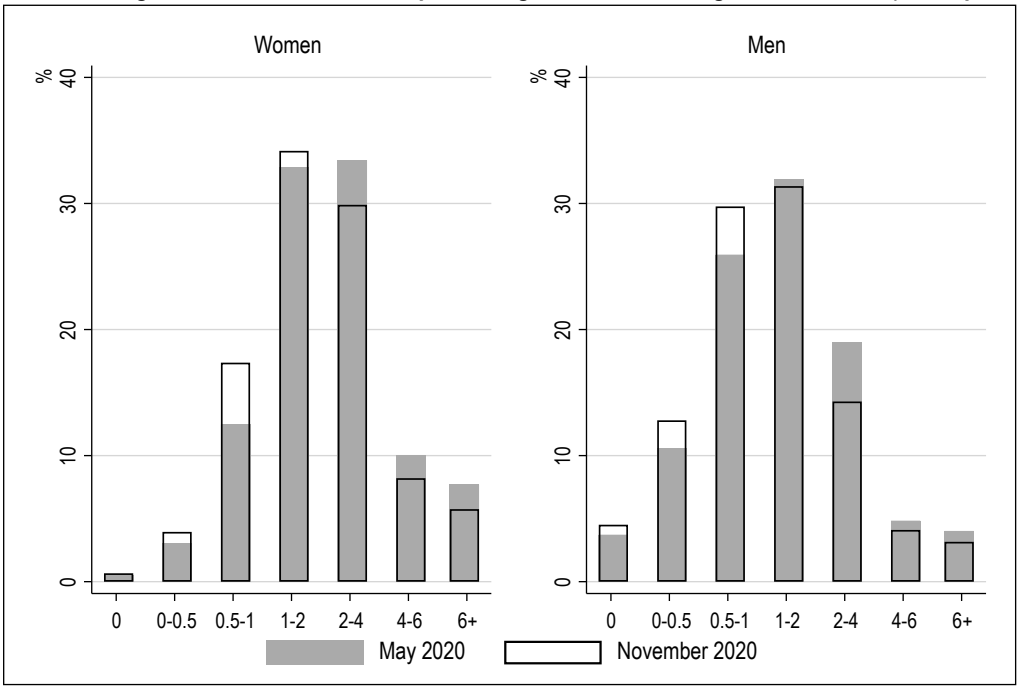
9. According to a Kolmogorov-Smirnov test for equality of distribution.

Figure II – **Distribution of working hours of men and women during the spring and autumn of 2020 (hours per day)**



Reading Note: The shaded histogram shows the distribution of working hours in May 2020; the transparent histogram relates to November 2020. In May 2020, 28% of men worked an average of between six and eight hours per day. This share increased to 32% in November 2020.
Sources and coverage: INSERM/DREES, EpiCov survey, waves 1 and 2-2020; people aged between 20 and 65.

Figure III – **Changes in the amount of time spent doing housework during the lockdowns (hours per day)**



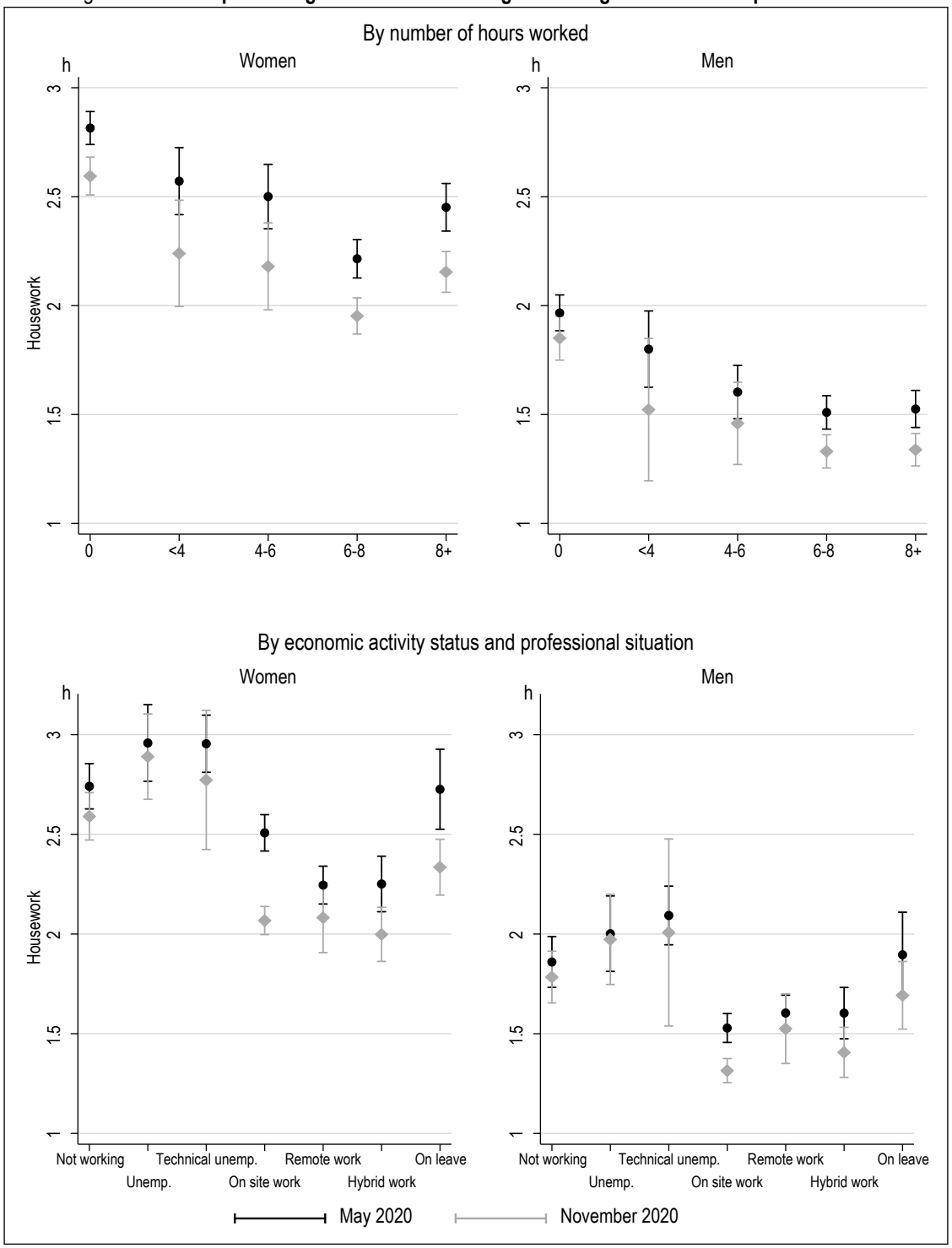
Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

where men and women spent the same amount of time doing paid work, on average, women spent more time on housework than men. For example, during the first lockdown, women who spent between six and eight hours per day on paid work also spent more than two hours doing housework. Men in the same situation only spent an hour and a half on housework. Regardless of the amount of time spent on paid work, but in particular where this exceeded six hours per day, the amount of time spent on housework was higher during the first lockdown than during the second. This gap clearly reveals the surplus of household chores during the spring of 2020,

particularly cooking as a result of the closure of canteens and restaurants, and housework due to the more continuous presence of adults and children in the home or the increased sanitary measures to be taken. This difference between the two periods with equivalent working time is significantly more marked for women, which demonstrates their greater over-investment during the first lockdown.

The type of professional activity is also linked to the amount of time spent on housework (Figure IV). Men and women who do not have a job, whether they be not working, unemployed or in technical unemployment due to a cessation of business brought about by the health crisis, or on leave at the time of the survey, report a higher average amount of time spent on household chores than those who are actively employed.

Figure IV – **Time spent doing housework according to working hours and occupational status**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

This discrepancy is more pronounced for women than for men. The amount of time spent on household chores is fairly similar for those who are working, whether that be on site, full-time from home or alternating between the two. It therefore does not appear that the commuting time reclaimed by remote workers has been reassigned to household chores.

With the given work situation and other characteristics, on average, people devoted an equivalent amount of time to household chores during the first and second lockdowns, with the exception of those working on site, who devoted more time to household chores during the first lockdown, particularly women working on site who even spent more time on household chores than women who were working from home. They may also have had to do more laundry and cleaning so as not to risk infecting other household members. This fairly surprising finding could stem from the unobserved characteristics of these on-site workers during the first lockdown. For example, some may have non-standard schedules, allowing them to perform more tasks during the day, or a need to over-invest in the household during a period in which they were the only ones not at home all the time. This finding could also be linked to the possible difficulty in accounting for time spent on household chores when the boundaries between the professional and private spheres become blurred. For example, those working from home could have performed household chores in short bursts, such as during tea breaks, or while working. This porosity between activities makes it more difficult to quantify the amount of time spent on household chores and may result in this being under-reported by homeworkers. The available data, which are less precise than the data from the French Time Use survey (Box 3) do not support these interpretation paths. Aside from women who work on site, the minor differences observed between the two lockdown periods in the amount of time spent on household chores for those with an equivalent work situation demonstrate that the changes in their working conditions have broadly contributed to the changes in their involvement in housework.

3.4. An Excessive Domestic Burden for Women with Young Children

The family configuration (couple life, family size and the age of children) influences both the amount of housework to be done and the possibility of sharing tasks between the various members of the household (Figure V). Ordinarily, the presence of children increases the amount of housework required, particularly when they are young. This phenomenon was also observed during the health crisis. Women who were living with a partner and had one or more children under the age of 12 reported the highest average amount of time spent on housework, followed by those living with a partner, but whose youngest child is over 12, then single mothers. Women living with a partner devote more time to domestic chores than those who do not live with a partner, taking on more than the additional chores associated with the fact that they are living with another person. The circumstances surrounding the first lockdown exacerbated these differences: mothers performed even more household chores, particularly those with children under the age of 12 (all else being equal, on average, they devoted almost three hours per day to housework) and single mothers (two and a half hours on average). Mothers and women living with a partner but without children spent almost half an hour more each day on housework during the spring than in the autumn. However, the amount of time spent on housework by single women without children did not change during the health crisis.

During the first lockdown, men living with a partner and fathers of young children participated far more than usual with the housework, spending more than two hours per day on this, compared with one and a half hours during the second lockdown, the same as men living with a partner but without children. In other family configurations, it was primarily the women who took on the additional household chores required as a result of the increased needs of the other members of the household. During the second lockdown, the participation of men was no longer dependent on their family situation, as is usually observed (Champagne *et al.*, 2015). Therefore, the over-investment of fathers has not continued, and the assumption of a return to normal appears to have been confirmed.

3.5. No Social Gradient for Women during the First Lockdown

Regardless of the standard of living and the period in question (May or November 2020), the amount of time spent on household chores by women was higher than that of men (Figure VI). All else being equal, there was no significant difference in the amount of time spent on housework by women during the first lockdown based on their standard of living. Conversely, during the second lockdown, the amount of time spent on household chores fell in line with the standard

Box 3 – **Measuring time on the basis of self-declarations**

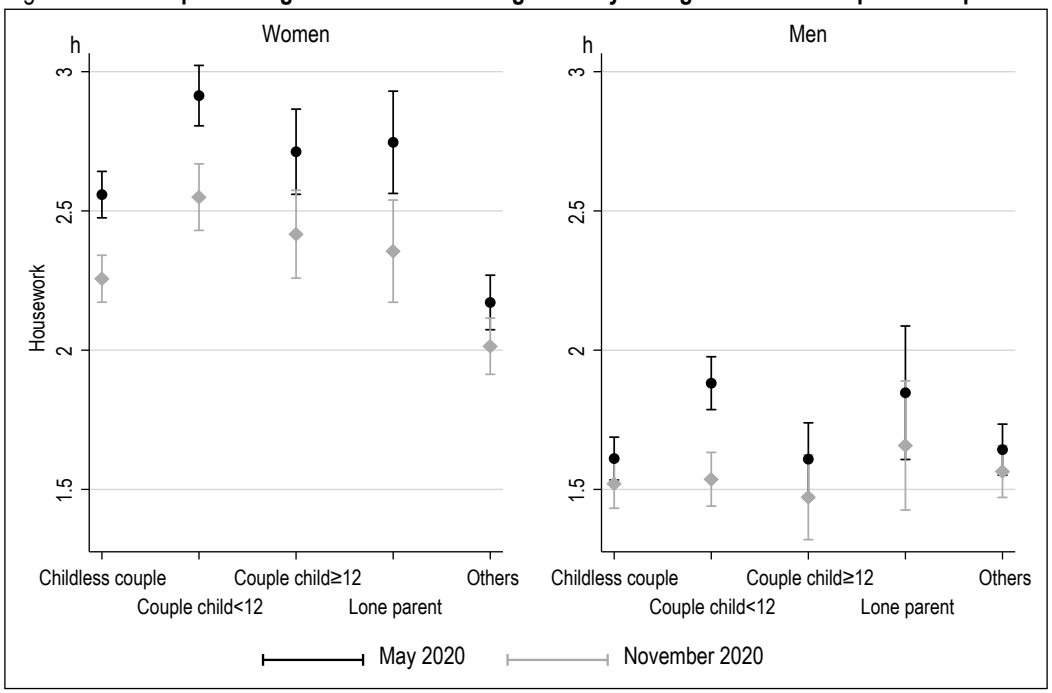
Different methods can be used to measure the amount of time spent on household and parenting activities (Solaz, 2009).

Activity diaries, used by Time use surveys, are the most reliable and objective method. People use the activity booklets to make a note of the way they used their time over one or two days using time intervals (usually 5 or 10 minutes). A duration is obtained by adding together the amounts of time spent on the various household activities performed throughout the day. This collection method is not particularly sensitive to memory and social desirability biases and limits measurement errors. However, such surveys are fairly costly, and response rates are sometimes low due to the significant amount of effort required on the part of the respondent.

Another method that can be used is to ask the respondent how much time they think they spend on average doing housework or a particular task. The findings are less precise and undoubtedly objective, but are less costly to obtain. This is the method that was used for the EpiCov survey used for this study.

Methodological studies comparing the two types of measurements have observed that self-reported times may be greater than those measured using activity diaries (Bianchi *et al.*, 2000). It is likely that respondents are including time spent doing housework simultaneously with other activities (Juster & Stafford, 1991; Kan, 2008). The discrepancy between the two measurements may be greater when working hours are irregular and when the amount of time spent on housework is small (Robinson, 1985; Gershuny *et al.*, 2005). Gender-based differences do not appear to be consistent. Women are better than men at reporting the amount of time they spend on housework in Britain (Kan, 2008), but this is not the case in Norway or Denmark (Bonke, 2005).

Figure V – **Time spent doing housework according to family configuration and the period in question**

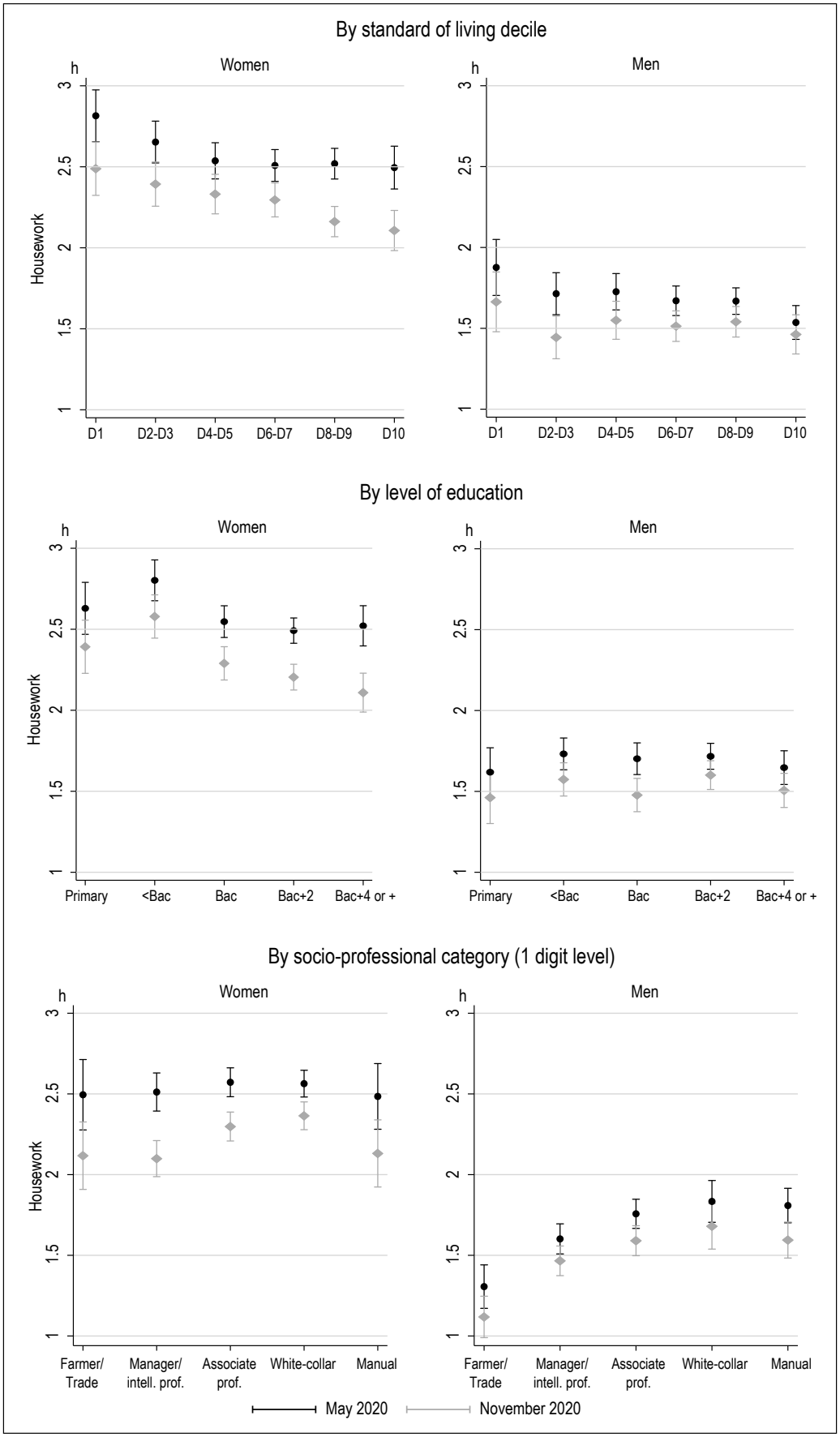


Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

of living, and was significantly reduced when compared with the first lockdown for women in the wealthiest households. The latter were no doubt – once again – able to outsource a certain number of chores; something that was almost impossible during the first lockdown. For men, on the other hand, the average time spent on household chores varied little based on their standard of living during both the first and second lockdowns. Regardless of their standard of living, the amount of time that they spent on housework during the first lockdown was higher than that observed during the autumn, but did not vary significantly based on their standard of living.

The findings are similar for other social stratification indicators, such as their level of education or their socio-professional category (Figure VI). During the first lockdown, the amount of time devoted to household chores was the same for those who have a secondary level of education and those with university degrees. Women with a qualification below spent more time on housework. In November, the social gradient was much steeper. Those with the highest level of

Figure VI – **Time spent doing housework according to socio-economic variables (income, educational level and socio-professional category) and the period in question**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

education devoted less time (around 20 minutes less per day) to housework than during the first lockdown. For men, the same was true of income: their degree of participation in household chores remained the same, regardless of their level of education. On average, they devoted a little more than an hour and a half per day to housework (so an hour less than women). No significant difference was observed between the first and second lockdowns with the exception of men with secondary level education, who participated less during the second one.

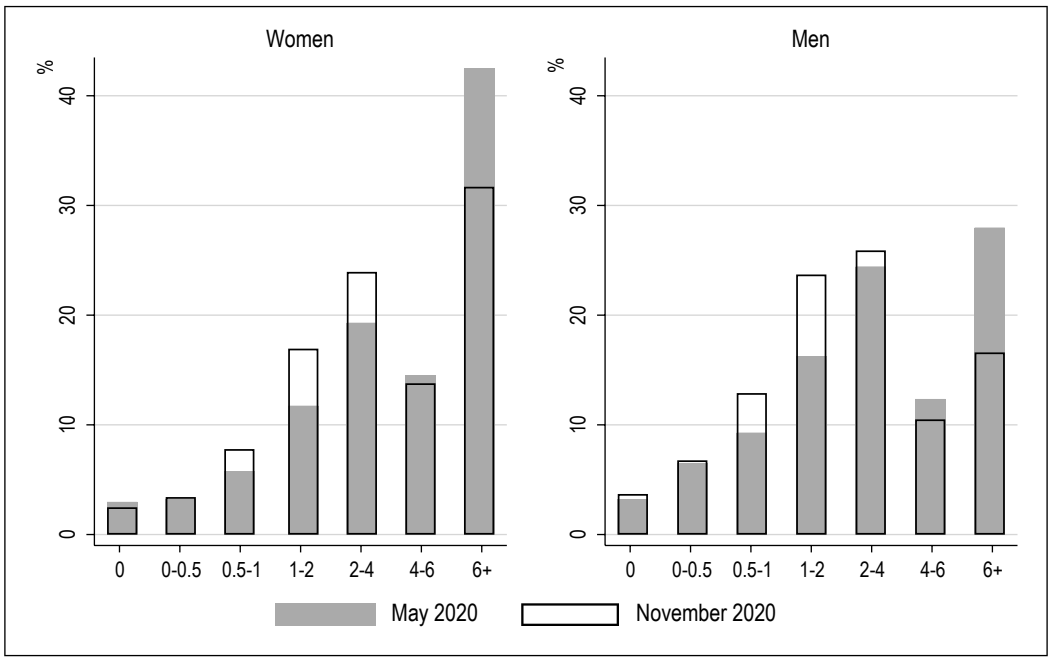
During the first lockdown, and still while checking individual, professional and family characteristics, no changes were observed in the average amount of time spent on household chores by women according to their socio-professional category, which is at odds with what is observed outside of the context of the pandemic, where the amount of time spent on housework decreases as their position in the social hierarchy increases (Brousse, 2015). However, this social gradient re-emerges during the second lockdown. Women in management positions and intellectual professions spent significantly less time performing housework, as was the case for associate professionals and white-collar workers, albeit to a lesser extent. The social gradient was more pronounced among men than among women during the first lockdown, and was more stable: tradespeople and managers spent less time on household chores than associate professionals, white-collar workers and manual labourers. In other words, the spring lockdown did not bring about any differences in participation in household chores for men depending on their social categories; however, it erased social categories for women.

3.6. Significant and Unevenly Shared Parenting Time during the First Lockdown

The time devoted to children, or parenting time, was particularly high during the first lockdown for both fathers and mothers with at least one minor child. They had to ensure that school work was monitored, organise activities for their children, keep an eye on their screen time and respond to their constant demands (Thierry *et al.*, 2021). Childcare was more time-consuming for mothers. For example, almost 30% of fathers and more than 40% of mothers reported having spent more than six hours per day looking after their children, more than 10 percentage points higher than during the second lockdown, when childcare services and schools remained open (Figure VII).

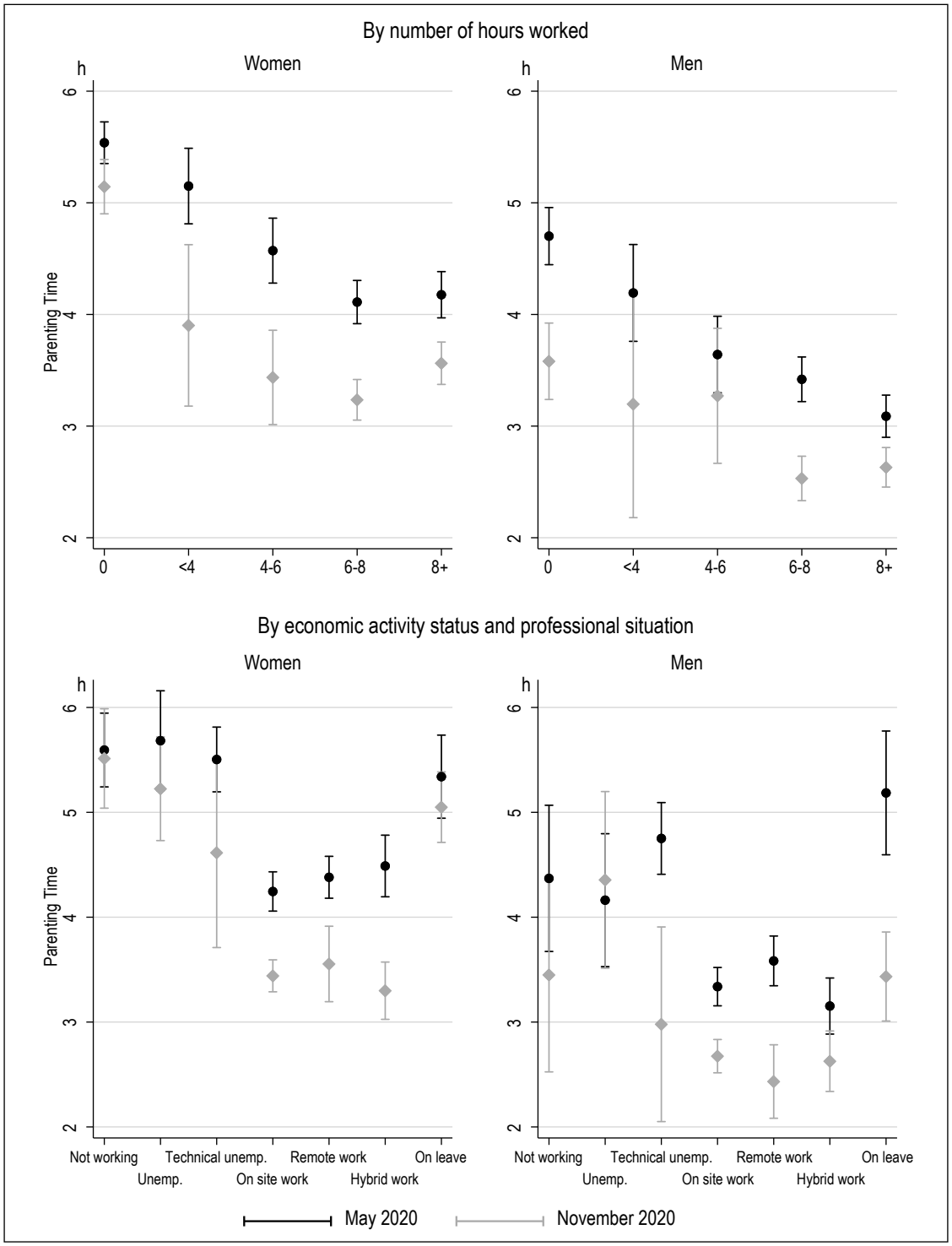
As was the case for time spent on housework, parenting time appears to fit around time spent on paid work, with a clearly inversely proportional relationship between parenting time and time spent on paid work for both men and women, plateauing for those who work at least six hours per day (Figure VIII). Mothers who work at least six hours per day devoted more than four hours per day to their children during

Figure VII – **Changes in parenting time during the lockdowns**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

Figure VIII – **Parenting time according to working hours and occupational status**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

the first lockdown. This stability of parenting time in the case of typical working hours is linked to the fact that the care that women provide cannot be compressed. Although men participated more in parenting during the first lockdown, their degree of investment was largely determined by their working hours: the more hours they worked, the less they helped out, and there was no plateau as was the case for women. This finding is consistent with what has been observed in other national contexts. In other words, parenting time is less flexible for women than it is for men. Regardless of their professional constraints, women devoted more time to their children. Nevertheless, fathers also took on double the amount of daily work during the first lockdown. Parenting time decreased significantly in November 2020 when compared

with the spring, regardless of the amount of time spent doing paid work, following the same trend as was observed for housework. The lower limit was around two and a half hours per day for men, regardless of whether they spend between six and eight hours per day on paid work, or more.

Among those who do not work, no difference was observed in the time devoted to children, regardless of whether they were unemployed or on leave, particularly during the first lockdown (Figure VIII). Parenting time is longer and men experiencing technical unemployment or on leave during the first lockdown took advantage of the time this freed up in order to look after their children, approximately five hours per day on average. Based on their working conditions, men working full-time from home devoted more time to their children during the first lockdown, although the differences between them and those working on site were not significant. Regardless of their working conditions, working fathers and mothers alike devoted more time to their children during the first lockdown than during the second (one hour more per day for those working full-time from home).

This parenting time is, of course, strongly linked to the family configuration, particularly when the children are young[10] (Figure IX). The care and educational supervision that a child requires varies depending on their age. During the pandemic, mothers living with a partner with at least one child under 12 and single mothers devoted significantly more time to their children than mothers living with a partner with one or more older children, regardless of the period, but more so during the first lockdown. Parenting time was particularly long during the first lockdown for mothers of children under 12, who spent five and a half hours a day looking after their children on average, compared with less than four and a half hours a day in November. Single mothers also devoted a great deal of time to their children, but there were no significant differences between the two periods, and they spent slightly less time than mothers living with a partner. The latter finding is unexpected, since single mothers are not able to rely on a partner to reduce the burden of looking after children. The smaller amount of parenting time spent by mothers who live alone when compared with those living with a partner during the first lockdown could be linked to the fact that the children from single-parent families were older[11] or more independent.

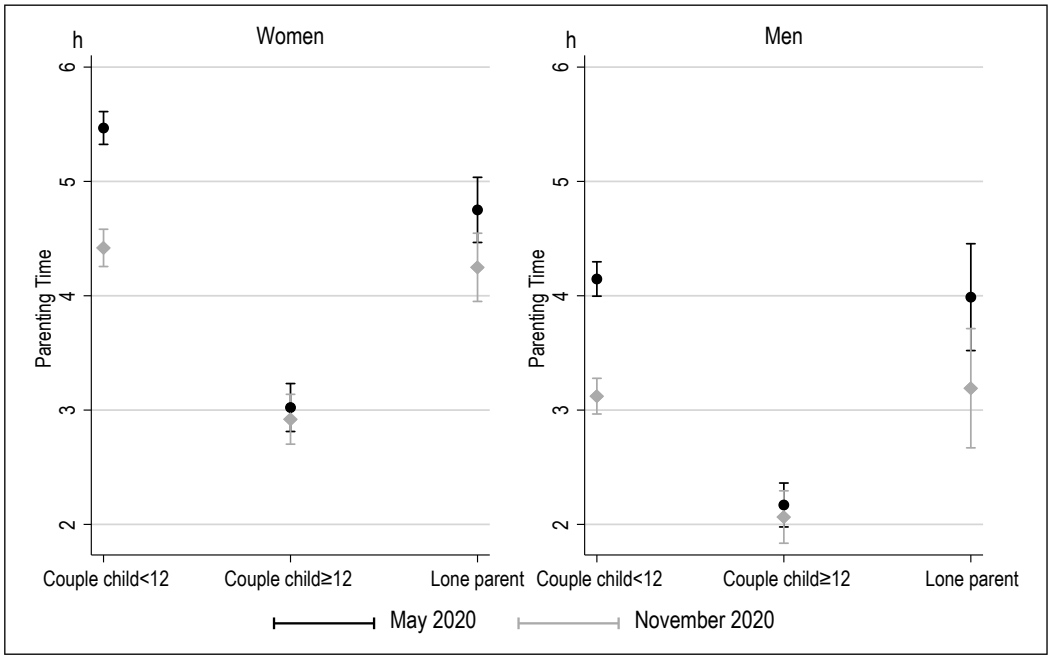
The same trends are observed for men: the differences in time between the two periods are large for fathers of preschool or primary school children, while the differences are small for other family configurations. For both men and women alike, the time devoted to children over the age of 12 did not change between the two lockdowns, since they are more independent when it comes to school work and leisure time.

In normal times, social differences are usually a little less marked for parenting time than for time spent doing housework: the women with the highest levels of education spend just as much time or even more time with their children, while they spend less time on housework than those that are not as well-educated (Sayer *et al.,* 2004). This relationship between the level of education and parenting time was also observed during the first lockdown: all else being equal, women with a secondary and higher education spent more time with their children than those with a lower level of education, with all mothers with a tertiary qualification spending the same amount of time with their children on average (Figure X), which demonstrates the value placed on education and good parenting standards by the most highly educated people during the first lockdown, that were relaxed during the second lockdown. The relationship between the level of education and parenting time therefore follows an inverse U curve. The trends among men are different, with very little difference being observed based on their qualification and among the most educated; however, those who *a priori* have more egalitarian standards participated less than the others during the first lockdown, which is at odds with what is usually observed (with the exception of men without qualifications). This lesser involvement by the most educated men during the first lockdown, a phenomenon that was also observed in Germany (Kreyenfeld & Zinn, 2021) may result from their more demanding professional constraints (tasks associated with managing a team remotely, for example). Finally, it is for those with a secondary education and those who have completed two years of higher education that the difference in parenting time between the two periods is the greatest, which is indicative of their greater involvement during the spring lockdown.

While there is no income gradient for parenting time for men, the differences are more marked for women, particularly during spring 2020. All

10. This parenting time is also linked to the number of children (Pailhé et al.*, 2019b) but we have decided to focus on the age of the eldest child to limit crossover and keep the number of subgroups reasonable.*
11. Our models do not check the age of the children in single-parent households for staffing reasons.

Figure IX – **Parenting time according to family configuration and period**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

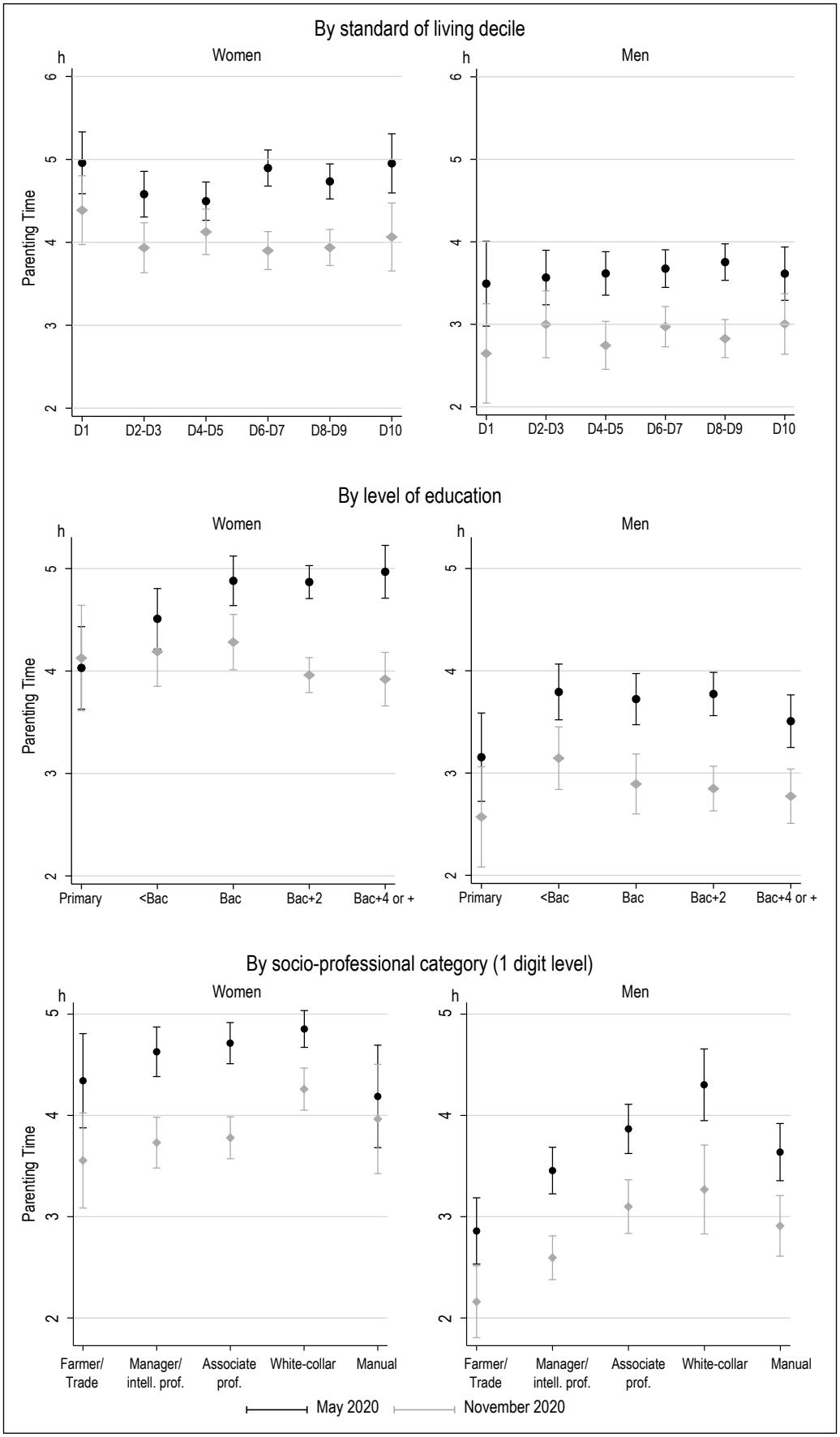
else being equal, the parenting time devoted to children was higher during the first lockdown for women belonging to the wealthiest households (above the 6th standard of living decile). These are also the women for whom the amount of time devoted to children fell the most between the first and second lockdowns, most likely as a result of heavier use of paid childcare or outsourced activities (extra-curricular activities, for example) at that time.

For men, there are clear differences based on socio-professional category: whether during the first or second lockdown, white-collar workers report the highest parenting times, followed by associate professionals. These differences across socio-professional categories are less marked among women, with the exception of manual labourers, who devoted less time on average to their children during the first lockdown, with equivalent activity, perhaps because their partner was not working (manual labourers, with whom they are often paired as a result of social homogamy, were the most likely to have been experiencing technical unemployment), or because they are less well-equipped for supervising their children's school work since, on average, they have a poor level of education. With the notable exception of female manual labourers, the socio-professional category has no impact: both men and women alike devoted significantly more time to their children during the first lockdown than during the second. Those who are in managerial or intermediate professions saw the largest reduction in the amount of time they devoted to their children between the first and second lockdowns. Regardless of the social stratification indicator used, it was the most privileged mothers who increased their parenting time the most during the first lockdown, whether that be because some had time when they would normally have been at work freed up, because their child's normal (extra-curricular) activities were no longer possible, because childcare services were closed or even because they over-invested in caring for their children to prevent them from spending too much time in front of a screen (CAFC, 2021).

* *
*

The lockdown measures and restrictions on movement put in place to combat the COVID-19 pandemic disrupted daily schedules and brought about an increase in housework and parenting. The amount of time that was devoted to these tasks was particularly high during the first lockdown in spring 2020, and that increased housework and parenting workload involved both men and women alike. The decline in time dedicated to household activities in the autumn, which was more marked among men, appears to indicate a rapid return to normal, as Sánchez *et al.* (2021) observed in the United Kingdom. The restructuring of people's time brought about

Figure X – **Parenting time according to socio-economic variables (income, educational level and socio-professional category) and the period in question**



Sources: INSERM/DREES, EpiCov survey, waves 1 and 2-2020.

by the first lockdown therefore does not appear to have had a lasting impact and our starting assumption of a return to normal in the autumn appears plausible.

Looking after children, and in particular the youngest ones, was especially time-consuming for parents: the equivalent of more than one part-time job. Some time devoted to children cannot be reduced, particularly during the times when schools were closed. However, the length of that time also reveals the weight of good parenting standards, such as that of parental availability to ensure the best possible development of the child (Hays, 1996; Lareau, 2011). The monitoring of school work presented a particular challenge for parents, they invested heavily in their children's education over long periods of time to provide schooling within the home (CAFC, 2021; Thierry *et al.*, 2021). This parenting time varied more than the amount of time spent doing housework during the lockdowns. It was very high during the first lockdown, but reduced during the second lockdown in the autumn of 2020 due to the fact that schools remained open and it was once again possible to outsource.

As studies conducted in other national contexts have shown, the time spent performing household and parenting tasks was highly sensitive to people's occupational status and working hours, with this being the same during the first and second lockdowns. Time availability, the assignment of which was exogenous during the first lockdown, played a key role in the amount of time allocated to household chores. However, contrary to the theoretical predictions, this difference in time spent on household chores based on occupational status does not have the same impact on men and women. Indeed, it was more marked for men than for women. This greater flexibility of time spent doing housework around time spent doing paid work has only been observed for men within the context of the pandemic, the increase in time spent on household chores in the event of unemployment generally being higher for women than for men. The exceptional period of the first lockdown, which was marked by a complete retreat into the home, increased needs and a change in the conditions under which paid work was carried out, which may even have involved the complete stoppage of work, resulted in men investing an unprecedented amount of time in household chores. Due to their initial low investment, men had a greater margin for increase, whereas women were already close to the limit of what it is possible to do.

The increase in time spent on household tasks was seen in all socio-professional categories. During the first lockdown, women belonging to higher social classes performed more housework than normal, to the point that the social differences usually observed in the performance of domestic tasks were eliminated during this period. The extra time spent on housework by the most educated women when compared with the least educated was greater for French women than for German women, but less than for Spanish women (Farré *et al.,* 2021; Kreyenfeld & Zinn, 2021). Those with the highest level of education typically rely more heavily than others on outsourcing housework, and their standards as regards home maintenance are more flexible. They were the least affected by the lockdown measures (CAFC, 2021). Parenting time, which usually depends little on the level of education, was actually higher for mothers with the highest levels of education during the first lockdown.

In spite of the occupational status of both men and women becoming more similar – and the reduced potential for outsourcing housework – women continued to perform the bulk of household chores. The amount of time spent by men on household chores has certainly increased, but to a lesser extent, such that the gender-based distribution of housework has only been slightly affected as a result of this exceptional situation. Gender-based differences were still prominent: with the same working hours or with identical occupational statuses, the differences between men and women remained. Although the amount of available time played a part in this, gender roles still explain a large proportion of the time spent on household chores, both during lockdown and in normal times. In addition, these findings indicate that gender-based differences are more resistant to change than social differences.

Although, in terms of available time, working hours remain a key factor in determining the amount of time invested in household and parental tasks, the differences between the sexes remain, even when their work situation is the same. The available time theory alone therefore cannot explain the allocation of time that was observed during lockdown. The fact that the most educated women and those in higher social classes participated particularly heavily in housework during the first lockdown suggests that their resources did not allow them to negotiate greater involvement by their partners. However, in the absence of couple-level data that would allow for the examination of the distribution of the relative financial resources of each partner, it is not possible to test the relative

resources theory in this case. Finally, the fact that the gender-based differences persist far more than social differences demonstrates that the weight of gender norms is heavy, even in situations where the professional activities of men and women are more evenly matched. This joins many other studies that demonstrate the resilience of gender norms, in keeping with the theories based on gender roles. This resilience is particularly evident when it comes to the types of tasks that are performed by men and women (Blair & Lichter, 1991; Tai & Treas, 2013). Men generally perform occasional tasks, which may be organised based on their availability, while women are more likely to take on the less pleasant, more time-consuming, repetitive and routine tasks. This need for permanent availability is added to by all of the work they do in organising family life and anticipating and taking care of the needs of others, which was especially burdensome during the lockdown periods. □

Link to the Online Appendix:
https://www.insee.fr/en/statistiques/fichier/6477744/ES_Pailhe-et-al_Annexe-en-ligne_Online-appendix.pdf

BIBLIOGRAPHY

Adams-Prassl, A., Boneva, T., Golin, M. & Rauh, C. (2020). Inequality in the impact of the coronavirus shock: Evidence from real time surveys. *Journal of Public Economics*, 189, article 104245. https://doi.org/10.1016/j.jpubeco.2020.104245

Akerlof, G. A. & Kranton, R. E. (2000). Economics and identity. *The Quarterly Journal of Economics*, 115(3), 715–753. https://doi.org/10.1162/003355300554881

Alon, T., Doepke, M., Olmstead-Rumsey, J. & Tertilt, M. (2020). The Impact of COVID-19 on Gender Equality. NBER, *Working Paper* N° 26947. Retrieved April 16, 2021. http://www.nber.org/papers/w26947.pdf

Andrew, A., Cattan, S., Costa Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., ... & Sevilla, A. (2020). The gendered division of paid and domestic work under lockdown. IFS, *Working Paper* N° W21/17. https://ifs.org.uk/publications/15497

Barhoumi, M., Jonchery, A., Lombardo, P., Le Minez, S., Mainaud, T., Raynaud, E., Pailhé, A., Solaz, A. & Pollak, C. (2020). Les inégalités sociales à l'épreuve de la crise sanitaire : un bilan du premier confinement. Insee, *France, portrait social* - édition 2020, pp. 3–36. https://www.insee.fr/fr/statistiques/4797670?sommaire=4928952

Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics*, 3(1, Part 2), S33-S58. https://doi.org/10.1086/298075

Behrman, J. R. (1997). Intrahousehold distribution and the family. In: *Handbook of Population and Family Economics*, Vol. 1 Part A, pp. 125–187. https://doi.org/10.1016/S1574-003X(97)80021-9

Berk, S. (1985). *The gender factory. The apportionment of work in American households*. New York: Plenum. https://doi.org/10.1007/978-1-4613-2393-8

Bianchi, S. M., Milkie, M. A., Sayer, L. C. & Robinson, J. P. (2000). Is anyone doing the housework? Trends in the gender division of household labor. *Social forces*, 79(1), 191–228. https://doi.org/10.1093/sf/79.1.191

Biroli, P., Bosworth, S., Della Giusta, M., Di Girolamo, A., Jaworska, S. & Vollen, J. (2021). Family life in lockdown. *Frontiers in psychology,* 12. https://doi.org/10.3389/fpsyg.2021.687570

Blair, S. L. & Lichter, D. T. (1991). Measuring the division of household labor: Gender segregation of housework among American couples. *Journal of Family Issues*, 12(1), 91–113. https://doi.org/10.1177/019251391012001007

Boll, C., Müller, D. & Schüller, S. (2021). Neither Backlash nor Convergence: Dynamics of Intracouple Childcare Division after the First COVID-19 Lockdown and Subsequent Reopening in Germany. IZA *Discussion Papers* N° 14375. https://www.econstor.eu/handle/10419/236406

Bonke, J. (2005). Paid work and unpaid work: Diary information versus questionnaire information. *Social Indicators Research*, 70(3), 349–368. https://doi.org/10.1007/s11205-004-1547-6

Boring, A. & Moroni, G. (2021). Turning back the clock: Beliefs in gender norms during lockdown. LIEPP *Working Paper*. https://www.sciencespo.fr/women-business/fr/node/75981.html

Brines, J. (1994). Economic dependency, gender, and the division of labor at home. *American Journal of Sociology*, 100(3), 652–688. https://doi.org/10.1086/230577

Brousse, C. (2015). Travail professionnel, tâches domestiques, temps « libre ». *Économie et statistique,* 478-480, 119–154. https://doi.org/10.3406/estat.2015.10560

Champagne, C., Pailhé, A. & Solaz, A. (2015). Le temps domestique et parental des hommes et des femmes : quels facteurs d'évolutions en 25 ans ? *Économie et statistique*, 478-480, 209–242. https://doi.org/10.3406/estat.2015.10563

Champeaux, H. & Marchetta, F. (2021). Couples in Lockdown, 'La Vie En Rose'? Evidence from France. CEPR, Covid Economics series, *Working paper*. https://hal.uca.fr/hal-03149087

Chiappori, P. A. (1997). Introducing household production in collective models of labor supply. *Journal of Political Economy*, 105(1), 191–209. https://doi.org/10.1086/262071

CAFC, Collectif d'Analyse des Familles Confinées (2021). *Familles confinées. Le cours anormal des choses*. Vulaines-sur-Seine: Éditions du Croquant.

Craig, L. (2020). Coronavirus, domestic labour and care: Gendered roles locked down. *Journal of Sociology*, 56(4), 684–692. https://doi.org/10.1177/1440783320942413

Craig, L. & Churchill, B. (2021). Dual-earner parent couples' work and care during COVID-19. *Gender, Work & Organization,* 28, 66–79. https://doi.org/10.1111/gwao.12497

Cunningham, M. (2001). Parental influences on the gendered division of housework. *American Sociological Review*, 66(2), 184–203. https://doi.org/10.2307/2657414

Del Boca, D., Oggero, N., Profeta, P. & Rossi, M. (2020). Women's and men's work, housework and childcare, before and during COVID-19. *Review of Economics of the Household*, 18(4), 1001–1017. https://doi.org/10.1007/s11150-020-09502-1

Dominguez-Folgueras, M. (2021). Difficult Times: The Division of Domestic Work under Lockdown in France. *Social Sciences* 10: 219. https://doi.org/10.3390/socsci10060219

Farré, L., Fawaz, Y., González, L. & Graves, J. (2021). Gender Inequality in Paid and Unpaid Work During Covid-19 Times. *Review of Income and Wealth*, online 17 December 2021. https://doi.org/10.1111/roiw.12563

Gershuny, J., Bittman, M. & Brice, J. (2005). Exit, Voice, and Suffering: Do Couples Adapt to Changing Employment Patterns? *Journal of Marriage and Family*, 67, 656–665. https://doi.org/10.1111/j.1741-3737.2005.00160.x

Greene, W. H. & Hensher, D. A. (2010). *Modeling ordered choices: A primer*. Cambridge University Press. https://doi.org/10.1111/j.1741-3737.2005.00160.x

Gupta, S. (2007). Autonomy, dependence, or display? The relationship between married women's earnings and housework. *Journal of Marriage and family*, 69(2), 399–417. https://doi.org/10.1111/j.1741-3737.2007.00373.x

Hank, K. & Steinbach, A. (2021). The virus changed everything, didn't it? Couples' division of housework and childcare before and during the Corona crisis. *Journal of Family Research*, 33(1). 99–114. https://doi.org/10.20377/jfr-488.

Hays, S. (1996). *The cultural contradictions of motherhood*. New Haven: Yale University Press.

Hipp, L. & Bünning, M. (2020). Parenthood as a Driver of Increased Gender Inequality during COVID-19? Exploratory Evidence from Germany. *European Societies*, 23, 658–673. https://www.tandfonline.com/doi/full/10.1080/14616696.2020.1833229

Hupkau, C. & Petrongolo, B. (2020). Work, Care and Gender during the COVID-19 Crisis. *Fiscal Studies*, 41(3), 623–651. https://doi.org/10.1111/1475-5890.12245

Jauneau, Y. & Vidalenc, J. (2020). Durée travaillée et travail à domicile pendant le confinement: Des différences marquées selon les professions. *Insee focus* N° 207. https://www.insee.fr/fr/statistiques/4801229

Juster, F. T. & Stafford, F. P. (1991). The Allocation of Time: Empirical Findings, Behavioral Models, and Problems of Measurement. *Journal of Economic Literature*, 29(2), 471-522. https://www.jstor.org/stable/2727521

Kan, M. Y. (2008). Measuring housework participation: The gap between "stylised" questionnaire estimates and diary-based estimates. *Social Indicators Research*, *86*(3), 381–400. https://doi.org/10.1007/s11205-007-9184-5

Kan, M. Y., Sullivan, O. & Gershuny, J. (2011). Gender convergence in domestic work: Discerning the effects of interactional and institutional barriers from large-scale data. *Sociology*, 45(2), 234–251. https://doi.org/10.1177/0038038510394014

Kreyenfeld, M. & Zinn, S. (2021). Coronavirus and care: How the coronavirus crisis affected fathers' involvement in Germany. *Demographic Research*, 44, 99–124. https://doi.org/10.4054/DemRes.2021.44.4

Lareau, A. (2011). *Unequal childhoods: Class, race, and family life* (2nd ed.). Berkley and Los Angeles: Univ of California Press. http://www.jstor.org/stable/10.1525/j.ctt1ppgj4.

Pailhé, A., Solaz, A. & Souletie, A. (2019a). How do women and men use extra time? Housework and childcare after the French 35-hour workweek regulation. *European Sociological Review*, 35(6), 807–824. https://doi.org/10.1093/esr/jcz039

Pailhé, A., Solaz, A. & Stanfors, M. (2021). The great convergence: Gender and unpaid work in Europe and the United States. *Population and Development Review*, 47(1), 181–217. https://doi.org/10.1111/padr.12385

Pailhé A., Solaz, A. & Tanturri, M. T. (2019b). The Time Cost of Raising Children in Different Fertility Contexts: Evidence from France and Italy. *European Journal of Population*, 35, 223–261. https://doi.org/10.1007/s10680-018-9470-8

Petts, R. J., Carlson, D. L. & Pepin, J. R. (2021). A gendered pandemic: Childcare, homeschooling, and parents' employment during COVID-19. *Gender, Work & Organization*, 28(S2), 515–534. https://doi.org/10.1111/gwao.12614

Presser, H. B. (1994). Employment schedules among dual-earner spouses and the division of household labor by gender. *American Sociological Review*, 59(3), 348–364. https://doi.org/10.2307/2095938

Robinson, J. P. (1985). The validity and reliability of diaries versus alternative time use measures. In: Juster FT & Stafford FP (eds.), *Time, Goods, and Well-being*, pp. 33–62. Ann Arbor: University Press of Michigan.

Safi, M., Coulangeon, P., Ferragina, E., Godechot, O., Helmeid, E., Pauly, S., Recchi, E. *et al.* (2020). La France confinée. Anciennes et nouvelles inégalités. In: Lazar, M., Plantin, G. & Ragot, X. (Eds.), *Le monde d'aujourd'hui*, pp. 95–116. Paris: Presses de Sciences Po. https://doi.org/10.3917/scpo.lazar.2020.01.0093

Sánchez, A. R., Fasang, A. E. & Harkness, S. (2021). Gender division of housework during the COVID-19 pandemic. *Demographic Research*, 45, 1297–1316. https://doi.org/10.4054/DemRes.2021.45.43

Sayer, L. C., Bianchi, S. M. & Robinson, J. P. (2004). Are parents investing less in children? Trends in mothers' and fathers' time with children. *American Journal of Sociology*, 110(1), 1–43. https://doi.org/10.1086/386270

Shafer, K., Scheibling, C. & Milkie, M. A. (2020). The Division of Domestic Labor before and during the COVID-19 Pandemic in Canada: Stagnation versus Shifts in Fathers' Contributions. *Canadian Review of Sociology*, 57, 523–549. https://doi.org/10.1111/cars.12315

Shelton, B. A. & John, D. (1996). The division of household labour. *Annual Review of Sociology*, 22(1), 299–322. https://doi.org/10.1146/annurev.soc.22.1.299

Sevilla, A. & Smith, S. (2020). Baby steps: The gender division of childcare during the COVID-19 pandemic. *Oxford Review of Economic Policy*, *36*(Supplement_1), S169–S186. https://doi.org/10.1093/oxrep/graa027

Solaz, A. (2009). « Histoire conjugale et division du travail au sein du couple », dans A. Régnier-Loilier (dir.), *Portraits de famille : l'enquête Étude des relations familiales et intergénérationnelles*, pp. 265–288. Paris: Ined.

Tai, T. & Treas, J. (2013). Housework Task Hierarchies in 32 Countries, *European Sociological Review*, 29 (4), 780–791. https://doi.org/10.1093/esr/jcs057

Thierry, X., Geay, B., Pailhé, A., Berthomier, N., Camus, J., Cauchi-Duval, N., Lanoë, J.-L. *et al.* (2021). Les enfants à l'épreuve du premier confinement. *Population & Sociétés*, N° 585. https://www.ined.fr/fr/publications/editions/population-et-societes/enfants-a-epreuve-du-premier-confinement/

van der Lippe, T., Treas, J. & Norbutas, L. (2018). Unemployment and the Division of Housework in Europe. *Work, Employment and Society*, 32(4), 650–669. https://doi.org/10.1177/0950017017690495

Warszawski, J., Bajos, N., Barlet, M. *et al.* (2021). A national mixed-mode seroprevalence random population-based cohort on SARS-CoV-2 epidemic in France: the socio-epidemiological EpiCov study. https://www.medrxiv.org/content/10.1101/2021.02.24.21252316v1

West, C. & Zimmerman, D. H. (1987). Doing gender. *Gender & Society*, 1(2), 125–151. https://doi.org/10.1177/0891243287001002002

Zoch, G., Bächmann, A. C. & Vicari, B. (2021). Who cares when care closes? Care-arrangements and parental working conditions during the COVID-19 pandemic in Germany. *European Societies*, *23*(sup1), S576–S588. https://doi.org/10.1080/14616696.2020.1832700

APPENDIX

Table A1 – **Description of the samples (first model), frequencies (standard error)**

	Women	Men	Mothers	Fathers
Time spent on housework (hours)				
0	0.005 (0.070)	0.034 (0.182)	0.002 (0.049)	0.028 (0.166)
0-0.5	0.035 (0.183)	0.115 (0.319)	0.018 (0.133)	0.107 (0.309)
0.5-1	0.148 (0.355)	0.279 (0.449)	0.113 (0.317)	0.252 (0.434)
1-2	0.336 (0.472)	0.322 (0.467)	0.331 (0.470)	0.337 (0.473)
2-4	0.319 (0.466)	0.170 (0.375)	0.351 (0.477)	0.192 (0.394)
4-6	0.091 (0.287)	0.046 (0.209)	0.097 (0.297)	0.051 (0.220)
6+	0.068 (0.252)	0.034 (0.182)	0.087 (0.282)	0.032 (0.177)
Time spent parenting (hours)				
0	0.028 (0.164)	0.038 (0.192)	0.026 (0.160)	0.035 (0.185)
0-0.5	0.033 (0.178)	0.064 (0.244)	0.033 (0.178)	0.065 (0.246)
0.5-1	0.064 (0.244)	0.111 (0.314)	0.064 (0.245)	0.109 (0.312)
1-2	0.142 (0.349)	0.203 (0.403)	0.142 (0.349)	0.206 (0.405)
2-4	0.224 (0.417)	0.245 (0.430)	0.228 (0.419)	0.245 (0.430)
4-6	0.151 (0.358)	0.120 (0.325)	0.151 (0.358)	0.120 (0.325)
6+	0.359 (0.480)	0.219 (0.414)	0.357 (0.479)	0.219 (0.414)
Time spent working (hours)				
0	0.430 (0.495)	0.362 (0.480)	0.356 (0.479)	0.225 (0.418)
<2	0.019 (0.136)	0.017 (0.130)	0.016 (0.126)	0.018 (0.134)
2-4	0.035 (0.184)	0.026 (0.158)	0.040 (0.196)	0.023 (0.151)
4-6	0.065 (0.247)	0.052 (0.222)	0.069 (0.254)	0.061 (0.239)
6-8	0.234 (0.423)	0.243 (0.429)	0.265 (0.441)	0.289 (0.453)
8-10	0.159 (0.366)	0.221 (0.415)	0.185 (0.388)	0.278 (0.448)
10+	0.058 (0.234)	0.080 (0.271)	0.069 (0.253)	0.106 (0.308)
Age				
<30	0.164 (0.371)	0.156 (0.363)	0.058 (0.234)	0.036 (0.186)
30-39	0.225 (0.417)	0.195 (0.396)	0.403 (0.490)	0.312 (0.463)
40-49	0.238 (0.426)	0.246 (0.431)	0.425 (0.494)	0.456 (0.498)
50-59	0.245 (0.430)	0.256 (0.436)	0.114 (0.317)	0.182 (0.386)
60+	0.127 (0.333)	0.147 (0.354)	0.001 (0.031)	0.015 (0.120)
Standard of living decile				
D1	0.096 (0.295)	0.079 (0.270)	0.095 (0.293)	0.062 (0.240)
D2-D3	0.142 (0.349)	0.119 (0.323)	0.159 (0.366)	0.125 (0.331)
D4-D5	0.168 (0.373)	0.158 (0.365)	0.178 (0.383)	0.179 (0.384)
D6-D7	0.203 (0.403)	0.211 (0.408)	0.234 (0.424)	0.241 (0.428)
D8-D9	0.227 (0.419)	0.246 (0.430)	0.219 (0.414)	0.256 (0.437)
D10	0.111 (0.314)	0.128 (0.335)	0.082 (0.274)	0.106 (0.308)
Standard of living missing	0.053 (0.223)	0.060 (0.237)	0.033 (0.178)	0.030 (0.172)
Qualification				
Primary	0.097 (0.296)	0.099 (0.298)	0.069 (0.254)	0.074 (0.262)
<Baccalaureate	0.165 (0.371)	0.243 (0.429)	0.139 (0.346)	0.207 (0.405)
Baccalaureate	0.216 (0.411)	0.199 (0.400)	0.198 (0.398)	0.201 (0.401)
2 years of higher education	0.353 (0.478)	0.272 (0.445)	0.399 (0.490)	0.306 (0.461)
4+ years of higher education	0.169 (0.375)	0.187 (0.390)	0.195 (0.396)	0.212 (0.409)
Type of household				
Couple without children	0.335 (0.472)	0.343 (0.475)	0.000 (0.000)	0.000 (0.000)
Couple with children <12 years	0.242 (0.428)	0.258 (0.437)	0.594 (0.491)	0.697 (0.460)
Couple with children ≥12 years	0.098 (0.297)	0.091 (0.288)	0.228 (0.420)	0.236 (0.425)
Single-parent family	0.075 (0.264)	0.031 (0.172)	0.178 (0.383)	0.067 (0.250)
Other	0.251 (0.433)	0.277 (0.448)	0.000 (0.000)	0.000 (0.000)

➔

Table A1 – *(contd.)*

	Women	Men	Mothers	Fathers
Socio-professional category				
Farmer, craftsman, trader	0.043 (0.203)	0.093 (0.290)	0.048 (0.214)	0.102 (0.302)
Manager	0.188 (0.390)	0.275 (0.447)	0.207 (0.405)	0.316 (0.465)
Intermediate occupation	0.275 (0.447)	0.227 (0.419)	0.283 (0.451)	0.235 (0.424)
White-collar worker	0.357 (0.479)	0.120 (0.325)	0.355 (0.479)	0.110 (0.313)
Manual worker	0.057 (0.232)	0.218 (0.413)	0.047 (0.211)	0.209 (0.406)
SC missing	0.080 (0.271)	0.068 (0.251)	0.059 (0.236)	0.028 (0.166)
Housing				
Apartment	0.331 (0.470)	0.315 (0.465)	0.280 (0.449)	0.228 (0.420)
House	0.659 (0.474)	0.674 (0.469)	0.712 (0.453)	0.767 (0.423)
Other	0.010 (0.101)	0.011 (0.105)	0.008 (0.089)	0.005 (0.072)
Region				
Overseas	0.034 (0.181)	0.032 (0.177)	0.040 (0.197)	0.031 (0.173)
Île-de-France	0.168 (0.374)	0.178 (0.382)	0.165 (0.371)	0.170 (0.375)
Other region	0.798 (0.402)	0.790 (0.408)	0.795 (0.404)	0.800 (0.400)
Partner working outside the home	0.349 (0.477)	0.305 (0.461)	0.510 (0.500)	0.443 (0.497)
Strict lockdown	0.453 (0.498)	0.461 (0.499)	0.448 (0.497)	0.446 (0.497)
Survey wave 2	0.436 (0.496)	0.425 (0.494)	0.429 (0.495)	0.415 (0.493)
Employment situation				
Not working	0.200 (0.400)	0.156 (0.363)	0.107 (0.309)	0.030 (0.172)
Unemployed	0.070 (0.255)	0.066 (0.248)	0.069 (0.253)	0.042 (0.200)
Technical unemployment	0.073 (0.261)	0.075 (0.263)	0.079 (0.270)	0.080 (0.272)
On site	0.339 (0.473)	0.404 (0.491)	0.364 (0.481)	0.479 (0.500)
Full-time remote working	0.133 (0.339)	0.127 (0.333)	0.161 (0.368)	0.153 (0.360)
Hybrid working	0.098 (0.298)	0.107 (0.309)	0.119 (0.324)	0.143 (0.350)
On leave	0.086 (0.280)	0.066 (0.248)	0.101 (0.301)	0.073 (0.260)
N	10,093	8,313	4,096	3,055

Couples in Lockdown: “La vie en rose”?

Hugues Champeaux* and Francesca Marchetta**

Abstract – Stay-at-home policies during the COVID-19 pandemic challenged household members who faced forced cohabitation and increased housework (domestic chores and childcare). Based on individual data collected online from partnered women during the spring 2020 in France, we study the lockdown effects on housework division and conflicts between partners. We find that during the lockdown, couples experienced minor changes in the allocation of housework, mainly carried out by women. Simultaneously, men increased their participation in the production of household goods mainly through “enjoyable” or “quasi-leisure” activities. Our results suggest that the gendered connotation of domestic work can be context-dependent and not stable over time. Tensions between partners, reported by women, increased during the lockdown, and appear to be strongly correlated with an unequal division of housework. Overall, our results suggest that this period did not structurally affect the gender stereotypes at home.

JEL: D13, J12, J13, J16, J22
Keywords: COVID-19, housework, childcare, intrahousehold tensions, gender roles

** Université de Namur, CRED; ** Université Clermont Auvergne, CNRS, CERDI.* Correspondence: *hugues.champeaux@unamur.be*

We are grateful to Martine Audibert, Jean-Marie Baland, Simone Bertoli, Habiba Djebbari, Elise Huillery, Perrin Lefebvre, Karine Marazyan and participants to the LIEPP-PRESAGE workshop (Feb. 2021) for their helpful suggestions and valuable comments. We thank two anonymous referees for their insightful comments. Part of this research is based on research conducted while Hugues Champeaux was affiliated with CERDI, CNRS, Université Clermont Auvergne. Francesca Marchetta gratefully acknowledges the support received from the Agence Nationale de la Recherche through the program “Investissements d’avenir” (ANR-10-LABX-14-01).

Received in April 2022, accepted in October 2022.
The views and opinions expressed by the authors are their own and do not necessarily reflect those of the institutions to which they belong or of INSEE itself.

Citation: Champeaux, H. & Marchetta, F. (2022). Couples in Lockdown: “La vie en rose”? *Economie et Statistique / Economics and Statistics*, 536-37, 27–50. doi: 10.24187/ecostat.2022.536.2087

In France, as in other countries applying stay-at-home policies at the start of the COVID-19 pandemic, the first lockdown in spring 2020[1] harshly affected and challenged couples' activities and organization. The effects of forced and constant presence at home impacted the quantity of domestic chores and childcare (Farré *et al.*, 2021; Del Boca *et al.*, 2020), the occurrence of domestic tensions (Biroli *et al.*, 2021), and even intimate partner violence (i.e. Arenas-Arroyo *et al.*, 2021; Beland *et al.*, 2021). Helplines observed a dramatic rise of distress calls in western countries (Leslie & Wilson, 2020; Bullinger *et al.*, 2021; Miller *et al.*, 2020) as well as in developing countries (Agüero, 2021; Perez-Vincent & Carreras, 2020). In France, 13% of couples (and 16% of those with children) reported more frequent disputes (Barhoumi *et al.*, 2020), police interventions for family disputes rose by 44%, and the number of calls to helplines for domestic violence doubled.[2] Furthermore, 49% of couples reported tensions or conflicts over the housework during the lockdown, and one-third of the women who reported frequent disputes suffered from verbal abuse.[3]

In this paper, we address two intertwined research questions: *(i)* Did the lockdown induce a redistribution of housework within couples? And if yes, in which tasks did men increase their participation? *(ii)* Is there a relation between the occurrence of conflicts and the unbalanced sharing of housework during the lockdown?

We use original data that we collected, *via* an online survey between April 21 and May 10, 2020 in France, from 2,844 partnered women. These data are not representative, since the women in our sample are younger, slightly more educated and more active in the labor market than French women on average. This survey provides fine-grained information, based on women's perceptions. They self-reported their own and their partner's contribution to housework, and the occurrence of conflicts in their couple before and during the lockdown.[4] The analysis takes into account the couples' confinement status, i.e. whether each partner continued to work at their workplace, or was at home, working remotely or in a status of reduced activity.

We find a reduction in the gender gap in participation in housework among couples who experienced an important increase of the home production (i.e. those with children) and for who women kept working, whether from home or at their workplace, during the lockdown. For totally confined parents, the change was driven mainly by fathers' participation in "enjoyable" or "quasi-leisure" activities during lockdown (shopping and playing with kids). This finding suggests a feeble effect of the lockdown on housework division between partners.

This also indicates that individual preferences play an important role in shaping intrahousehold equilibrium. When the quantity of household public goods that need to be produced increases and the opportunities for leisure are reduced, men's preferences have a crucial role in determining the new equilibrium. The increase in the men's contribution to activities that became a "quasi-leisure" in the lockdown period, indicates that the gendered nature of a task could respond to its relative attractiveness rather than being an absolute feature. This finding confirms Stratton's finding that men's preferences drive their commitment to household tasks (Stratton, 2012).

For couples with children, we also find that conflicts increased when the gender gap in the distribution of household activities increased during the lockdown. We document that this increase in tensions is mainly associated with an increased gap in the contribution to the task of cleaning, known as one of the most time-consuming and less enjoyable domestic tasks.

Our paper first contributes to the literature on the gendered division of production of public goods within households, and in particular on the relationship between gender preferences and the within-couple variation of household tasks division over time. We also relate to the economic and sociological literature analyzing the link between the occurrence of conflicts and the allocation of tasks between partners, and between men's participation in household activities and the risk of separation. We show that an increase in the unbalanced division of

---

1. The first announcement of the lockdown, on March 12, 2020, imposed the closure of kindergardens, schools and universities for an unspecified time. Other restrictive measures followed, announced on March 16, 2020: going out of home was limited to essential activities, such as food shopping and working (when working from home was unfeasible, e.g. for "essential workers"), plus the possibility of going out for a walk or physical activities for at most one hour per day within a one-kilometer radius from home.

2. France Inter's website, "Violences faites aux femmes : que s'est-il vraiment passé pendant le confinement ?"*, May 15, 2020. https://www.franceinter.fr/violences-faites-aux-femmes-que-s-est-il-vraiment-passe-pendant-le-confinement.*

3. Data from the Ifop survey "Enquête sur les conditions de logement des Français confinés et les tensions au sein des foyers" *on a representative sample of 3,011 respondents, published on April 7, 2020 (https://www.ifop.com/wp-content/uploads/2020/04/117261_IIfop_Consolab_Confinement_2020.04.07.pdf). In a previous Ifop survey in 2019, 45% of the French couples surveyed reported conflicts due to the division of housework.*

4. We use the terms 'housework', 'household tasks', 'household activities', to refer to the production of household goods. Housework includes domestic chores (i.e. cleaning, laundry, shopping and cooking) and childcare (i.e. helping with homework, playing); these two components will be distinguished along the analysis.

housework during a stressful situation is correlated to the occurrence of conflicts between partners, particularly in presence of children and when the woman is active in the labor market. Finally, we contribute to the emerging literature on the effects of stay-at-home policies during the COVID-19 pandemic. To the best of our knowledge, our paper is the first in the literature to explore the link between the division of housework and the occurrence of conflicts between partners during the confinement period and the only one that looks at the partner's involvement in specific household activities for France.

The rest of the paper is structured as follows: Section 1 provides a brief review of relevant literature, then Section 2 presents a conceptual framework where the possible effects of lockdown on the division of household tasks and on the probability of conflict occurrence are presented. Section 3 describes our original dataset and illustrates the empirical strategy. The results are presented in Section 4, then we conclude.

1. Literature Review

The fact that women carry out a disproportionate share of housework – the "lion's share" – is well established in the empirical literature. The asymmetric allocation of housework between partners has also been largely highlighted since the seminal theoretical papers by Becker (1965) or Gronau (1977). Despite a large reduction of the gender gap in the labor market, women continue to perform most of the housework (see a literature review by Lachance-Grezla & Bouchard, 2010). Besides time availability, many unobservable factors, such as social norms, stereotypes or preferences, remain and are shaping the gender gap across cohorts. Exploiting changes in the labor market participation of partners, Killewald & Gough (2010) and Foster & Stratton (2018) show that recently unemployed men increase their share of housework, but to just around half of the time devoted by women to them. Álvarez & Miles-Touya (2019), exploiting a specific feature of the Spanish Time Use Survey, provide evidence that men increase their contribution to housework in their non-working days, but to a lesser extent than women.

As observed by Kahneman *et al.* (2004), household tasks differ in terms of pleasantness and physical effort. Van Berkel & De Graaf (1999) show that cooking and shopping are considered enjoyable housework by men and women, while both dislike cleaning. This is in line with Shaw (1988), who found that cooking was among the preferred tasks by both partners. Empirical work on housework often distinguishes between "female-type housework" or chores, which includes laundry, housecleaning, washing dishes and cooking, and "total housework". Shopping is included in the second category, together with gardening, pet care and other tasks that can be considered as semi-leisure (Kahneman *et al.*, 2004). Using an experiment, Couprie *et al.* (2020) investigate the influence of gender stereotypes and find that partners overspecialize in specific tasks in accordance with gender role. Interestingly, Stratton (2012) shows that the more men dislike doing housework, the less they are committed to it and the more time their partner spends on it. Gender preferences could thus drive the involvement of the partner in housework.[5]

The literature also points to interactions between the housework division, marriage stability and the risk of separation. Sociological empirical work shows that the risk of separation is lower in couples where the man is more involved in domestic chores and childcare (Cooke, 2006; Sigle-Rushton, 2010; Ruppanner *et al.*, 2018). Norman *et al.* (2018) find that fathers' involvement in childcare in the first year after birth is associated with couple stability, but this is not necessarily so with other tasks. Altintas & Sullivan (2016) and Van der Lippe *et al.* (2014), show that frictions about housework division among partners are one of the main sources of marital conflict.[6]

The COVID-19 pandemic and lockdown have logically incentivized issues and research about housework division. Several studies have documented the increase in the number of hours allocated to domestic chores and childcare, and the change in couples' behavior. In Spain, Farré *et al.* (2021) show a slight increase in male partners' share of housework, but also that women still do most of it. They also show that the increase in men's contribution to housework was mostly concentrated on shopping. In Italy, Del Boca *et al.* (2020) find that men increased the time spent on gratifying tasks, such as activities with children, rather than the time spent on chores. Andrew *et al.* (2020), using data

5. *Van der Lippe* et al. *(2013) suggest that gender preferences for housework also matter for outsourcing. Conversely, Auspurg* et al. *(2017) find little evidence of any systematic gender difference in preferences.*
6. *There is also evidence of a negative association between psychological distress and the distribution of housework among partners (Lennon & Rosenfield, 1994; Kalmijn & Monden, 2012; Harryson* et al.*, 2012). Carlson* et al. *(2016) show that a more egalitarian division of housework matters for sexual relations.*

from England, show that mothers increased the time spent in housework relatively more than fathers during the lockdown.

In France, Pailhé *et al.* (2022, this issue) show that both men and women have increased the time dedicated to household goods production during the spring 2020 lockdown, but that women still spent more time on it, even when the time constraint of the two partners was the same. Dominguez-Folgueras (2021) observes that French men who were at home during the lockdown, whether working from home or temporary unemployed, increased their participation in domestic work. On the contrary, Zamberlan *et al.* (2022) showed for the UK that gender equality in domestic work improved only if men's workload decreased during lockdown.[7] Concerning the long-term impact of the lockdown on gender inequality, Sánchez *et al.* (2021) remark that couples with young children reverted to the pre-lockdown division of housework after a few months.

To our knowledge, there is less evidence of conflicts between partners during the pandemic. Arenas-Arroyo *et al.* (2021), Beland *et al.* (2021), and Hsu & Henke (2021) have documented an increase in domestic violence and family tensions during the lockdown. Berniell & Facchini (2021) document an increase in Google searches of topics related to domestic violence in European and Latin American countries, a few weeks after the beginning of the lockdown. More specifically on our research question, Biroli *et al.* (2021) document that, in Italy and in the United States, families experienced an increase in intrahousehold tensions, even where men had increased their share of childcare and grocery shopping duties.

2. Conceptual Framework

2.1. The Setting

In this section we present a setting inspired from theoretical family economics, more specifically Browning *et al.* (2014). Consider a household composed of two parents and their child(ren).[8] We denote the two parents with $i = 1,2$, denoting the father as the first parent, and the mother as the second parent. Each parent's utility function takes the following form:

$$U_i = \alpha V_1 + (1 - \alpha)\, V_2, \text{ with } i = 1,2$$

where $\alpha \in [1/2, 1]$, $i, j = 1,2$, and $\frac{\partial U_i}{\partial V_j} > 0$, when $i = j$. This specification allows for altruism between the parents. The inner utility V_i, with $i = 1,2$, is a function of three arguments: the consumption of a vector of private consumption goods C^i, a vector of household-level public goods X with N elements, and leisure L^i:

$$V_i = g_i\left(C^i, X, L^i\right),\ i = 1,2.$$

This specification allows heterogeneity in preferences, as the function g_1 might be different from the function g_2, e.g., $\frac{\partial V_1}{\partial L^1} > \frac{\partial V_2}{\partial L^2}$ when $C^1 = C^2$ and $L^1 = L^2$, so that the father derives a greater utility from leisure than the mother.

Consumption goods can be purchased on the market, and the vector p^C denotes their prices. Public goods, such as child care, education and cleaning, can be either purchased on the market and/or home-produced, and the vector p^X denotes the prices of these goods. X_k^m is the quantity of the public good k purchased on the market.

Home production X_k^h is given by:

$$X_k^h = h_k\left(t_k^1, t_k^2\right);$$

where t_k^1 and t_k^2 represent the time devoted respectively by the father and by the mother to the production of the public good k. If the two parents are perfect substitutes in the production of this public good and are equally productive, then X_k^h is simply a function of $t_k^1 + t_k^2$, and neither parent has an advantage in the production of the public good k. The total quantity of the public good k that is consumed is given by $X_k = X_k^m + X_k^h$.

Leisure L^i depends on the time l^i spent on two pure leisure activities, defined as activities that do not generate an income and do not contribute to the production of any public good. One activity, e.g., going for a walk, does not require the payment of a price, while a second pure leisure activity, e.g., playing tennis, is denoted with $p^L \geq 0$. The time devoted to each of these activities is denoted with l_1^i and l_2^i respectively.

We assume that L^i also depends on the vector t^i of the time devoted by the parent i to home production of public goods, as some of these activities, e.g., playing with the children, may also have a leisure dimension. In particular: $L^i = l^i + \sum_1^N a_k t_k^i$ where the parameter a_k

7. *Boring & Moroni (2022) find that, in France, beliefs in traditional gender norms increased during the pandemic, particularly among couples with children.*
8. *This can easily be adapted to couples without children. For them, the increase in the home public goods is lower and the spectrum of domestic activities is reduced.*

translates the time devoted to the home production of the public good k into an equivalent time devoted to a pure leisure activity. We have that $a_k \in [0,1]$, i.e., some activities (such as cleaning) might not have any leisure component, and no activity is as effective as pure leisure activity. Without loss of generality, we can label the various activities related to the production of public goods in a way such that $a_1 \leq a_2 \leq \ldots \leq a_N$.

Each parent has a fixed time endowment (which can be normalized to unity without loss of generality), and can work for a wage w^i, with $i = 1,2$. The income y^i, with $i = 1,2$, is then given by:

$$y^i = w^i * t_w^i, \text{ with: } \left(t_w^i + \sum_{k=1}^{N} t_k^i + l^i \right) = 1$$

The household chooses $C^1, C^2, X^m, t_w^1, t_w^2, t_k^1, t_k^2$ l^1 and l^2 taking the prices and the wages as given in order to achieve a Pareto efficient outcome.

2.2. Lockdown

The various effects the lockdown can have on home working can be integrated in the model as follows:

1. The elements the vector p^X and the price p^L of the second pure leisure activity diverged to infinity, i.e., household-level public goods can only be home-produced,[9] and leisure L^i can only be generated with the costless leisure activity, or as a by-product of the time devoted to the production of public goods.

2. Some parents could rely on teleworking; if working from home was impossible, either a parent kept on going to work, or the parent received a transfer from the government which was equivalent to his or her pre-lockdown income. This, in turn, implies that the lockdown did not give rise to any variation in household income.[10]

3. Working from home also represents a technological shock for the home production of some public goods: the time devoted to home working can also generate a nonnegative amount of time devoted to home production of the household-level public goods. For instance, taking care of the children is (to some extent) possible also while working from home. Letting d^i being equal to 1 if the parent i works from home and 0 otherwise, we have that:

$$t_k^{i'} = t_k^i + b_k * (d^i * t_w^i)$$

where the parameter $b_k \in [0,1)$ translates the time t_w^i devoted to home working into additional time devoted to the production of the public good k.[11]

2.3. Home-Production of Public Goods during the Lockdown

The lockdown can change the working conditions of the partners, which can generate changes in the partners' comparative advantage in the production of public goods. In particular:[12]

1. Suppose only one of the two partners works during the lockdown (whether working from home or outside). In that case, the other should unambiguously provide most of the increase in the home production of public goods as his or her time constraint has been relaxed.[13]

2. Suppose both partners work during the lockdown but only one works from home. In that case, the increase in the production of public goods should be disproportionately provided by the one working from home as he or she benefits from the technological shock induced by the lockdown.

3. Suppose both partners work from home or do not work, then the technological shock is either affecting both or neither. In that case, the lockdown does not give rise to any change in advantage in the production of public goods, and the relative contribution of the two partners to the increase in the production of public goods would reflect only a possible heterogeneity in their preferences for leisure. In particular, if $\frac{\partial V_1}{\partial L^1} > \frac{\partial V_2}{\partial L^2}$ when $C^1 = C^2$ and $L^1 = L^2$, then the woman will provide most of the increase in home production, and the man will mostly contribute to the production of public goods having a higher leisure component, represented by the parameter a_k.

2.4. Variations in Utility, Home-Production of Household Goods and Conflicts between Partners

The theoretical framework delineated above allows us to make some hypotheses on the

9. For instance, childcare or cleaning services could no longer be purchased on the market, so that $X_k = X_k^h$.

10. In France, public transfers for partial unemployment in France were equivalent to 72% of the wages, and could not fall below the minimum wage. Furthermore, in the extraordinary situation, many employers maintained the same income (completing the public transfers). Partial unemployment concerned 25% to 30% of French workers during the first two months of the pandemic.

11. This assumption can also be seen as a natural by-product of the fact that home working saves on commuting time, which is not included in the time constraint of each parent.

12. We do not consider here the particular case where both parents were working at their workplace during the lockdown. For most couples in this situation both partners worked in the health sector; the increase in the need of production of public goods was lower, as childcare was provided for their children in French schools and kindergartens.

13. If one of the parents works outside, then he or she would have an advantage in the provision of some specific public goods implying to go out, such as shopping.

relationship between the variations in the utility of partners, home-production of household goods and intrahousehold conflicts. The reduction in the opportunities for leisure, the increase in the home production of household public goods and the variation in (paid) work hours and conditions during lockdown clearly induced an (inward) shift of the utility possibility frontier of the households. Partners were forced to negotiate a new equilibrium on this new possibility frontier. The point that describes the level of utility of the two parents during the lockdown can correspond to a different (absolute or relative) variation in each partner's utility with respect to the pre-lockdown equilibrium. We hypothesize that, if either the woman or the man (or both) perceives the new equilibrium (corresponding to an abrupt change and not to the outcome of repeated interactions in a stable setting) as unfair, tensions could arise from attempts to induce a movement along the (new and lower) utility frontier. During the lockdown, a variation in the time devoted to the home-production of public goods, and in the allocation between the partners of the tasks with a higher leisure component, represent the two main ways to move along the utility possibility frontier of the household. Conflicts could thus be associated to the perception by one of the partners to make a disproportionate contribution to the home-production of public goods (while possibly not benefiting from a reduction in her own labor supply compared to her partner), and notably for those tasks that have a low or non-existent leisure component.

In the article, we draw from Section 2.3 the testable assumption that different outputs in terms of housework division depend on the type of working shock experienced in the couples. When the lockdown shock is asymmetric, the partner whose time constraint is the most reduced or benefiting from the technological shock of remote working will provide most of the increase in the home production. We can empirically verify this assumption on couples in which only one partner worked outside during the lockdown or for those at home but with different employment statuses. When the shock is symmetric, i.e. both faced the same working conditions (remote working or not working), the redistribution of housework is driven by preferences for leisure. If men derive a greater utility for leisure, they should be more involved in activities with higher leisure components, while women should provide most of the increase in home production. We can empirically test this prediction on both (temporary) unemployed or remote working partners. From Section 2.4, we empirically test if changes in the home production division lead to an increase in conflicts among partners during the lockdown. We notably assume that highly unequal division of housework drives conflicts.

3. Data and Empirical Strategy

3.1. The Survey and Variables

3.1.1. The Survey

In the context of the global pandemic, we conducted an online survey to investigate intrahousehold changes during the first lockdown in spring 2020.[14] The questionnaires were disseminated online from April 21 to May 10 (the end of the first – and strictest – lockdown) in three steps: *(i)* among our personal and professional networks, using the university's tools (such as mailing the university communities); *(ii)* through a mass mailing to kindergartens and primary schools (from May 2); *(iii)* through a marketing campaign on Facebook (from May 5).[15] The survey campaign was aimed at free and voluntary respondents (no rewards were offered to participants), and targeted adults, without any reference to gender or location.

We collected 4,639 individual questionnaires, mostly from women (88.3%), whilst they were not explicitly targeted in the survey campaign.[16] Based on our research interests and the low proportion of men among the respondents, we only retain a sample of partnered women. We finally rely on 2,844 women who reported background characteristics (location, age, education, and activity status before and during lockdown). The same background information is reported for their partners.

Because of the participants' self-selection and the absence of a sampling strategy, this is not a representative sample of women. Indeed, beyond the fact that all of them live in couple, the sample differs notably from national-level figures in some other characteristics (see Table A1 in Appendix). First, it includes 40% of graduated

14. A first version of the survey was developed by Lidia Farré (Universitat de Barcelona) and Libertad Gonzales (Universitat Pompeu Fabra) with the aim of collecting early data on the labor market and intrahouseholds relationships during the lockdown. For France, we developed our survey, named Enquête sur l'Impact économique et social du Covid-19 sur les Ménages (EICM)*, using online tools. Similar surveys were carried out in Italy, Germany and Austria. The French and the Italian versions of this survey included detailed questions to parents on children's time use, and the French survey included some questions on the conflicts between partners during the lockdown. Our survey also provides information on parents' evaluation of children learning process and emotional well-being, and on distance learning methods, analyzed in Champeaux* et al. *(2022).*

15. Using Facebook Ads Manager (FAM) allowed us to promote our survey and to amplify our audience. Most of the information was collected during the last two phases of the survey campaign (80% of the sample).

16. This might reflect a greater interest of women in the topics of the survey.

women compared to 24.4% among women aged 25 to 64, according to national statistics from INSEE. This might reflect a particular interest of highly educated women in the survey's topics. We consider this by weighting to correct for the representativeness of the lowest educated women.[17] Second, it over represents women active in the labor market: 80.5% in our sample, vs. 76.7% in the population of French women aged 25 to 49. The women in our sample are also younger, with an average age of 37 vs. 43.3[18] in the French population. Finally, 57% of them have a child; this makes two-child families also over-represented in our sample, leading to a potential overestimation of the childcare burden during the lockdown. Otherwise, thanks to the sample size and the dissemination of the survey, the geographical location of respondents across regions is close to that of the metropolitan French population (except for Paris and its region, and the Auvergne Rhône-Alpes region). Aware of these specific characteristics, we underline that our results only refer to this population sample.

3.1.2. The Variables

The main variables used in the analysis are based on the responses to questions on the share of housework carried out by the respondent and her partner, on their activity status, and on conflicts between partners, all before and during the lockdown.[19]

Woman's share of housework – For four domestic chores (cleaning, cooking, laundry, shopping) and for two activities related to children (helping with homework and playing), respondents were asked who carried out the task before and during the lockdown. The response included six modalities: 1- always me; 2- me most of the time; 3- my partner and me equally; 4- my partner most of the time; 5- always my partner; 6- another person. Only a minority of respondents selected the sixth modality (less than 1% either before or during the lockdown, except for cleaning before the lockdown, with 4.4%).

We use these responses to build measures of the woman's participation in the production of household goods. Specifically, we respectively assign the values 1, 0.75, 0.5, 0.25 and 0 to the first five modalities,[20] and the value of 0.5 (i.e. equal sharing) to the sixth modality.

For each housework task and childcare activity, we then obtain a value from 0 to 1, that indicates the woman's share in the task. Correspondingly, the man's share is considered as the reverse of the woman's involvement. For example, if woman declares that she takes care of the task most of the time, we consider her share of the task being 75% and partner's share 25%.

We also build two general indexes obtained by computing the average of the woman's participation in all activities; the first index is only composed of domestic chores, the second adds childcare.

We denote $Share_{it}$ the share of housework done by women, that can be measured for each of the three scopes of the indicator: *(i)* the woman's share of domestic chores; *(ii)* the woman's share of domestic chores and childcare (for women with children); *(iii)* the women's share of work for each one of the household activities.

Confinement status – To take into account the different types of situations that were possible during the first lockdown, we differentiate four "confinement status": 1- both partners working outside (at their workplace); 2- the woman working outside; 3- her partner working outside; 4- both partners staying at home. In this last situation, we further distinguish more in detail the combination of (temporary) unemployment and teleworking: either both partners teleworking, or both temporary unemployed, or one teleworking and the other – the man or the woman – temporary unemployed.

Conflicts – Each respondent was asked whether the occurrence of conflictual situations with their partner had changed during the lockdown compared with before. Five responses were proposed: much more frequent, a little more, not different, a little less, much less. Based on this question, we create a dependent variable named $Conflict_{it}$, that takes the value one for the period t_0 or t_1 in which the woman experienced the highest conflictual situations. Therefore, if the occurrence of conflicts decreased during the lockdown, the dummy is equal to 1 in t_0 and 0 in t_1. Conversely, $Conflict_{it}$ is equal to 1 at time t_1 and 0 for t_0 if the occurrence of conflicts increased. For a couple that did not experience any change in conflict's occurrence, the dummy is equal to 0 in both t_0 and t_1.

Beyond these three central variables, the survey also provides information on the employment status of the respondent and her partner before and during the pandemic, on their respective contribution to the total household income, and on some other household characteristics.

17. *All our results (available upon request) remain stable when unweighted.*
18. *See https://www.insee.fr/fr/statistiques/2381476.*
19. *The complete questionnaire is available from the authors upon request.*
20. *Tests of sensitivity changing these values (e.g. 0.66 instead of 0.75; 0.33 for 0.25) did not affect the results.*

The questionnaire also includes questions on the number of weekly hours devoted to cleaning, cooking and laundry, only used for descriptive statistics.

3.2. Descriptive Statistics on Housework and Conflicts

As mentioned earlier, the lockdown may have strongly affected the production of household goods, because of the increase in the time spent at home and the disappearance of outsourcing options (especially childcare with the closed schools). Table A2 in Appendix presents the main descriptive statistics based on our sample of partnered women, before and during the lockdown. Before the pandemic, women with children devoted 80 minutes more to domestic chores than those without, but both reported a similar increase of about 3 hours in such activities during the pandemic. Unsurprisingly, the time spent in childcare considerably increased during the lockdown, from 2.5 to 10 hours, i.e. four times higher.[21]

Figure I shows that women did most of the housework before the pandemic and the lockdown did not change this situation, as the gender gap remained positive in each activity.[22] This is consistent with other research using representative data (e.g. Barhoumi *et al.*, 2020; Pailhé *et al.*, 2022). Gender gaps were already higher before the lockdown for couples with children (see also Figure A1 in Appendix), indicating that women take the additional burden due to the presence of kids. Couples with children experienced on average a substantial reduction of the gap in shopping activities, while fathers also increased their participation in all activities except cleaning. Conversely, in couples without children, men did not increase their share for most tasks, except for shopping which presents the greatest change. This is similar to the results of Mangiavacchi *et al.* (2021) in Italy and Farré *et al.* (2021) in Spain, where the gender gap on shopping became negative during the lockdown. Cooking and shopping (and playing with kids for couples with children) are the activities in which men were already more involved before lockdown. This stylized fact might illustrate the leisure component of some tasks and a difference in preference for leisure between genders.

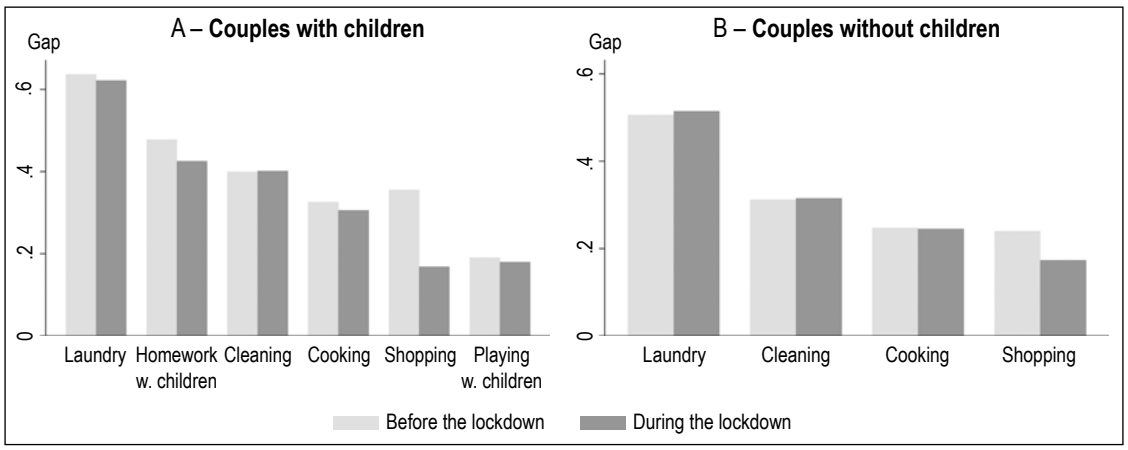
Figure II illustrates the change in the gender gap in housework by confinement status for all couples (for children related activities only couples with children are used). We observe a higher reduction in the gender gap in the group where only the woman worked outside during the lockdown. Conversely, the gender gap increases for all activities when men worked outside, except shopping. Figure II also shows a very small reduction in the gender gap for some activities when both partners were in the same situation (i.e. working outside or both at home). This illustrates the heterogeneity of the division of housework across confinement statuses and the necessity to consider the couple's confinement status in our empirical strategy.

Concerning conflicts, Figure III shows that most women reported that there was not any change in the frequency of conflicts with their partner. However 28% of those with children and 22% of those without reported an increase.

21. The survey asked no question about activities like changing nappies, bathing, feeding or dressing babies. This could affect the measurement of the distribution of tasks for couples with at least one young child, i.e. 39.4% of the couples with children in our sample.

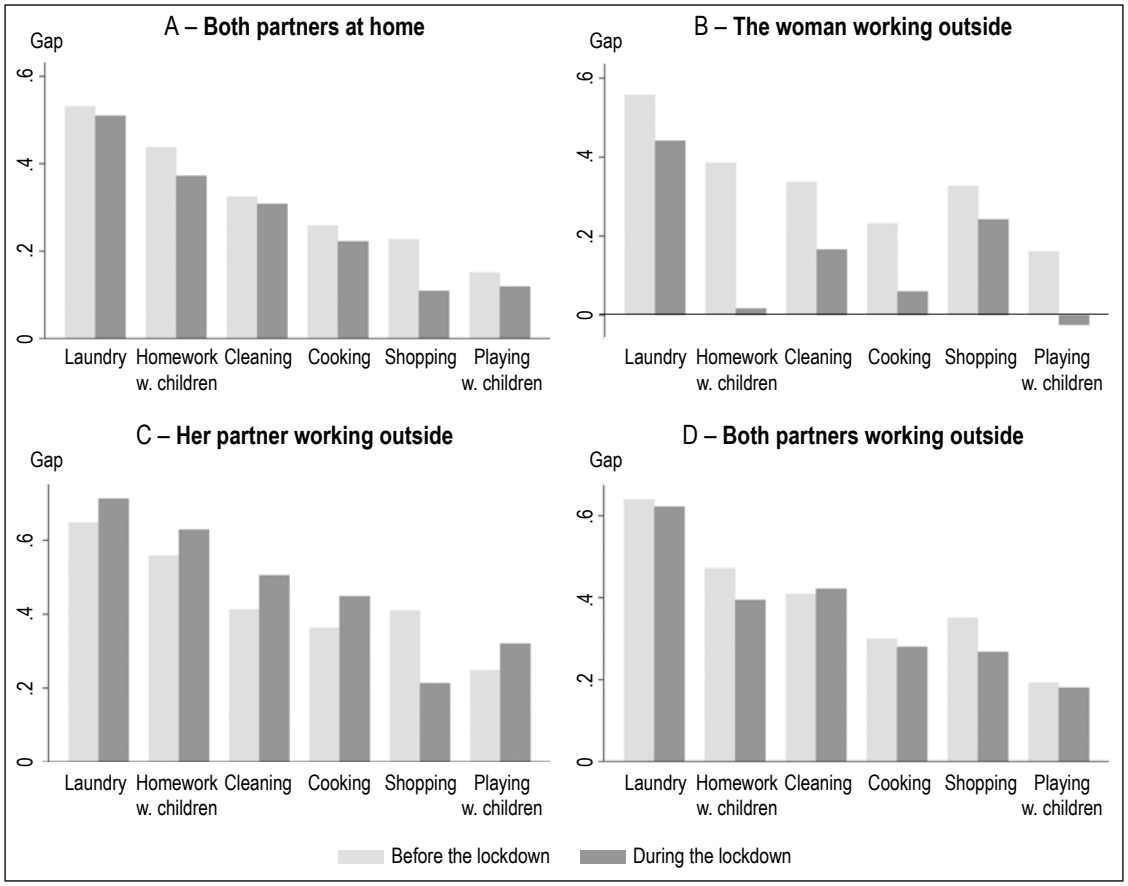
22. Here, the gender gap is computed as the difference between women's and men's shares. When the gender gap is zero, the task is equally distributed among partners, while a positive gap means that women take care of most of the burden.

Figure I – **Gender gap[(a)] in housework by task**



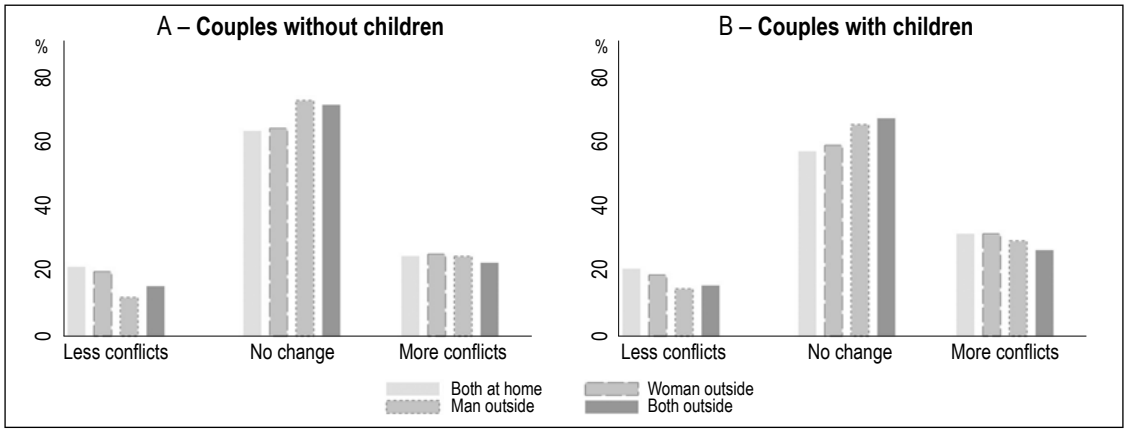
[(a)] Woman's share – Man's share
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

Figure II – **Gender gap in housework, by task and confinement status**



Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

Figure III – **Occurrence of conflicts**



Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

This difference between couples with and without children is also observed with INSEE data (Barhoumi *et al.*, 2020). Here again, the patterns appear heterogeneous across confinement statuses.[23]

3.3. Empirical Strategy

3.3.1. Household Division of Housework

Our first objective is to determine the influence of the lockdown on the division of household goods production between partners. The dependent variable is the share of housework carried out by women (as defined in Section 3.1). We alternatively consider the share of domestic chores, childcare, global housework, and by detailed tasks. Our specification applies a panel

23. Income inequality between partners (measured by the woman’s contribution to the couple’s total income reported by women) does not appear to change the occurrence of conflicts during the lockdown: around 25% reported more conflicts whether the contribution was equal or not.

fixed-effects model with two time periods, before and during the pandemic. It is estimated as follows:

$$Share_{it} = \theta_0 Lockdown_t + \sum_{s=1}^{3} \theta_s Lockdown_t \times Status_s + \gamma X_{it} + u_i + \epsilon_{it} \quad (1)$$

with $Share_{it}$ the measure of housework done by the woman i in the period t. The variables of interest include $Lockdown_t$, a dummy variable equal to 1 for lockdown period, and its interactions with $Status_s$, the confinement status of the couple. s corresponds to three situations where at least one partner (only the woman, only the man, both) worked outside during the pandemic. The coefficient θ_0 consequently captures the effect of the lockdown on the distribution of housework when both partners stayed at home and θ_s capturing the conditional effect to each s situation. Therefore, we need to interpret total effects as $\theta_0 + \theta_s$ for each s situation.[24] In one specification, $Lockdown_t$ is also interacted with a dummy (*Children*) that is equal to 1 if the couple lived with one child or more during the lockdown. The vector X_{it} includes controls for the respondent's and her partner's employment status before and during the lockdown. u_i captures time-invariant characteristics of the respondent, her partner and the household, and ε_{it} is the error term. Estimates are weighted to account for the over-representation of highly educated women in our sample. Since t has two dimensions, 0 and 1, Eq. (1) is estimated as a first difference estimator, as follows:

$$\Delta Share_i = Share_{i0} - Share_{i1} = \theta_0 + \sum_{s=1}^{3} \theta_s \Delta Status_s + \gamma \Delta X_i + \Delta c_i$$

3.3.2. Intrahousehold Conflicts

The second objective of our analysis is to explore the link between housework task division and tensions between partners. This is done on the basis of the question on the change in the occurrence of conflicts during the lockdown, as described in Section 3.1.

We estimate the following panel fixed effects model:

$$Conflict_{it} = \theta Lockdown_t + \alpha Share_{it} + \beta Share_{it} \times Lockdown_t + \sum_{s=1}^{3} \theta_s Lockdown_t \times Status_s + \gamma X_{it} + u_i + \varepsilon_{it}, \quad (2)$$

where $Share_{it}$, $Lockdown_t$ $Status_s$ and X_{it} are defined as above. As in Equation (1), we control for the specific role played by the confinement status of the couple, interacting $Status_s$ with $Lockdown_t$. u_i captures time-invariant characteristics. ε_{it} is the error term. As in Eq. (1), we use weights in order to correct the over-representation of high educated women in the sample. Considering the time-dimension of our model with two period, the analysis is akin to an estimation in first differences:

$$\Delta Conflict_i = \theta + \alpha \Delta Share_{it} + \sum_{s=1}^{3} \theta_s \Delta Status_s + \gamma \Delta X_i + \Delta c_i.$$

Our empirical strategy has some important limitations. First, as the outbreak affected the whole population in France, we are unable to establish a counterfactual group, which would have helped us to clearly identify the relationships between lockdown, housework division and conflicts among partners.[25] In other words, we are not able to assess what would have been intra-household dynamics during this period without the pandemic. Furthermore, our data only allow observing the division of housework perceived by the respondent, but not the actual housework division. Consequently, we can only analyze women's perceptions on the variations in household task division and conflicts occurrences during the lockdown. In the survey, we asked for retrospective pre-lockdown information; this could have induced a recall bias and thus a measurement error. We believe that this is not the case because the survey took place only 5 to 7 weeks after the beginning of the lockdown, and because the lockdown induced a really clear-cut change in the daily life. Moreover, although respondents' time invariant characteristics are absorbed in first differences, our identification strategy fails to capture potential time-variant unobservables, which can both play on housework division and on conflicts, e.g. the respondent's ability to deal with time constraints. Finally, our results are valid for a specific population of women, living in heterosexual couples, better educated and more often active in the labor market than on average.

4. Results

4.1. Changes in the Division of Housework during the Lockdown

We estimate Eq. (1) firstly for all the respondents, then for the subsamples of couples without and with children. The results are presented in Table 1. Columns 1 to 4 use the overall share of

24. We will also provide a subsample analysis on couples where both members were at home, detailing whether they were teleworking or temporary unemployed.

25. Even if their work situation was not affected during the lockdown, workers who continued to work outside cannot be associated to a counterfactual group as they experienced other shocks (e.g. cleaning or babysitting services were no more available, opportunities for leisure were considerably reduced).

Table 1 – **Lockdown effect on the woman's share of housework**

	All couples		Without children(*)	With children	
Dependent variable	Domestic chores (1)	Domestic chores (2)	Domestic chores (3)	Domestic chores (4)	Housework (5)
Lockdown	−0.0225***	−0.0120	−0.0177	−0.0297***	−0.0296***
	(0.00625)	(0.00785)	(0.0103)	(0.00520)	(0.00587)
Children (=1) x Lockdown		−0.0236**			
		(0.00884)			
Woman working outside x Lockdown	−0.0272**	−0.0252**	−0.00767	−0.0384**	−0.0546***
	(0.0114)	(0.0113)	(0.0229)	(0.0154)	(0.0137)
Partner working outside x Lockdown	0.0265***	0.0319***	0.0378*	0.0266***	0.0376***
	(0.00809)	(0.00902)	(0.0182)	(0.00742)	(0.00658)
Both working outside x Lockdown	0.00399	0.00785	0.000531	0.0105	0.00889
	(0.00901)	(0.00936)	(0.0137)	(0.0120)	(0.00901)
Woman is employed	−0.0296*	−0.0296*	−0.0405**	−0.0213	−0.0297*
	(0.0148)	(0.0149)	(0.0171)	(0.0174)	(0.0164)
Man is employed	0.0533***	0.0497***	0.0434**	0.0539***	0.0473***
	(0.00933)	(0.00907)	(0.0190)	(0.00904)	(0.00792)
Mean Share when *t*=0	0.693	0.693	0.663	0.715	0.699
R-squared	0.860	0.861	0.873	0.851	0.853
Observations	5,688	5,688	2,458	3,230	3,230
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes

(*) In this case, housework consists only of domestic chores.
Notes: All the specifications correspond to Eq. (1), and the estimations use sampling weights. Standard errors in parentheses are clustered at regional level. ***, ** and * indicate significance at 1%, 5% and 10% respectively. The situation of reference is "Both partners at home during the lockdown".
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

domestic chores (thus excluding childcare) as the outcome. Col. 1 presents the results on the full sample of respondents. We add in col. 2 an interactive term between the lockdown variable and a dummy equal to one for couples with children to explore the heterogeneity of the lockdown effect on housework sharing according to the presence of children at home. Col. 3 provides a subsample analysis for couples without children, and col. 4 and 5 focus on couples with children at home during the lockdown. Col. 5 uses the global share of housework as the outcome.

Overall, we notice that the effects of the lockdown on housework sharing are heterogeneous across couples' confinement status. Moreover, comparing col. 1 and 2, we remark that the effects for couples where both partners stayed home (i.e. the reference category) are different according to the presence of children at home. In what follows, we focus our analysis on the subsamples.

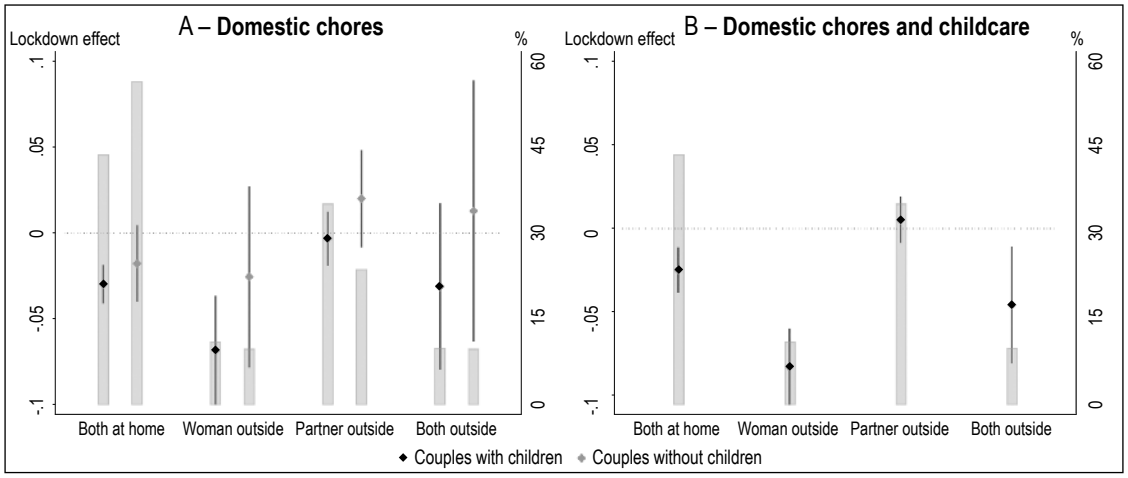
The results shown in columns 3 and 4 are presented in Figure IV-A, and those from col. 5 in Figure IV-B; we draw point estimates and 95% confidence interval, as well as the sample distribution across confinement situations.

For couples with children at home (Figure IV-A), there is a redistribution of housework in favor of women only when men were at home during the lockdown. When both partners were at home, the estimated coefficient is negative and significant, meaning a more equal division. When the woman was the sole working outside the home, we find that this redistribution is even stronger in her favor. On the other hand, when the man was the only one to work outside or when both partners worked outside, there is not any significant change of the housework division during the pandemic. Interestingly, the situation is not symmetric across gender: while men increased their participation in household tasks when their partner was working outside, women did not do the same. Below, we will see that this null effect for women is explained by the change in the type of activities men are involved in. For couples without children, we find that the distribution of the housework during the lockdown has not significantly changed, regardless of the confinement status.

The results remain stable to the inclusion of childcare in the outcome (Figure IV-B), except for the case where both partners worked outside during the lockdown, which becomes significant, suggesting an increase in the time fathers devoted to childcare in this specific situation.

As mentioned above, the case of both partners staying at home can correspond to various situations with regard to work: both partners could be teleworking *(i)*, both temporary unemployed *(ii)*,

Figure IV – **Lockdown effect on the woman's share of housework by confinement status**

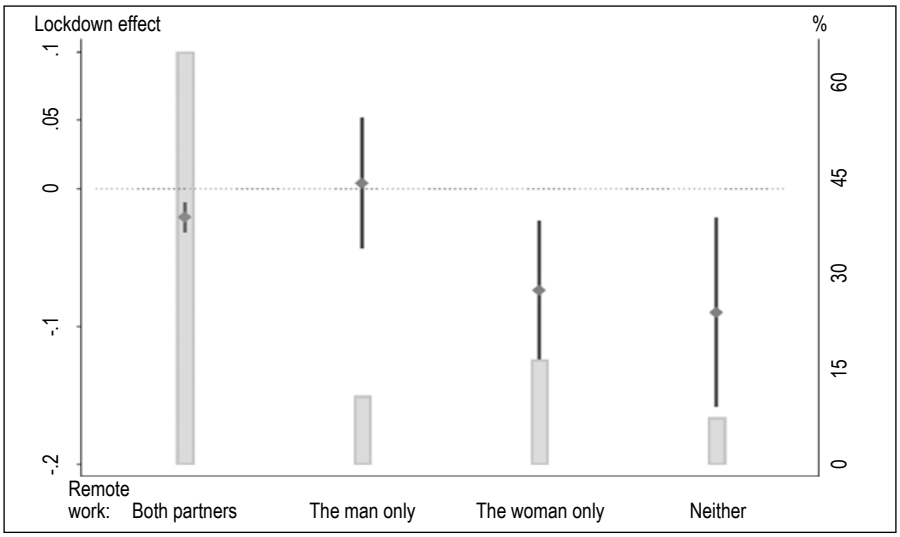


Notes: The marginal effects are directly computed from the coefficients presented in Table 1 (Col. 3 to 5) relative to the confinement status of the couple. The vertical bars represent the share respondents in each confinement status.
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

or one teleworking – the man or the woman – while the other was temporary unemployed *(iii)*. In cases *(i)* and *(ii)*, the time constraint is similar for the two partners, but not in case *(iii)*. We then reexamine more closely the redistribution of the household tasks in each of these situations, limiting the analysis to couples with children, since no redistribution is observed in couples without children where both partners are at home. The results are presented in Figure V. First of all, it is worth noting that, in the vast majority of couples in our sample who stayed at home during the lockdown, both partners were teleworking. There was no redistribution when the father was working from home while the mother was not. This result is symmetric to that shown in Figure IV-B, where the father was the only outside worker of the household. We find an important redistribution of tasks in favor of women when they were the only parent working from home, again in line with the results for women who worked outside. Here again, the lockdown effect is then not similar across genders: while men in temporary unemployment increased their participation when their partner was teleworking, women did not. Most interesting are the situations in which the two partners experienced the same working condition: the redistribution was significant but small when both worked from home, while relaxing the time constraint for both created a more substantial redistribution in favor of women.[26]

26. Note that couples at home where both partners were unemployed and couples where only the man was teleworking during the lockdown represent a small part of the sample (respectively 2% and 4.5%). Estimates could be less precise on these subsamples.

Figure V – **Lockdown effect on housework division in couples with children, the two parents staying at home**

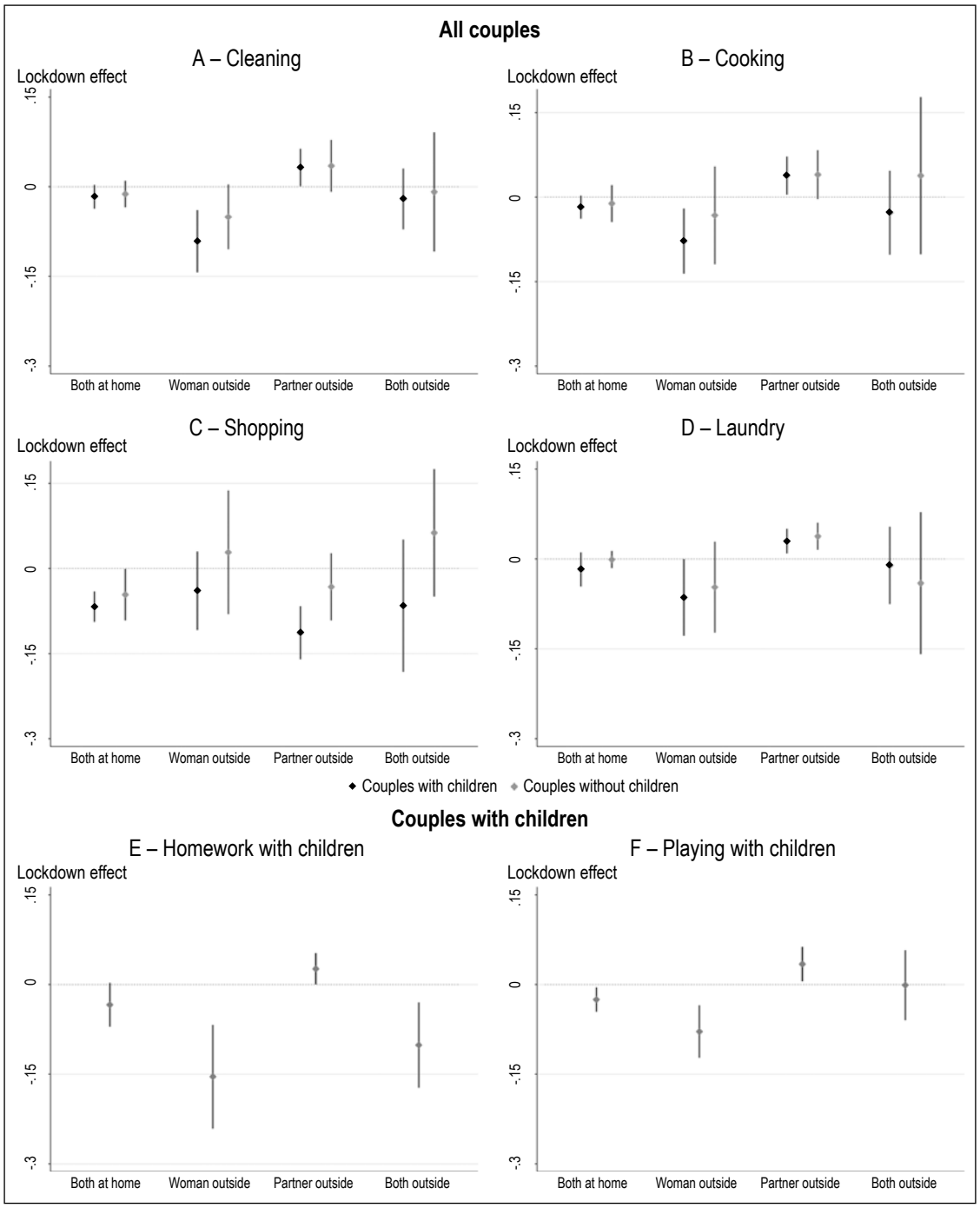


Notes: The marginal effects of the lockdown are directly computed from the coefficients, for different configurations relative to remote working. The vertical bars represent the share of respondents in each configuration.
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

So far, we have considered the aggregate shares of domestic work and childcare. Based on our conceptual framework, we now explore the potentially heterogeneous involvement of the partners in different tasks, following the assumption that preferences might drive the tasks redistribution, notably in couples whose partners experienced a symmetric shock on the labor market. In order to understand if some specific tasks are behind the results, we re-estimate Eq. (1) with the woman’s share in each task as outcome. The results are presented in Figure VI.

When mothers were the only one working out of home, their partner’s contribution increased in all tasks, except shopping. This is the situation in which the redistribution is really effective between partners. For couples without children, when the woman was the only one working outside, men only increased their participation in cleaning, thus not inducing a significant redistribution.

Figure VI – **Effects of the lockdown on housework division by task**



Notes: The marginal effects of the lockdown are directly computed from the estimated coefficients of Eq. (1) with the woman’s share by task as dependent variable.
Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

While we found an overall no-effect when only men worked outside during the lockdown, we note here that they significantly reduced their participation in the main domestic chores such as cleaning, cooking or laundry, as well as in childcare, while fathers increased their participation only in shopping. The absence of an overall effect may then result from a reorientation of the type of activities men are involved in. When both partners worked outside, we only find a redistribution in favor of women for homework with children. This is consistent with the previous result of a significant effect of the lockdown on the overall share of housework for couples where both partners worked outside only when childcare was included in the index. For couples with children where both partners were at home, the redistribution effect is driven only by shopping and playing with children. Looking more closely at couples at home, we remark that the only situation in which men took care of the activities with a low leisure component (e.g. cleaning and laundry), is when his partner was working from home.[27] For couples without children, although the effect on total housework was not significant, we observe a reduction in the woman's contribution to shopping for confined couples, even if this decrease is smaller than for couples with children in the same situation. We also observe a positive effect of the lockdown on women's share of laundry when their partner worked outside during the pandemic. Other results for couples without children are non-significant.

We can conclude from these analyses that, on average, the lockdown did not result in a large change in the division of housework. The main changes are observed, almost exclusively, for couples with children and where at least one of the two partners was staying at home during the lockdown, i.e. couples who experienced both a significant increase in the production of household public goods and a shock on the labor market. Where only one of the partners worked outside, the other logically increased his or her contribution to all housework activities. The case of shopping suggests a rational assignation of this task to the partner who was already out for his/her work.

For couples where both partners were at home during the lockdown, we showed that the reduction in women's overall share of housework is mainly driven by couples where the man was not teleworking. This finding confirms the intuition, mentioned in the conceptual framework, that the partner whose time is least constrained takes care of most of the household tasks.

However, gender preferences seem to play a role as well, considering the leisure dimension (in the context of the lockdown) of the task – shopping – in which men increased their participation. In a situation where people were only allowed to go out for essential tasks, shopping became an interesting activity for those staying at home, a kind of leisure, and may have represented an escape from forced cohabitation. The case of shopping during the lockdown suggests that the "gender" of a task could be context-dependent rather than being a stable, essential feature.[28]

4.2. The Change in Housework Division and Conflicts Occurrence

We explore now whether the harmony between partners has been affected by the lockdown. As mentioned earlier, this period represented a sudden shock in the household environment. We assume that the process of renegotiation about household goods production led to an increase in tensions.

The results of the estimation of Eq. (2) are presented in Table 2. We firstly show results for the full sample (col. 1 to 2) then distinguish between couples without and with children (col. 3 to 5). We find that the occurrence of conflicts increased on average for all the couples during the lockdown (col. 1). However, only couples with children experienced more conflicts linked to the distribution of the housework during the lockdown.[29] Given that, we decide to focus exclusively on couples with children.

To clearly depict our main findings (col. 5), Figure VII represents the results across the confinement situations.[30]

Firstly, we observe a significant and positive relationship between women's share of housework

---

27. The results on the various working situations of partners at home, not presented here, are available from the authors upon request.

28. An alternative explanation for the increase in men's participation in shopping might exist. Shopping could have been considered a risky activity due to the pandemic, and men could have assumed their traditional role of 'protector' of the family, taking the risk upon themselves. In this scenario, shopping was likely to become a male-connoted task and the household's choice was to conform to social gender roles (Couprie et al.*, 2020).*

29. For couples without children, we find that only an extremely unbalanced housework division was associated to a significant increase in the occurrence of conflicts between partners when the woman was at home. However, very few couples were in such a situation. When the woman was working outside, no increase in conflicts due to housework division is observed. These results are available upon request.

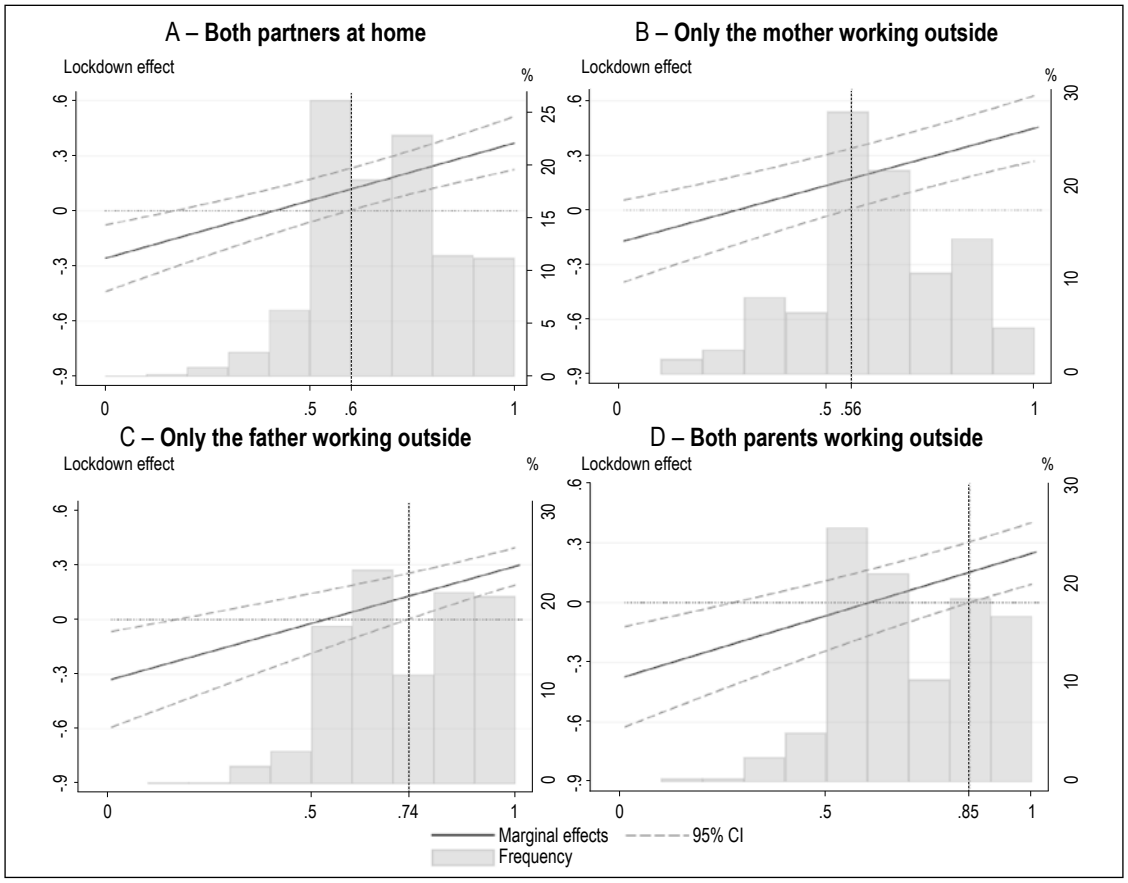
30. Due to the interaction terms in the Eq. (3), θ *captures the effect of the lockdown on conflicts when both* $Share_{it}$ *and* $Status_s$ *are equal to 0. The* β *measures the average effect of the division of housework during the lockdown. As* $Share_{it}$ *is a continuous variable from 0 to 1, and in order to obtain the total effect, we need to carry out non-linearity analyses for each value of* $Share_{it}$*. Moreover, as we included interaction terms between the lockdown dummy and the couple's confinement status, we also need to interpret each situation during the pandemic. For couples with both partners at home (*$Status_0 = 0$*, the reference), this means interpreting total effects* $\theta + \beta \times Share_{it}$*, and computing the combined coefficients' values and standard errors for each potential value of* $Share_{it}$*. For couples in other status, total effects are interpreted as* $\theta + \beta \times Share_{it} + \theta_s Status_s$*.*

Table 2 – **Lockdown, housework division and conflicts between partners**

	Full sample		No Children	With Children	
	(1)	(2)	(3)	(4)	(5)
Lockdown	0.0810** (0.0288)	−0.142 (0.0937)	−0.167 (0.148)	−0.0910 (0.108)	−0.257** (0.0923)
Domestic Chores		0.0414 (0.158)	0.0320 (0.312)	0.0633 (0.238)	
Domestic Chores x Lockdown		0.338** (0.118)	0.277 (0.198)	0.375*** (0.0983)	
Housework(*)					−0.104 (0.227)
Housework x Lockdown					0.625*** (0.117)
Partner outside x Lockdown	0.0501 (0.0441)	0.0209 (0.0458)	0.0958 (0.0646)	−0.0586 (0.0958)	−0.0766 (0.0996)
Both outside x Lockdown	−0.0162 (0.0676)	−0.0332 (0.0646)	0.0506 (0.131)	−0.117 (0.0820)	−0.121 (0.0806)
Woman outside x Lockdown	0.0545 (0.0935)	0.0667 (0.0961)	0.0627 (0.194)	0.0641 (0.0581)	0.0812 (0.0550)
R-squared	0.507	0.512	0.511	0.517	0.521
Observations	5,688	5,688	2,458	3,230	3,230
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes

(*) For couples without children, housework is equal to domestic chores.
Notes: All the specifications correspond to Eq. (2), and the estimations use sampling weights. Standard errors in parentheses are clustered at regional level. ***, ** and * indicate significance at 1%, 5% and 10% respectively. The situation of reference is “Both partners at home during the lockdown”.
Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

Figure VII – **Effect of housework division during the lockdown on conflicts in couples with children**



Notes: The marginal effects are directly computed from the coefficients presented in Table 2, Column (5). The vertical bars represent the woman’s share of housework during the lockdown for each confinement status, and the vertical line corresponds to the threshold from which the woman’s share of housework increased the occurrence of conflicts.
Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

(i.e. domestic chores and childcare) during the lockdown and the increase in conflicts regardless of the couple’s confinement status. When both parents worked outside, the effect is significant and positive only for an extremely unequal sharing, i.e. where the woman carried out almost all the housework. Only a few couples (161) were in this confinement situation. When only the father was working outside, the turning point of the mother’s share of housework, i.e. from which we observe a significant effect on conflicts, is lower than in the previous situation, suggesting a lower tolerance for an unequal distribution of tasks in this case. Most of the

couples in this subgroup experienced conflicts because of the prevalence of an unequal housework division during the lockdown. Finally, when the father stayed at home (i.e. either when both parents stayed at home or only the mother was working outside), even a slightly unbalanced housework division led to increase the conflicts during the lockdown. The threshold from which the woman's share of housework increased the occurrence of conflicts does not differ between couples with both partners at home and couples where the woman was the only one working outside (respectively 60% and 56%). However, the magnitude of the effect is different, more substantial when only the father stayed at home, as expected.[31]

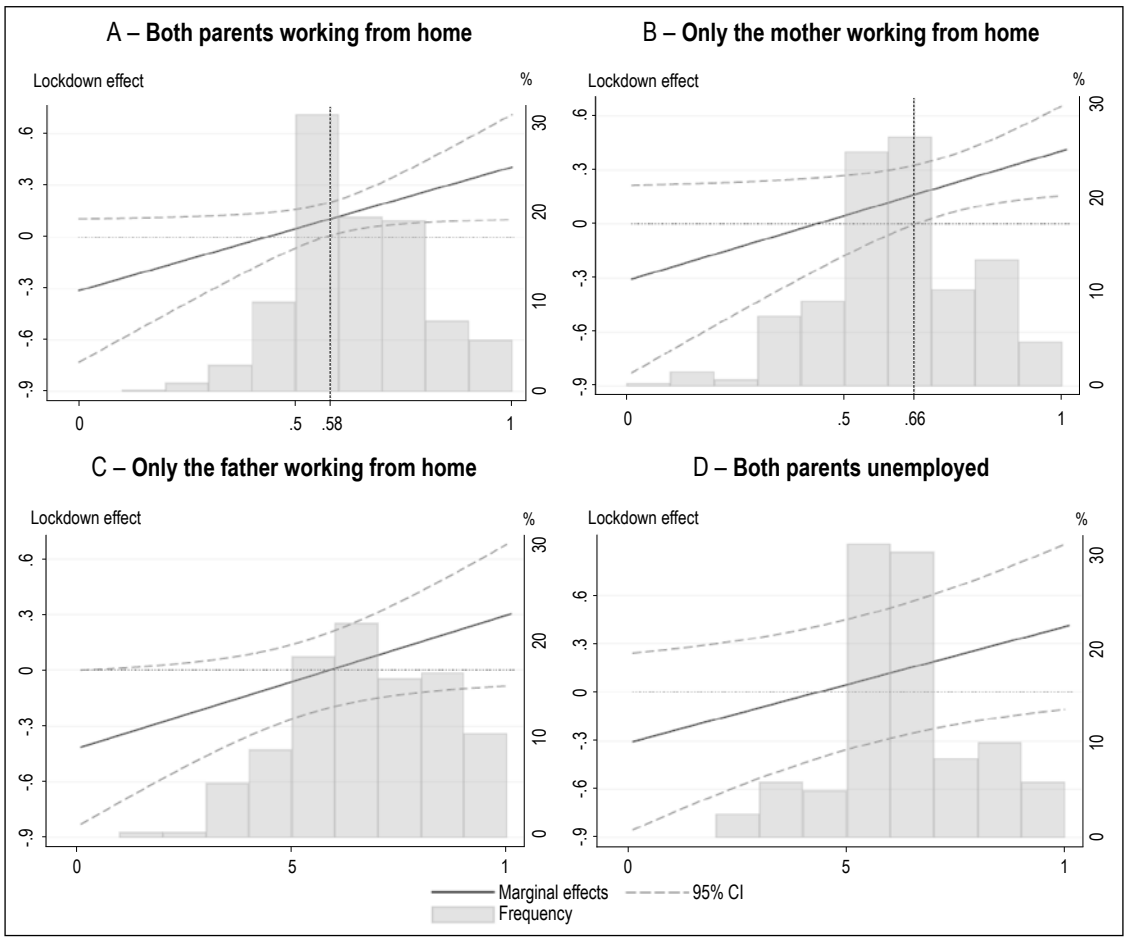
We now explore the specific case of both partners at home, distinguishing teleworking and (temporary) unemployment. The results, presented in Figure VIII, show that conflicts are linked to an unequal division of housework only when women worked from home.

The estimation results of the role of each activity in the occurrence of tensions among at-home parents and a graphical presentation are provided in Appendix 2. We remark that an increase in the woman's participation in any household activity during the lockdown increased the occurrence of conflicts between partners. Remarkable differences emerge across activities, with the magnitude of coefficients systematically higher and the slope steeper for cleaning and for the two activities related to children. The results[32] are similar for couples in which one of the two partners worked outside during lockdown, while conflicts increased in couples where both parents worked outside only in the case of an unequal division for the activity "playing with children".

All in all, these results suggest that an unequal division of housework was more likely to result

31. The results are similar when only domestic chores are considered (cf. Table 2, col. 4).
32. Not presented in the paper but available upon request.

Figure VIII – **Effect of housework division during the lockdown on conflicts in couples with children, the two parents staying at home**



Notes: The marginal effects are directly computed from the coefficients of Eq (2) on the subsample of parents staying at home. The vertical bars represent the share of respondents by woman's share of housework during the lockdown within each confinement status, and the vertical line on panels A and B corresponds to the threshold from which the woman's share of housework increased the occurrence of conflicts.
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

in increased conflicts during the lockdown when only the mother was working outside or when both parents stayed at home and the mother was teleworking. In these two situations, women experienced an intense time constraint (combining work and increased domestic tasks) which may have led to tensions with the partner over the distribution of housework. This would be consistent with the assumption, made in Section 2, that the necessity to negotiate a new equilibrium in a short period could increase the risk of conflicts. We also show that conflicts particularly increased when mothers increased their share of cleaning and childcare (see Appendix 2). Being the most time consuming task, cleaning is also one of the chores with the lowest leisure component and the highest female connotation. It is likely that mothers were unsatisfied with an equilibrium where their partners carried out the most pleasant tasks, and conflicts appeared as a mean to renegotiate a better sharing.

* *
*

The allocation of housework within couples is typically stable over time, with a gendered connotation of a large number of tasks (Akerlof & Kranton, 2010). However, the COVID-19 epidemic, and the ensuing lockdown adopted in spring 2020, have brought a sudden and unprecedented shock to this stable allocation. The quantity of household tasks increased and challenged the partners’ abilities to respond to the shock. At the same time, the disappearance of most leisure opportunities may have led to changes in the attractiveness of some household tasks, given their possible “quasi-leisure” connotation. Furthermore, in addition to the increased burden of housework, the anxiety about the pandemic, its evolution and its economic consequences, the disruption of social life and a forced cohabitation also contributed to an increase in the likelihood of the occurrence of violence (Arenas-Arroyo *et al.*, 2021) and tensions between partners.

Based on an original conceptual framework and data collected in France during the spring 2020 lockdown, our results suggest no drastic changes in housework division between partners. Women remained the main provider, notably in activities with a low leisure component. Substantial heterogeneities are observed according to the presence of children in the household, the confinement status of the couple and the employment status of the individual. As drawn in the conceptual framework, we empirically show that the redistribution became more favorable to women only when the two partners experienced an asymmetric shock on the labor market and women had a tight time constraint (i.e. when the mother worked outside and the father at home or the mother worked from home while the father was temporarily unemployed). Facing a sizeable increase in household tasks, it is likely that fathers who were at home during the lockdown felt compelled to increase their share of household tasks. Nevertheless, when possible (i.e. when their partner was also at home), they increased only their share in activities already considered as enjoyable (especially playing with kids) or that became in the context (such as shopping). Compared to the other tasks, shopping was also a highly noticeable activity for the other household members during the lockdown and could help the protagonist to bargain his lower involvement in other housework.

Our results also suggest that conflicts between partners in couples with children increased with the share of household activities carried out by women, particularly when men stayed at home during the lockdown. Most of the increase in conflicts were related to childcare and cleaning, suggesting that the unequal division of work in these activities could be perceived by women as less acceptable in the context. As expected, the renegotiation of the production of household public goods on a short period of time is associated for women to an increase in the perceived occurrence of conflicts with their partners, in particular when men’s involvement is low in less pleasant activities, like cleaning.

Based on the perceptions of a population of relatively highly educated and active women, we show that men behave following their gender role. However, they adapt to the contingent situation. A female-connotated activity like shopping became an almost exclusive prerogative of males when it gained in attractiveness. The gendered nature of a task does not seem stable and responds to its changing attractiveness. Male preferences seem to drive the division of household activities between partners, and the choice of domestic activities in which they engage, notably depending on their leisure component, is not neutral on the harmony between partners.

All in all, the lockdown does not seem to have redefined gendered roles at home or induced a structural change of the housework division. These findings shed light on the importance of gendered preferences as well as time constraints to understand what barriers remain for an equal housework division between partners. With the recent development of remote work in many sectors, further research is needed to investigate mid and long-term effects of such situations. □

BIBLIOGRAPHY

Agüero, J. M. (2021). COVID-19 and The Rise of Intimate Partner Violence. *World Development*, 137, 105217. https://doi.org/10.1016/j.worlddev.2020.105217

Akerlof, G. A. & Kranton, R. (2010). Identity Economics. *The Economists' Voice*, 7(2). https://doi.org/10.2202/1553-3832.1762

Altintas, E. & Sullivan, O. (2016). Fifty years of change updated: Cross-national gender convergence in housework. *Demographic Research*, 35, 455–470. https://www.jstor.org/stable/26332084

Álvarez, B. & Miles-Touya, D. (2019). Gender imbalance in housework allocation: A question of time? *Review of Economics of the Household*, 17(4), 1257–1287. https://doi.org/10.1007/s11150-019-09467-w

Andrew, A., Cattan, S., Costa Dias, M., Farquharson, C., …, & Sevilla, A. (2020). The Gendered Division of Paid and Domestic Work under Lockdown. IZA *Discussion Paper* N° 13500. https://www.iza.org/publications/dp/13500/the-gendered-division-of-paid-and-domestic-work-under-lockdown

Arenas-Arroyo, E., Fernandez-Kranz, D. & Nollenberger, N. (2021). Intimate Partner Violence under Forced Cohabitation and Economic Stress: Evidence from the COVID-19 Pandemic. *Journal of Public Economics*, *194*, 104350. https://doi.org/10.1016/j.jpubeco.2020.104350

Auspurg, K., Iacovou, M. & Nicoletti, C. (2017). Housework share between partners: Experimental evidence on gender-specific preferences. *Social Science Research*, 66, 118–139. https://doi.org/10.1016/j.ssresearch.2017.01.003

Barhoumi, M., Jonchery, A., Lombardo, P., Le Minez, S., …, & Pollak, C. (2020). Les inégalités sociales à l'épreuve de la crise sanitaire: un bilan du premier confinement. In: Insee, *France, portrait social*, édition 2020, pp. 11–44. https://www.insee.fr/fr/statistiques/fichier/4797670/FPS2020-VE.pdf

Becker, G. S. (1965). A Theory of the Allocation of Time. *The Economic Journal*, *75*(299), 493–517. https://doi.org/10.2307/2228949

Beland, L.-P., Brodeur, A., Haddad, J. & Mikola, D. (2021). Determinants of Family Stress and Domestic Violence: Lessons from the COVID-19 Outbreak. *Canadian Public Policy*, 47(3), 439–459. https://doi.org/10.3138/cpp.2020-119

Berniell, I. & Facchini, G. (2021). COVID-19 Lockdown and Domestic Violence: Evidence from Internet-Search Behavior in 11 Countries. *European Economic Review*, 136, 103775. https://doi.org/10.1016/j.euroecorev.2021.103775

Biroli, P., Bosworth, S., Della Giusta, M., Di Girolamo, A., Jaworska, S. & Vollen, J. (2021). Family Life in Lockdown. *Frontiers in Psychology*, 12. https://doi.org/10.3389/fpsyg.2021.687570

Boring, A. & Moroni, G. (2022). Turning back the clock: Beliefs about gender roles during lockdown. LIEPP, *Working Paper* N° 133. http://www.anneboring.com/uploads/5/6/8/5/5685858/boring-moroni_turning_back_the_clock-beliefs_about_gender_roles_during_lockdown.pdf

Browning, M., Chiappori, P. A. & Weiss, Y. (2014). *Economics of the Family*. Cambridge: Cambridge University Press.

Bullinger, L. R., Carr, J. B. & Packham, A. (2021). Effects of Stay-at-Home Orders on Domestic Violence. *American Journal of Health Economics*, *7*(3), 249–280. https://www.journals.uchicago.edu/doi/abs/10.1086/713787

Carlson, D. L., Miller, A. J., Sassler, S. & Hanson, S. (2016). The Gendered Division of Housework and Couples' Sexual Relationships: A Reexamination. *Journal of Marriage and Family*, 78(4), 975–995. https://doi.org/10.1111/jomf.12313

Champeaux, H., Mangiavacchi, L., Marchetta, F. & Piccoli, L. (2022). Child Development and Distance Learning in the Age of COVID-19. *Review of Economics of the Household*, 20, 659–685. https://doi.org/10.1007/s11150-022-09606-w

Cooke, L. P. (2006). "Doing" Gender in Context: Household Bargaining and Risk of Divorce in Germany and the United States. *American Journal of Sociology*, 112(2), 442–472. https://doi.org/10.1086/506417

Couprie, H., Cudeville, E. & Sofer, C. (2020). Efficiency versus Gender Roles and Stereotypes: An Experiment in Domestic Production. *Experimental Economics*, 23(1), 181–211. https://doi.org/10.1007/s10683-019-09612-3

Del Boca, D., Oggero, N., Profeta, P. & Rossi, M. (2020). Women's and men's work, housework and childcare, before and during COVID-19. *Review of Economics of the Household*, 18(4), 1001–1017. https://doi.org/10.1007/s11150-020-09502-1

Dominguez-Folgueras, M. (2021). Difficult times: The division of domestic work under lockdown in France. *Social Sciences*, 10(6), 219. https://doi.org/10.3390/socsci10060219

Farré, L., Fawaz, Y., González, L. & Graves, J. (2022). Gender Inequality in Paid and Unpaid Work During Covid-19 Times. *Review of Income and Wealth*, 68(2), 323–347. https://doi.org/10.1111/roiw.12563

Foster, G. & Stratton, L. S. (2018). Do significant labor market events change who does the chores? Paid work, housework, and power in mixed-gender Australian households. *Journal of Population Economics*, 31(2), 483–519. https://link.springer.com/article/10.1007/s00148-017-0667-7

Gronau, R. (1977). Leisure, Home Production, and Work – the Theory of the Allocation of Time Revisited. *Journal of Political Economy*, 85(6), 1099–1123. https://doi.org/10.1086/260629

Harryson, L., Novo, M. & Hammarström, A. (2012). Is gender inequality in the domestic sphere associated with psychological distress among women and men? Results from the Northern Swedish Cohort. *J Epidemiol Community Health*, 66(3), 271–276. http://dx.doi.org/10.1136/jech.2010.109231

Hsu, L.-C. & Henke, A. (2021). COVID-19, staying at home, and domestic violence. *Review of Economics of the Household*, 19(1), 145–155. https://doi.org/10.1007/s11150-020-09526-7

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N. & Stone, A. A. (2004). A Survey Method for Characterizing Daily Life Experience: The Day Reconstruction Method. *Science*, 306(5702), 1776–1780. https://www.science.org/doi/10.1126/science.1103572

Kalmijn, M. & Monden, C. W. (2012). The division of labor and depressive symptoms at the couple level: Effects of equity or specialization? *Journal of Social and Personal Relationships*, 29(3), 358–374. https://doi.org/10.1177/026540751143118

Killewald, A. & Gough, M. (2010). Money Isn’t Everything: Wives’ Earnings and Housework Time. *Social Science Research*, 39(6), 987–1003. https://doi.org/10.1016/j.ssresearch.2010.08.005

Lachance-Grzela, M. & Bouchard, G. (2010). Why Do Women Do the Lion’s Share of Housework? A Decade of Research. *Sex Roles*, 63(11-12), 767–780. https://doi.org/10.1007/s11199-010-9797-z

Lennon, M. C. & Rosenfield, S. (1994). Relative fairness and the division of housework: The importance of options. *American journal of Sociology*, 100(2), 506–531. https://doi.org/10.1086/230545

Leslie, E. & Wilson, R. (2020). Sheltering in place and domestic violence: Evidence from calls for service during COVID-19. *Journal of Public Economics*, 189, 104241. https://doi.org/10.1016/j.jpubeco.2020.104241

Mangiavacchi, L., Piccoli, L., and Pieroni, L. (2021). Fathers matter: Intrahousehold responsibilities and children’s wellbeing during the COVID-19 lockdown in Italy. *Economics & Human Biology*, 42, 101016. https://doi.org/10.1016/j.ehb.2021.101016

Miller, A. R., Segal, C. & Spencer, M. K. (2020). Effects of the COVID-19 Pandemic on Domestic Violence in Los Angeles. NBER *Working Paper* N° 28068. https://doi.org/ 10.3386/w28068

Norman, H., Elliot, M. & Fagan, C. (2018). Does fathers’ involvement in childcare and housework affect couples’ relationship stability? *Social Science Quarterly*, 99(5), 1599–1613. https://www.nber.org/papers/w28068

Pailhé, A., Solaz, A. & Wilner, L. (2022). Housework and Parenting during the Lockdowns in France: How Have Socio-Economic and Gender Inequalities Changed? *Economie et Statistique* / *Economics and Statistics,* 536-37, 3–25 (ce numéro).

Perez-Vincent, S. M., Carreras, E., Gibbons, M. A., Murphy, T. E. & Rossi, M. A. (2020). *COVID-19 Lockdowns and Domestic Violence*. Washington, DC: Inter-American Development Bank. https://www.iassw-aiets.org/wp-content/uploads/2021/01/COVID-19-Lockdowns-and-Domestic-Violence-Evidence-from-Two-Studies-in-Argentina.pdf

Ruppanner, L., Brandén, M. & Turunen, J. (2018). Does Unequal Housework Lead to Divorce? Evidence from Sweden. *Sociology*, 52(1), 75–94. https://doi.org/10.1177/0038038516674664

Sánchez, A. R., Fasang, A. E. & Harkness, S. (2021). Gender division of housework during the COVID-19 pandemic. *Demographic Research*, 45, 1297–1316. https://www.jstor.org/stable/48640814

Shaw, S. M. (1988). Gender Differences in the Definition and Perception of Household Labor. *Family Relations*, 37(3), 333–337. https://www.jstor.org/stable/584572

Sigle-Rushton, W. (2010). Men’s unpaid work and divorce: Reassessing specialization and trade in British families. *Feminist economics*, 16(2), 1–26. https://doi.org/10.1080/13545700903448801

Stratton, L. S. (2012). The Role of Preferences and Opportunity Costs in Determining the Time Allocated to Housework. *American Economic Review*, 102(3), 606–611. https://doi.org/10.1257/aer.102.3.606

Van Berkel, M. & De Graaf, N. D. (1999). By Virtue of Pleasantness? Housework and the Effects of Education Revisited. *Sociology*, 33(4), 785–808. https://doi.org/10.1177/S0038038599000498

Van der Lippe, T., Frey, V. & Tsvetkova, M. (2013). Outsourcing of domestic tasks: A matter of preferences? *Journal of Family Issues*, 34(12), 1574–1597. https://doi.org/10.1177/0192513X12468099

Van der Lippe, T., Voorpostel, M. & Hewitt, B. (2014). Disagreements among cohabiting and married couples in 22 European countries. *Demographic Research*, 31, 247–274. https://www.jstor.org/stable/26350064

Zamberlan, A., Gioachin, F. & Gritti, D. (2022). Gender inequality in domestic chores over ten months of the UK COVID-19 pandemic: Heterogeneous adjustments to partners' changes in working hours. *Demographic Research*, 46, 565–580. https://doi.org/10.4054/DemRes.2022.46.19

APPENDIX 1

DESCRIPTIVE STATISTICS

Table A1-1 – **Sample statistics and national figures**

	EICM sample		INSEE
	Observations	%	%
Auvergne Rhône-Alpes	690	24.3	11.9
Bourgogne	158	5.6	4.4
Bretagne	143	5.0	5.1
Centre	127	4.5	3.9
Corse	6	0.2	0.5
Grand Est	278	9.8	8.4
Hauts-de-France	209	7.5	8.6
Île-de-France	226	8.0	17.6
Normandie	147	5.2	5.1
Nouvelle Aquitaine	238	8.4	9.2
Occitanie	263	9.3	9.1
Pays de la Loire	147	5.2	5.6
Provence-Alpes-Côte d’Azur	204	7.2	7.8
Outre-Mer	8	0.3	2.6
Total	2,844		
Education [a]			
High school diploma or less	1,702	59.9	75.4
Above high school diploma	1,142	40.2	24.4
Unknown			0.2
Children			
None	1,229	43.2	35.0
1 child	568	35.2	44.8
2 children	776	48.1	38.7
3 children	230	14.2	12.7
4 and plus children	41	2.5	3.8
Employment rate (%) [b]	2,289	80.5	76.7
Age (years)	2,844	37	43.3
Age of partner (years)	2,835	39	-

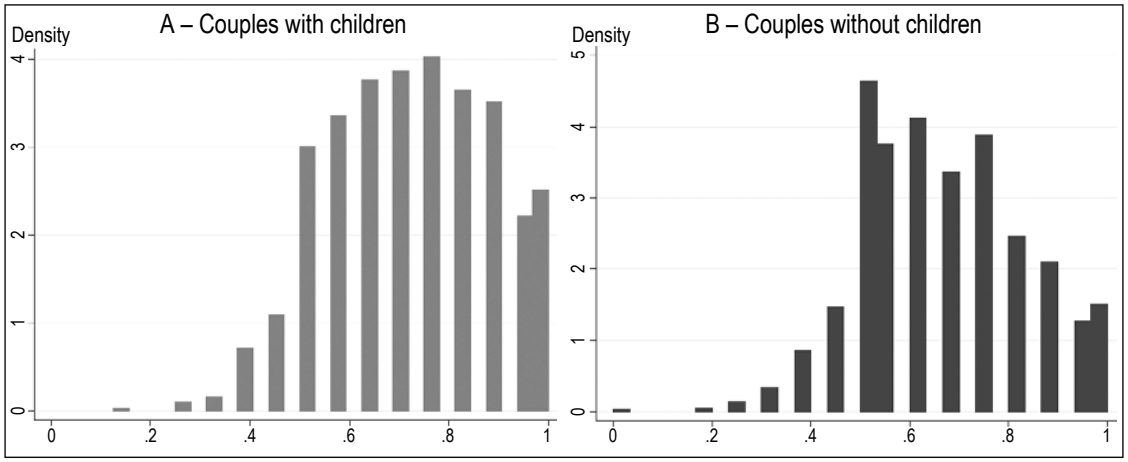
[a] ”High school diploma or less” groups all respondents with a high school diploma at most, including no education, *CAP, Brevet* (equivalent to apprenticeship or other professional diploma) and baccalaureate (equivalent to a highschool level). “Above high school diploma” groups all respondents with a level higher than the baccalaureate.
[b] Before the pandemic.
Sources and coverage:
EICM: Authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.
INSEE:
- Regional population and number of children: Population Census 2016.
- Education level: Labor force survey 2019; women aged 25 to 64.
- Labor force participation: Labor force survey 2019; women aged 25 to 49.
- Average age: https://www.insee.fr/fr/statistiques/2381476

Table A1-2 – **Summary statistics**

		Pre-lockdown			Lockdown		
	N	Median	Mean	St. Dev.	Median	Mean	St. Dev.
Woman share							
Overall (total housework)	2,844	0.69	0.71	0.17	0.69	0.69	0.18
Domestic chores	1,615	0.63	0.68	0.18	0.63	0.67	0.21
Childcare	1,615	0.71	0.72	0.15	0.67	0.69	0.16
Woman share by task							
Shopping	2,844	0.75	0.67	0.27	0.50	0.60	0.35
Laundry	2,844	1.00	0.81	0.24	1.00	0.81	0.25
Cooking	2,844	0.75	0.67	0.28	0.75	0.66	0.28
Cleaning	2,844	0.75	0.71	0.24	0.75	0.70	0.25
Helping children with homework	1,615	0.75	0.76	0.22	0.75	0.73	0.26
Playing with children	1,615	0.50	0.61	0.21	0.50	0.60	0.22
Conflicts between partners	2,844	0.00	0.15	0.36	0.00	0.25	0.44
Panel covariates [(a)]							
Woman working	2,844	1.00	0.76	0.43	1.00	0.56	0.50
Partner working	2,844	1.00	0.88	0.32	1.00	0.69	0.46
Confinement status							
Both partners working at home	2,844				0.00	0.45	0.50
Woman working outside	2,844				0.00	0.11	0.31
Partner working outside	2,844				0.00	0.34	0.47
Both partners working outside	2,844				0.00	0.10	0.30
Hours of housework [(b)]							
Domestic chores, couples without children	646	7.00	8.35	6.52	9.00	11.27	8.14
Domestic chores, couples with children	503	8.00	9.61	7.01	10.00	12.53	9.70
Childcare, couples with children	1,615	2.00	2.60	3.28	10.00	9.99	7.81

Notes: All statistics are computed using sampling weights.
[(a)] Panel covariates are the variables related to the labor market participation of the woman and her partner before and during the lockdown, equal to one if the woman (resp. her partner) was working during the considered period.
[(b)] The number of missing values is due to the possibility for respondents to skip the questions on the number of hours spent by type of tasks.
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

Figure A1 – **Density (histogram) of the overall woman's share of housework before the lockdown**



Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

APPENDIX 2

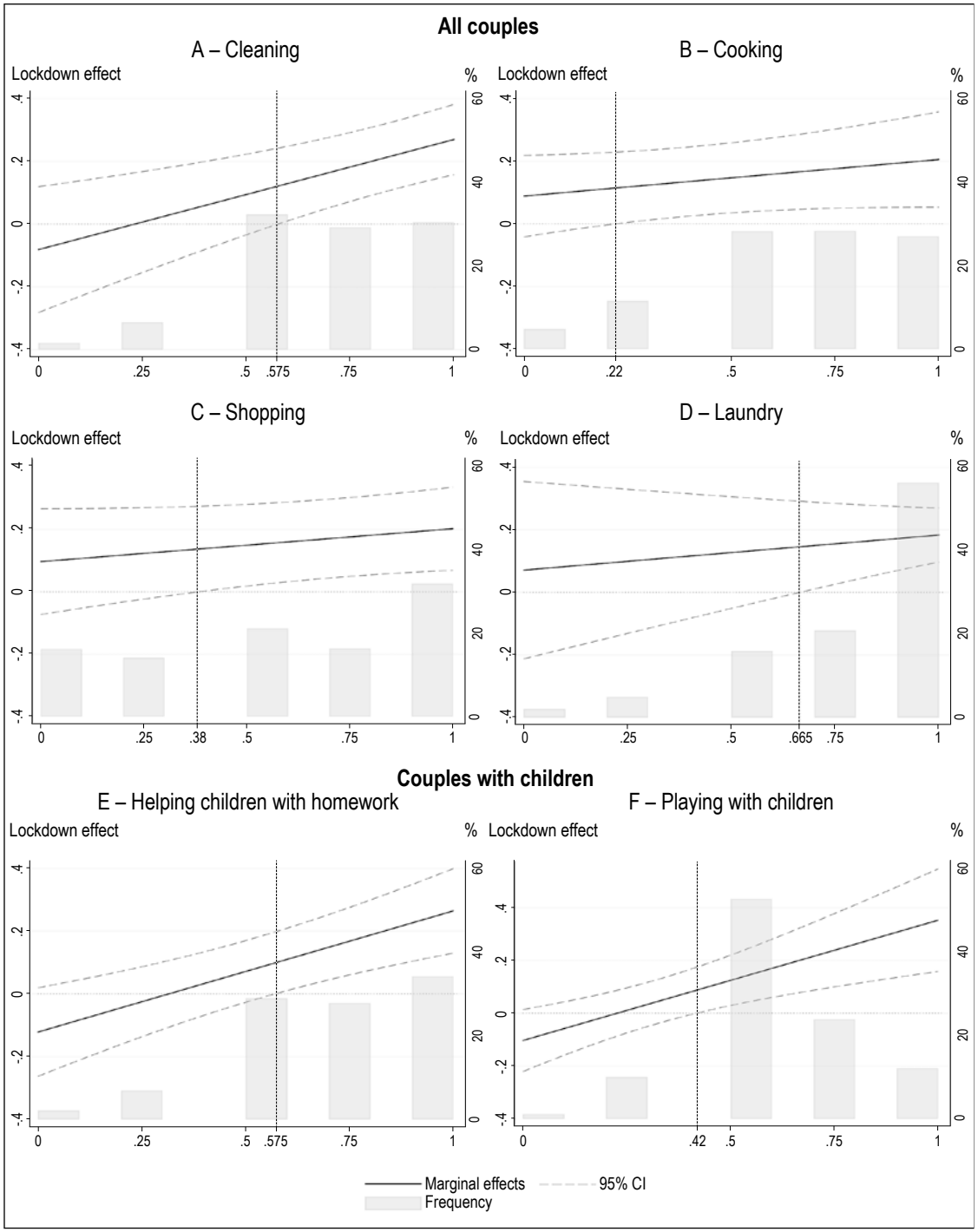
HOUSEWORK AND CONFLICTS

Table A2 – **Detailed estimation results**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lockdown	0.160**	0.0970	0.0711	0.0886	−0.0815	−0.122	−0.104
	(0.0597)	(0.0866)	(0.145)	(0.0663)	(0.102)	(0.0720)	(0.0599)
Shopping	−0.0345						
	(0.142)						
Shopping x Lockdown	0.106						
	(0.0799)						
Laundry			0.0262				
			(0.171)				
Lauudry x Lockdown			0.112				
			(0.112)				
Cooking				0.169			
				(0.119)			
Cooking x Lockdown				0.117			
				(0.0884)			
Cleaning					−0.0211		
					(0.122)		
Cleaning x Lockdown					0.351***		
					(0.101)		
Homework with children						−0.289*	
						(0.152)	
Homework with children x Lockdown						0.386***	
						(0.0988)	
Playing with children							−0.119
							(0.187)
Playing with children x Lockdown							0.456***
							(0.132)
Woman working outside x Lockdown	0.0389	0.0340	0.0500	0.0619	0.0727	0.0649	0.0598
	(0.0571)	(0.0615)	(0.0580)	(0.0610)	(0.0481)	(0.0438)	(0.0479)
Partner working outside x Lockdown	−0.0245	−0.0307	−0.0357	−0.0471	−0.0585	−0.0501	−0.0542
	(0.0928)	(0.0878)	(0.0923)	(0.0957)	(0.0934)	(0.0963)	(0.0933)
Both working outside x Lockdown	−0.102	−0.108	−0.107	−0.102	−0.117	−0.112	−0.110
	(0.0800)	(0.0812)	(0.0803)	(0.0802)	(0.0821)	(0.0764)	(0.0774)
R^2	0.511	0.512	0.512	0.515	0.519	0.519	0.521
Observations	3,230	3,230	3,230	3,230	3,230	3,230	3,230
Labor Market Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All the specifications correspond to Eq. (2), and the estimations use sampling weights. Standard errors in parentheses are clustered at regional level. ***, ** and * indicate significance at the 1%, 5% and 10% thresholds, respectively. The situation of reference is “Both partners at home during the lockdown”.
Sources and coverage: EICM, authors’ online survey collected in France from April 21 to May 10, 2020; partnered women.

Figure A2 – **Effects of housework division by task during the lockdown on conflicts between partners – Couples with children, the two parents staying at home**



Notes: The marginal effects are directly linked to the coefficients presented in Table A2, for Status = 0 when both parents were at home. The vertical bars represent the share of respondents according to the woman's share of a task during the lockdown for each confinement status, and the vertical line corresponds to the threshold from which the woman's share of housework increased the occurrence of conflicts.
Sources and coverage: EICM, authors' online survey collected in France from April 21 to May 10, 2020; partnered women.

COMMENT

Did the COVID-19 Crisis Contribute to a Change in the Gender-Based Division of Work within Families?

Hélène Couprie*

Abstract – This commentary puts into perspective two of the articles in this issue, which analyse the impact of the COVID-19 crisis on the allocation of time within families in France: one written by Ariane Pailhé, Anne Solaz and Lionel Wilner, the other by Hugues Champeaux and Francesca Marchetta. Both reveal that family arrangements appeared generally flexible, since time use changed significantly in the context of the crisis, leading to men becoming much more involved in household chores and parenting in particular. However, far from being unprecedented, this flexibility is compatible with a traditional division of roles according to gender. The changes observed may result from a model of domestic production in which the man plays the role of a secondary worker who can be mobilised in the event of the unavailability of the primary worker, the woman. Decisions made by families in France are still anchored to gender norms; not only does this constitute a waste of resources, it also generates temporal inequalities that may manifest as intra-family conflicts.

JEL : J16, D13, I31
Keywords: Domestic production, parental time, intra-household decision-making

**Aix Marseille Univ, CNRS, LEST, Aix-en-Provence.* Correspondence : *helene.couprie@univ-amu.fr*

Translated from "La crise du Covid-19 a-t-elle contribué à modifier la division du travail selon le genre au sein des familles ?".
The views and opinions expressed by the authors are their own and do not necessarily reflect those of the institutions to which they belong or of INSEE itself.

Citation: Couprie, H. (2022). Did the COVID-19 Crisis Contribute to a Change in the Gender-Based Division of Work within Families? *Economie et Statistique / Economics and Statistics*, 536-37, 51–55. doi: 10.24187/ecostat.2022.536.2088

The COVID-19 pandemic emerged in our economic and social lives, bringing with it a range of unexpected upheavals. "Non-essential" economic activity was stopped or relegated to working from home where possible. Of all of the upheavals experienced at this time, one has attracted particular attention: the near-universal switch to remote working blurred the line between people's professional and private lives. The closure of schools and nurseries during the first lockdown increased the parental burden and would have encouraged men's involvement in the home, contributing to shatter the thin and artificial boundary between these two worlds.

This interweaving of the family and professional spheres is nothing new, nor is it unknown. Family life (children, partner) generates a set of constraints and opportunities that have their share of consequences on the professional lives of those involved. Such constraints most often affect women, whose role remains largely devoted to the family, in accordance to the norms governing gender-based distribution of roles in society. The difficult balance between family life and professional life is, in fact, widely used to explain gender inequality on the labour market.

The inverse relationship, from job characteristics to intra-family arrangements, requires a study into the private sphere, whose functioning is far less observed. Family arrangements informally determine the terms of those productions said domestic (housework and looking after children). Family is a key element in the production of living standards as well as in the reproduction and transmission of human capital. Unpaid domestic production, which is poorly observed, uses time as its primary resource, a common denominator that is visible and measurable, subject to compromises and conflict between family and professional lives which are deeply intertwined.

Many European countries take action to facilitate the coordination of these two areas. In this regard, France ranks among the most generous countries (Thévenon, 2008). It has high fertility rates coupled with a high level of women's participation in the labour market. However, Goodin *et al.* (2008) temper this finding of the effectiveness of the French welfare state: based on the concept of temporal autonomy, the authors find that gender inequality is particularly marked when it comes to discretionary time[1] (a difference of 5 hours on average in France in 1998 compared with just 1 hour in Germany).[2] Moreover, the socio-fiscal system does not seem to reduce the significant temporal inequalities within families in which both partners work. Regardless of the measure adopted, the unequal distribution of domestic work between men and women in France was, and still is, the norm. It creates huge inequality within couples in cases where both partners work (Ponthieux & Schreiber, 2006). Women still take on the bulk of the domestic work, even if they are more productive than their partner and invest more of their time in paid work (Sofer & Thibout, 2015). One thing is for sure: some of the public or private means of outsourcing domestic production, which reduced intra-family temporal inequalities between men and women, became unavailable as a result of the lockdown imposed during the COVID-19 crisis.

A Common Approach, but Different Methodologies

The articles by Ariane Pailhé, Anne Solaz and Lionel Wilner (referred to as PSW below) and by Hugues Champeaux and Francesca Marchetta (referred to as CM below) in this issue both analyse the impact of the COVID-19 crisis on time use within families. Indeed, the crisis constituted an exogenous contextual change of unprecedented magnitude. Observing the behaviours adopted by families in response to this crisis provides valuable insights into intra-family arrangements and their possible disruptions. Such studies are of interest for a number of reasons. First, they provide valuable recent descriptive data on the distribution of time within families in France. They contribute to the literature measuring the economic and social impacts of the COVID-19 crisis. Finally, they provide basic insights into the way in which families function.

In particular, the exogeneity and the magnitude of the shock that affected the majority of households makes it possible to observe the impact of context variables the variation of which can usually only be observed by comparing different households. However, the measure of the inherent impact that variations in context between households have on behaviour is usually blurred by the fact that the context is in part chosen by the households themselves

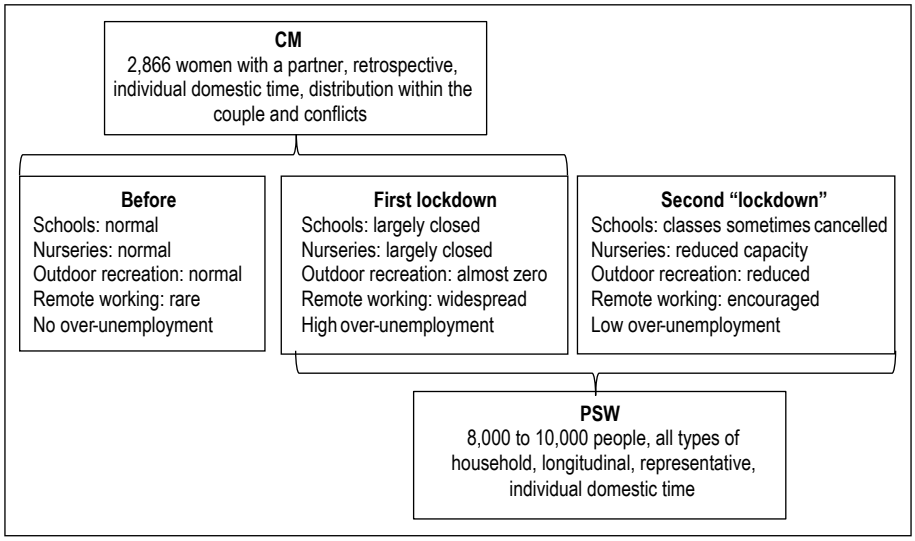
1. Discretionary time is time that can be spent as chosen. It is defined as the total amount of time available during a week (168 hours) minus the time needed to meet economic needs (number of working hours required in order to reach the poverty line), social needs (half of the median time spent on housework, cooking, shopping and looking after children) and biological needs (4/5ths of the median time spent on personal care and sleep).
2. See Goodin et al. *(2008), Figure 3.1.*

(through intra-household negotiation interactions or couple formation). Consider, for example, the impact of remote working. It is possible to compare the distribution of domestic time between households working on site and households in which one member is working from home. However, such a measure would not allow identifying the impact of remote working, since work from home can be chosen based on objectives related to time use (e.g. working from home on a Wednesday to take care of children). This issue of endogeneity does not arise here and is one of the key elements of value added of the two articles.

However, the methodology applied differs between the two articles. PSW rely on a set of cross-tabulations based on the longitudinal EpiCov survey, which is representative of the French population and was conducted during the two lockdowns in 2020. CM use multivariate regressions, isolating the specific impact of the context from the results of a one-off survey, based on a non-representative sample of women with partners. The information on the pre-lockdown situation is based on retrospective question. PSW compare the two lockdowns interpreting the second lockdown as a return to normal. In both cases, the information about time use was collected in a minimalist manner, *via* a question requiring an individual evaluation. PSW do not have any information regarding the partner, whereas CM have unilateral information about the intra-family sharing of tasks. This second article is better equipped to identify the lockdown impact on intra-family arrangements, while the first article is more robust, and provides an overview of the heterogeneity of the impacts for different types of family.

The main context impacts considered in the two articles are outlined in the Diagram below.

Diagram – **Comparison of the context impacts measured by the two articles**



This diagram shows that, unlike during the first lockdown, the context effects of the second lockdown are relatively close to the pre-crisis situation; however, their magnitude differs within each sub-dimension.

What about the multi-dimensional nature of the shock? Based on recent theories on intra-family decision making, the authors identify different transmission channels through which the shock of the first lockdown could have changed domestic time (household tasks and parenting) and its inter and intra-household distribution. The closure of schools, nurseries and restaurants would have contributed to an increase in family needs in terms of domestic production. At the same time, unemployment, a reduction in commuting time and reduced leisure opportunities outside the home created more available time for domestic production, with potential differences between the household members. The emergence of remote working is, for its part, likely to have brought about a change in domestic production technology, allowing for an intensification of time use, which also amounts to an increase in resources in terms of available time.[3] In short, the first COVID-19 lockdown gave rise to more family needs, but also more individual

3. The authors mention other channels, such as a change in the valuation of domestic time (shopping preferences, etc.).

temporal resources. Variations in needs depend on the structure of families, whereas variations in temporal resources depend on the employment situation of individuals. There is therefore a change in the distribution of temporal resources. Family and individual effects combine in the "black box of intra-household decision-making", leading to behavioural changes in the way in which time is used.

Impacts of Lockdown on the Use of Time by Men and Women: Major Impacts, but No Role Reversal

It is no surprise that, under the double impact of increased time resources and increased needs, the first lockdown generally brought about a significant increase in the amount of time devoted to domestic chores and parenting. For domestic chores, the median impact was around +15 to +30% per person. The amount of time devoted to parenting increased in even greater proportions, but with considerably different magnitudes between the two articles.

Time spent on housework and, particularly, on parenting by men appears highly elastic depending on the context variations (increased needs, employment conditions and working hours). The temporal resources gained as a result of partial unemployment, remote working and leave were used in unprecedented ways during the lockdown to increase the amount of time devoted to parenting by men. The amount of time spent on household chores and parenting by women, which was already very high, appeared to be less sensitive to the context impacts.

In spite of this, the distribution of domestic chores between men and women changed very little on the whole with the COVID-19 crisis. Women continued to take on the bulk of household chores and parenting duties (especially doing the laundry, teaching children, cleaning and cooking). The increased investment of men observed at the aggregate level comes mainly from an increased investment by men living in couples with children where the woman went out to work during lockdown. In this specific case, unprecedented falls are observed in the proportion of time spent by women on parenting, the distribution of which becomes more equal. For couples where both partners worked, the majority of whom working from home during the first lockdown, the slight reduction in the amount of time spent on domestic chores by women came exclusively from a change in the distribution of time spent on shopping (a type of time subject to changes in valuation).

Previous work based on INSEE's *Enquêtes Emploi du Temps* (Time Use Surveys) have demonstrated that the amount of time spent by men on household chores and parenting can be more flexible than that of women. This is a surprising finding given what we know about the lack of flexibility in the time men spend on paid work. Ponthieux & Schreiber (2006) observed that the time spent by men on domestic chores increases with the amount of domestic production (total housework time). It also increases when the woman is relatively more invested in paid work (higher wage or more working hours). Bloemen & Stancanelli (2014) estimate all direct and cross elasticities of wages for different joint time allocations within couples. They observe that the amount of time spent on parenting and domestic chores by men appears to react positively to women's wages;[4] this is not the case for time spent on domestic chores and parenting by women, which is very weakly influenced by men's wages. Conversely, women's allocation of time (paid work, domestic chores and parenting) is highly dependent on their own hourly wage, whereas men's use of time is only weakly determined by their own wage level. In other words, it is the situation of women on the labour market that determines the way in which domestic time is distributed within families, and this is indeed what is observed by CM. This situation is in line with the idea of a gender-based distribution of roles, assigning the main role in terms of contributing to domestic production to the woman. However, this traditional distribution of roles leaves room for exceptional and reversible adjustments, as shown by CM and PSW as well, in this case with an increase in the amount of time spent outside of paid work by men, which would be comparable in its functioning to the phenomenon of the additional worker, and would be activated in case of unavailability of the main worker.

This interpretation is in line with the conclusions drawn by Sofer & Thibout (2015). The absence of a role reversal when the woman is more heavily invested in the labour market than the man reflects the existence of deep-rooted gender norms in the division of chores within households, counteracting the logic of economic efficiency, which predicts that the members of the couple specialise according to their productivity and comparative advantages rather than their gender (see the literature from the seminal research by Becker, 1965). Where both partners

4. A 1% increase in a woman's hourly wage brings about a 0.5% increase in the amount of time spent on domestic chores and parenting by men.

work, as most often in France, the loss of financial and temporal resources resulting from inefficient choices within families is coupled with inequalities in time use which are harmful for the intra-family relationships.

* *
*

Intra-household conflict and violence can therefore arise during a crisis as the manifestation of inefficient and highly unequal intra-household arrangements. A temporary deviation from the social norm can also be a cause of tension and violence. It is extremely difficult and somewhat arbitrary to establish a causal link, but the correlations between lockdown, temporal inequalities and conflicts highlighted by CM undoubtedly point to possible avenues to improve the understanding of families function.

The economic and societal challenges of studying the family as a source of production for the current and future well-being of the population are crucial.

The conclusions of PSW and CM clearly converge. No, the COVID-19 crisis has not helped to change the gender based distribution of domestic chores and parenting within families. The intra-family adjustments observed constitute crisis adjustments. In this sense, families were able to make use of unusual resources, in this case men's time, to perform the share of the domestic chores that the women were unable to take on.

While it is gratifying to note that the alignment of the distribution of roles with societal gender norms did not prevent intra-family adjustments being made in times of crisis, those adjustments were largely inadequate. Intra-household violence has increased. Could some of these tensions have been avoided if such gender norms limiting behaviour societal did not exist?

Many of the explanations referred to in this commentary refer to studies based on old data (the last French TUS, the *Enquête Emploi du Temps*, dates from 2010). Regular time use surveys, supplemented by information that allows volumes and preferences for domestic and parental production to be assessed, are essential if we are to learn more about the family sphere functioning. This sphere, the functioning of which is still largely dependent on women, is a major source of gender inequality. Lacking visibility, its role as a shock absorber in times of crisis is worth highlighting and should be recognised. □

BIBLIOGRAPHY

Becker, G. S. (1965). A theory of the Allocation of Time. *The Economic Journal*, 75(299), 493–517. https://doi.org/10.2307/2228949

Bloemen, H. & Stancanelli, E. (2014). Market hours, household work, child care, and wage rates of partners: an empirical analysis. *Review of the Economics of the Household,* 2(1), 51–81.

Champeaux, H. & Marchetta, F. (2022). Couples in Lockdown: « La vie en rose »? *Economie et Statistique / Economics and Statistics,* 536-37*,* 27–50 (ce numéro).

Goodin, R. E., Rice, J. M., Parpo, A. & Eriksson, L. (2008). *Discretionary Time: A New Measure of Freedom*. Cambridge and New York edt.

Pailhé, A., Solaz, A. & Wilner, L. (2022). Housework and Parenting during the Lockdowns in France: How Have Socio-Economic and Gender Inequalities Changed? *Economie et Statistique / Economics and Statistics,* 3–25 (ce numéro).

Ponthieux, S. & Schreiber, A. (2006). Dans les couples de salariés, la répartition du travail domestique reste inégale. In: Insee Références, *Données sociales : La société française, édition 2006*, pp. 43–51. https://www.insee.fr/fr/statistiques/1371951?sommaire=1372045

Sofer, C. & Thibout, C. (2015). La division du travail selon le genre est-elle efficiente ? *Economie et Statistique*, 478-479-480, 273–304. https://www.insee.fr/fr/statistiques/1303236?sommaire=1303240

Thévenon, O. (2008). Politiques de conciliation du travail et de la vie familiale en Europe : Quelle(s) complémentarité(s) des aides publiques et des entreprises ? *Brussels Economic Review/Cahiers économiques de Bruxelles*, 51(2/3), 365–385.

Residential Migration and the COVID-19 Crisis: Towards an Urban Exodus in France?

Marie-Laure Breuillé *, Julie Le Gallo * and Alexandra Verlhiac **

Abstract – Much has been written about the potential effect of the COVID-19 crisis on residential mobility. To explore its effects in France, we reconstruct flows of mobility intentions based on owner and buyer estimates on the platform MeilleursAgents from January 2019 to September 2021, and we analyze, using logit and nested logit models, how the pandemic has changed the probability that individuals from both urban and rural intend to relocate. Our results show that, after a time of shock during the first lockdown in spring 2020, the desire to migrate, either to rural municipalities or to other catchment areas, increased as the pandemic and the restrictive measures continued, and was particularly pronounced after the end of the third and last lockdown.

JEL: C35, R23
Keywords: COVID-19, platform data, residential location choice, discrete choice models, real estate

** CESAER UMR1041, INRAE, Institut Agro, Université de Bourgogne Franche-Comté; ** Meilleurs Agents.* Correspondence*: marie.breuille@inrae.fr*

This work benefited from financial support from Plan Urbanisme Construction Architecture (PUCA). We thank two anonymous reviewers, and Hélène Bouscasse, Camille Grivault, Barbara Castillo Rico, Thomas Lefebvre, Hélène Milet, Eva Simon and Pierre Vidal for their valuable comments as well as participants of the Journées de Méthodologie Statistique 2022 (INSEE), Séminaire CREM 2022 and the 2022 AFSE Conference.

Received in December 2021, accepted in July 2022.

Citation: Breuillé, M.-L., Le Gallo, J. & Verlhiac, A. (2022). Residential Migration and the COVID-19 Crisis: Towards an Urban Exodus in France? *Economie et Statistique / Economics and Statistics*, 536-37, 57–73. doi: 10.24187/ecostat.2022.536.2084

In France, since the first lockdown put in place in March 2020 to contain the COVID-19 pandemic, urban exodus has become a highly popular topic in the press. Households are described as eager to move to bigger homes, with large green spaces, in less dense areas. According to a survey by MeilleursAgents (an online real estate platform) in 2021,[1] among people who have changed their primary residence since July 2020 or planned to do so before January 2022, one half changed their search criteria to have a garden (39% of them), to be closer to nature (34%) or to live in a smaller city (19%).

Yet, attraction to rural areas is not a new phenomenon. Over the previous three decades, a report from the Observatoire des Territoires (2018) concludes that France has experienced a decrease in population concentration, with big centres losing attractiveness while the surrounding areas attract new inhabitants. According to D'Alessandro *et al.* (2021), between 2007 and 2017, the average annual population growth was 0.66% in rural areas, but only around half of that (0.38%) in urban areas. The attraction for rural areas seems to be mostly restricted to rural suburban cities. In 2017, 26.9% of people moving from an urban to a rural area moved to a city in the catchment area of a city centre (D'Alessandro *et al.*, 2021).

In addition, though yearly residential mobility is higher in France than in Europe on average (11% of the French population moving each year *vs* 9% in Europe), the Observatoire des Territoires (2018) notes that French people move less and less far since 1990. Three-quarters of movers choose a location close to their current residence (in the same *département*). This report also shows that the mobility rate decreases with age and increases with education level, and that managers, professionals and associate professionals tend to move further, between Paris and other big cities, than clerical or service and sales workers. Housing market constraints prevent all social classes from moving in the same direction or to the same places, which may reinforce social segregation.

In 2019, a survey from Ifop[2] revealed that 57% of people living in urban areas wanted to leave. Three main obstacles prevented them from taking the leap, specifically, the lack of services (for 60%), the lack of transport infrastructures (for 53%), and difficulties in accessing employment (for 46%). The use of telework since COVID-19 crisis, firstly widespread and mandatory during the first lockdown and then more balanced and negotiated between workers and employers, could remove this third obstacle to urban exodus, at least partially.[3] Since March 2020, MeilleursAgents has noted a 13% increase in transaction volume in rural areas.[4] This trend also seems to be reflected in the evolution of residential property prices:[5] in 2020, Paris experienced a decline in prices, while rural areas experienced a greater increase in prices than the largest cities. The price increase mainly concerns rural suburban areas[6] (+9.7% in 2020) and rural areas with a large proportion of secondary homes.

However, can we speak of an urban exodus since the COVID-19 crisis? The impact of the COVID-19 crisis on the determinants of residential mobility is obviously an emerging subject in the literature. Based on the New York Fed Consumer Credit Panel/Equifax microdata, Li & Su (2021) observe that, since the COVID-19 pandemic, Americans both moved from immediate dense surroundings of city centers to suburbs that are more distant with lower density, and from high-density population metropolitan statistical areas (MSAs) to low density MSAs, thus partially counterbalancing the spatial sorting. They then use a spatial equilibrium model to analyze the welfare effects of these migration changes. Ramani & Bloom (2021) use both data from address changes from the US Postal Service to estimate migration patterns and real estate rents, and price indices from the website Zillow to proxy for real estate demand. They find that CBDs (Central Business Districts) and dense areas experienced a relative price decrease compared with less dense areas. They interpret this as a "donut effect" for prices, which seems to be limited to highly populated, dense cities. Additionally, they find that migrations are less frequent between than within metropolitan areas. Introducing both part-time and full-time work-from-home in their equilibrium model allow them to explain this by the fact that telework will only concern part of the working time, and thus, a significant

---

1. Toluna survey for MeilleursAgents, conducted from July 5 to 11, 2021 on 2,722 people representative of the French population, including 1,133 people who have moved or intend to move.

2. https://www.ifop.com/publication/le-retour-a-la-campagne/

3. In the Toluna survey, MeilleursAgents show that around 50% of workers consider pursuing work-from-home after the pandemic. However, 60% of them would like to work remotely only two days or less per week and only 19% would like to work remotely full-time.

4. 2021 MeilleursAgents Press Conference: "Quelles sont les nouvelles tendances pour le marché immobilier ?"
https://backyard-static.meilleursagents.com/press/6b615242cec200af47aec27515746e25a8174bf6.pdf

5. MeilleursAgents Real Estate Price Index of September 1, 2021.

6. Rural suburban areas are rural cities that are part of catchment areas of cities with more than 50,000 inhabitants.

distance to employment location remains. In other words, households are prepared to move away but not too far. Also relying on Zillow data, in addition to productivity, amenity and industry indices, Brueckner *et al.* (2021) find no support for their model's prediction of falling prices and rents in low-amenity cities with high work-from-home potential. They also show that telework imposes capital losses on real estate owners in high-productivity cities and capital gains to renters. Furthermore, as remote work reduces commuting costs, they find that it increases disutility for places with high crime rates and high taxes. This phenomenon makes the suburbs more attractive.

In the case of France, the detailed and representative data that would allow analyzing whether the determinants of residential mobility have changed since the COVID-19 crisis are not yet available.[7] To provide some early answers to this question and contribute to the literature, we turn to an analysis of the change in households' intentions to move since the start of the COVID-19 crisis, based on users' searches on the real estate platform MeilleursAgents. The originality of our paper is to exploit, over a period of almost three years (from 2019 to 2021), the processing traces left by users on the platform. We reconstruct 100,193 rows of residential mobility intentions from users who log on to the platform first to estimate a property with an owner status, then to estimate another property with a buyer status, tracking them with their user ID. The data from these searches provide, almost in real time, the price estimate, the location and characteristics of the current and targeted properties.

Based on these data, we first estimate, using binary logit models separately for urban and rural residents, the probability of intentions to stay in the same catchment area[8] or to move to another one and the probability of choosing an urban destination. We then estimate nested logit models, again separately for urban and rural residents, to analyze users' intentions in a sequence where they choose first whether they intend to stay in the same catchment area or to move to another one and, in each options, if they target an urban or a rural city. We capture the effect of the COVID-19 through the timing of the search.

Our results show that the pandemic has influenced residential mobility intentions, both through the choice of the catchment area and the location on the urban-rural gradient. The COVID-19 effect varies over the course of the pandemic (and the lockdowns), the appeal for other catchment areas and rural cities being the strongest after the end of the last lockdown in early May 2021. Moreover, comparing the probability of intentions to move before or since the COVID crisis, the odds (i.e. the ratio of these probabilities) that an urban resident searches for a property in an urban rather than a rural city is 0.923 times lower, and even decreases to 0.644 for a resident from a city centre (*pôle urbain*) also searching for a residence in the city centre, whereas the crisis seems to have had no impact on the choice of rural residents.

The rest of the article is organized as follows. We present the data in Section 1 and the methodology in Section 2. In Section 3, we analyze the results from the discrete choice models. Finally, we conclude and highlight the challenges for further research.

1. Data, Sample and Descriptive Statistics

1.1. Platform Data Description

MeilleursAgents (hereafter MA) is the main real estate platform providing online property estimates in France. It attracts 2.4 million unique visitors per month, with 500,000 online estimates per month made by the users.[9] The use of such high frequency data in the academic literature is very recent and promising, since it makes it possible to explore users' behaviour by following each step of their home-buying project. MA traffic data has already been used by Vidal (2021) to analyze matching and pricing mechanisms on the real estate market. Van Dijk & Francke (2018), Rae & Sener (2016) and Piazzesi *et al.* (2020) also exploit platform traffic data to calculate market tightness indicators and to analyze market segmentation.

We can track users who log onto the MA platform with their user ID, which is required to obtain estimates (but not for consulting ads for instance). The estimation tool is based on a form in which users provide information on their status (owner, owner-seller or buyer), the characteristics of the dwelling estimated and its location. The tool returns a price range for the dwelling. For users who seek an estimate as buyers, the tool is used at an advanced stage of

7. The new data from the population census and from the Housing survey, required to compare residential mobility since the COVID-19 crisis to the pre-COVID situation, will only become available in the years to come.
*8. This zoning, which is consistent with the zonings used by Eurostat and the OECD, has been used as the zoning of reference since 2020 in France. It divides the territory in more than twice the number of "*zones d'emploi*" (employment areas), enabling a more detailed analysis; it also contains a category "*hors attraction des villes*" (i.e. excluding cities' attraction), which is of particular interest for our study.*
9. Figures for November 2021.

their project. Indeed, because users need specific information, they generally use it to estimate the price of a dwelling that they have visited or they are going to visit: they want to have an idea of the price to make an offer close to market price. Consequently, we use these estimations, that reveal a strong intention to buy (but not that the purchase was actually made), as an early information of a buying process.

In order to reconstruct an intended mobility path, we select in our database the users who make an estimate both as owner and as buyer. We thus have information on the initial location (from the owner estimate) and on the desired location (from the buyer estimate). Moreover, we have information on the characteristics of the current residence and of the searched one (detailed in Appendix).

The sample consists exclusively of homeowners. Beyond credit access conditions, income or anticipation of price changes, the choice of occupancy status is influenced by position in the life cycle (see Artle & Varaiya, 1978 for the first theoretical model that introduced life cycle in the determinants of home-ownership). The rate of home-ownership sharply increases with the stabilization of professional situations at the start of a professional career. The birth of children often leads homeowner couples to opt for a house with more space around, with a stable peak zone reached around at 60 years of age. The rate of home-ownership also varies over the territory, with larger shares of owners in the crowns of local hubs, periurban spaces and less densely populated hinterland than city centres (INSEE, 2017).

We cannot rule out potential selection bias linked to the use of remote matching tools, either in terms of users' education or distance between the current and the desired location.[10] Unfortunately, we have no information on the characteristics of the users (e.g. age or income) or their household (e.g. number of children living at home) though the literature has stressed their role in explaining residential mobility choices. However, the size of the dwelling and the number of rooms, likely to be correlated with family size, can capture part of this effect. Another data limitation is that the MA website is not used uniformly throughout France, the activity being mainly driven by Paris and other big cities areas. We also need to keep in mind that the increase in website traffic is simultaneous to our period of study.

1.2. Platform Data Processing

We process the data from our database in several ways. Firstly, we remove the outliers, i.e. estimates for dwellings with a very small (less than 9 square meters) or a very large (more than 250 square meters) surface. In addition, we ensure consistency between the surface and the number of rooms. We also remove estimates that return a very low or a very high price, i.e., for which the price is lower than half the first percentile and more than twice the 99th percentile of prices estimated. Finally, to avoid having estimates made by robots in our data set, we remove the percentile of users who made the highest number of estimates in the period.

Secondly, we account for multiple estimates by the same user. Regarding buyer estimates, if a user made several estimates of the same dwelling, we keep only the most recent one. Regarding owner estimates, if a user made several estimates for the same address in the same city (or for another address but in an identical area or with an identical number of rooms), we keep the oldest one because it represents the first intention to move. In the event of several searches in the same month by the same user, we keep only the last estimate because we infer that the user's visits for the previous properties were unsuccessful. Thirdly, among all possible types of property that are estimated (principal residence, secondary residence, dwelling owned for investment purposes), we only keep the estimates done for principal residences.[11]

Once this data processing is complete, we keep all owner estimates (i.e. those who have an intention to move and those who do not) and we merge them by user ID with buyer estimates. As a result, we have information concerning the owner estimate (location and characteristics of the principal residence) and the buyer estimate (location and characteristics of the principal residence, as well as those of the desired property).[12] In the database, each row then links an estimate made as an owner and an estimate made as a buyer by the same user.

---

10. The average distance calculated from the INSEE Fichiers détails "Migrations résidentielles des individus" *between previous and new housing is close to 80 km. At the same time, according to a CSA Research study for Codis France published in 2019, the average distance between previous and new housing (for both renters and home-owners) is 118 km, regardless of the channel through which they moved (platform, local real estate agency, etc.). In our dataset of home-owners, the average distance is in between, with 103 km.*

11. As it does not provide any information on the intention to move, we also removed links when owner and buyer estimates are done for the same dwelling, which could result from tests carried out by the same user. However, we have kept such users in the database in case they carry out estimates for other properties.

12. We postulate that the typical user first estimates the value of the property they own to have an approximate idea of their maximum budget before starting their search for a new home, and then make estimates for the dwellings they visit to ensure that they are not overpriced. We cannot, however, completely exclude the case of a user making first an estimate as a buyer and then as an owner.

At last, in order to avoid searches for investment purposes, we removed the observations for which the size of the current dwelling was too different from that of the desired dwelling. We also removed extreme outliers, i.e. the first percentile (surface difference lower than −157 square meters) and the last percentile (surface difference above 132 square meters).

Our final database contains owner estimates from February 22, 2012, to September 20, 2021, matched to buyer estimates from January 1, 2019, to September 20, 2021, covering periods of relatively similar length before and after the beginning of the COVID-19 crisis.

1.3. Characteristics of the Location

With regards to the location, a key factor to address our question is whether the dwelling is located in a rural or an urban area. For that purpose, we use the rural zoning from the Observatoire des Territoires,[13] which splits French cities between 4,193 urban cities and 30,772 rural cities based on the INSEE communal density grid. Figures S1-1 and S1-2 in the Online Appendix (link at the end of the article) map the territorial coverage of our owners and buyers estimates.

We also use the INSEE zoning of catchment areas[14] to characterize more precisely the intended mobility, accounting for the area of influence of major French cities. A catchment area is a set of municipalities, in a single block and without enclaves, which defines the extent of the influence of a population and employment pole on surrounding municipalities, this influence being measured by the intensity of commuting. A catchment area is composed of a "*pôle*" (cluster) and a "*couronne*" (periphery). The "*pôle*" is determined with respect to thresholds of population density and employment level. Among the cities that belong to the *pôle*, the city with the highest population is the "*commune centre*". Other municipalities where at least 15% of the workforce is employed in the "*pôle*" constitute the "*couronne*" of the area. Figure S2-1 in the Online Appendix maps this split in 699 catchment areas ("*aires d'attraction des villes*" as defined by INSEE and based on the intensity of commuting to the employment cluster). Additionally, catchment areas are ranked according to their population size (see Online Appendix, Figure S2-2).

Furthermore, we characterize municipalities using a large range of socioeconomic data from INSEE, specifically the median population income, services and equipment levels (cf. Hilal *et al.*, 2020), age distribution of the population and structure of the housing stock.[15] The list of all variables is provided in Appendix.

1.4. Descriptive Statistics

Our dataset contains 100,193 observations of intentions to move (i.e. estimations of a property to buy) from 01/01/2019 to 20/09/2021. These observations are split between 83,991 observations of users who originally live in an urban city and 16,202 observations of users who originally live in a rural city. The dataset contains 80,662 different users including 66,507 users with a unique link and 14,155 users with several links. Table 1 shows that 40.5% of our sample concern dwelling searches between January 2019 and the announcement of the first lockdown (12 March 2020) and 59.5% after. We decompose the time after the beginning of the crisis into six periods that are described in Appendix 1. Our sample splits into 2.6%, 4.5% and 4.4% respectively for each of the three lockdowns, 18.4% in the intermediate period between the first two lockdowns, 13.6% in the intermediate period between the last two lockdowns, and 16% afterwards. Interestingly, after dividing the number of estimates with respect to

13. *https://www.observatoire-des-territoires.gouv.fr/typologie-urbain-rural*
14. Aire d'attraction des villes *in French.*
15. *See Delance & Vignolles (2017), for an analysis of the key factors influencing residential mobility.*

Table 1 – **Evolution of buyers estimates with respect to the timing of the crisis**

	Number of days	Number of buyers estimates	% of buyers estimates	Average number of estimates per day
Before	436	40,557	40.5	93.0
Lockdown 1	60	2,572	2.6	42.9
Intermediate 1	170	18,468	18.4	108.6
Lockdown 2	49	4,519	4.5	92.2
Intermediate 2	105	13,641	13.6	123.7
Lockdown 3	33	4,400	4.4	133.3
After	141	16,036	16.0	113.7
Sum	994	100,193	100	

Source: Authors based on data from MeilleursAgents.

the number of days in the period considered, the first lockdown appears as a time of shock leading to a decrease by more than half of the number of buyer estimates on the platform. This number then sharply increased just after the first lockdown to such an extent that it exceeded the level before COVID-19, with an average of 108.6 estimates per day against 93. After a decrease during the second lockdown, this number continued to grow until the end of the last lockdown, reflecting an increasingly marked desire to migrate as the pandemic (and the restrictive measures) continue.

Regarding the place of origin of people with an intention to move, there is almost no difference before and after COVID-19. By contrast, we observe an effect on the choice of destination. Searches in rural areas represented 16.7% before the COVID-19 crisis and have increased to 20.4% since the beginning of the pandemic. Looking at the sub-periods within the crisis (Table 2), we observe that the rate of searches in rural areas is the highest during the first lockdown, with 22.6% of searches. It then slightly dropped between the end of the first lockdown and the end of second lockdown, yet remaining above the pre-COVID level. Since then, the attraction for rural areas has been persistent, showing moderate growth. The demand for houses follows a similar trend with respect to the timing of the crisis, showing an increasing desire to live in a house (see Table 3).

Table 2 – **Evolution of buyers estimates in rural versus urban areas with respect to the timing of the crisis**

	Start date	End date	Rural (%)	Urban (%)
Before	01/01/2019	11/03/2020	16.7	83.3
Lockdown 1	12/03/2020	10/05/2020	22.6	77.4
Intermediate 1	11/05/2020	27/10/2020	19.8	80.2
Lockdown 2	28/10/2020	15/12/2020	18.6	81.4
Intermediate 2	16/12/2020	30/03/2021	20.0	80.0
Lockdown 3	31/03/2021	02/05/2021	20.5	79.5
After	03/05/2021	20/09/2021	21.5	78.5

Source: Authors based on data from MeilleursAgents.

Table 3 – **Evolution of buyers estimates for flats versus houses with respect to the timing of the crisis (%)**

	Flats	Houses
Before	52.7	47.3
Lockdown 1	45.8	54.2
Intermediate 1	47.0	53.0
Lockdown 2	50.3	49.7
Intermediate 2	48.6	51.4
Lockdown 3	46.7	53.3
After	47.2	52.8

Source: Authors based on data from MeilleursAgents.

The analysis of migration intentions (Table 4) shows that urban-urban intentions to move were largely predominant before the crisis with three-quarters of intentions, followed by urban-rural (9.2%), rural-urban (8%) and rural-rural (7.5%) migration. During the first lockdown, intentions of urban-urban migration decreased to two-thirds, essentially due to the simultaneous rise of rural-rural and urban-rural migration intentions. The largest increase over the period concerns urban to rural migration intentions, from 9.2% to 12.2%.

Table 4 – **Analysis of migration intentions (%)**

	Rural to rural	Urban to urban	Rural to urban	Urban to rural
Before	7.5	75.3	8.0	9.2
Lockdown 1	10.4	67.3	10.1	12.2
Intermediate 1	8.3	72.7	7.5	11.5
Lockdown 2	8.1	73.6	7.8	10.5
Intermediate 2	8.5	71.8	8.1	11.6
Lockdown 3	9.2	71.4	8.1	11.3
After	8.7	70.1	8.3	12.9

Source: Authors based on data from MeilleursAgents.

Lastly, we combine the categorization of catchment areas with the intention to move to a rural *vs* an urban zone. Before the COVID-19 crisis, 61% of users had the intention to move to an urban city in the same catchment area, whereas this decreases to 55.5% from the beginning of the crisis, as shown by Table 5.

Table 5 – **Evolution of the intention to move to another catchment area combined with the destination choice "rural *versus* urban"**

	Different area		Same area	
	Rural	Urban	Rural	Urban
Search before COVID	9.1	22.3	7.6	61.0
Search after COVID	11.8	24.1	8.6	55.5

Source: Authors based on data from MeilleursAgents.

2. Empirical Strategy

To estimate the effect of the COVID-19 crisis on the residential migration intentions, we estimate logit models. Discrete choice models are used in most empirical studies to describe and understand household location choices. In addition to national factors (mortgage, inflation rates, demographic changes and economic context), the literature distinguishes among three categories of determinants. The first concerns the trade-off between prices (and thus dwelling size) and accessibility to employment (Waddell, 1993; Srour *et al.*, 2002; Rivera & Tiglao, 2005; Cornelis *et al.*, 2012). Additionally, the sensitivity to the distance to place of work may vary if remote working is available (Ettema, 2010, in the Netherlands). The second set of determinants groups spatial and social amenities, e.g. school quality (Pinjari *et al.*, 2009; Kim *et al.*, 2005; Bayoh *et al.*, 2006), service density (Zondag & Pieters, 2005), security (Filion *et al.*, 1999), presence of green spaces (Gueymard, 2006) or quality of the neighborhood (De Palma *et al.*, 2005, 2007; Goffette-Nagot & Schaeffer, 2013). The last set of determinants includes household characteristics, i.e., income and household size (Waddel, 1996) and life cycle (Walker & Li, 2007; Habib & Miller, 2007). Regarding all these determinants, Schirmer *et al.* (2014) notice that household preferences should be compared with the same level of choice. Indeed, in their literature review, Schirmer *et al.* (2014) point out that early studies used discrete choice models at an aggregated level (choice of zone) but that building- or unit-level data should be preferred (Habib & Miller, 2009; Lee *et al.*, 2010).

We estimate two binary logit models and then a nested logit model, both estimated on two distinct sub-samples, one of urban residents and the other of rural residents. The dependent variable is the location of the target property, and the effect of the COVID-19 crisis is captured *via* the date of the search. We use alternatively only a binary variable equal to 1 if the search occurred after March 12, 2020 (i.e. the announcement of the first lockdown) and 6 binary variables corresponding to the sub-periods defined by the lockdowns (see Appendix 1), the pre-COVID period going from January 2019 to the start of the first lockdown. All the specifications include a wide range of structural and socioeconomic variables describing the origin and the destination. The selection of control variables is done by elastic net (Zou & Hastie, 2005).

The choice of location is made among a set of mutually exclusive alternatives and decision makers choose the alternative that provides them the highest level of utility. Independent variables describe each alternative in terms of location characteristics (socioeconomic environment) and dwelling characteristics (area, number of rooms, etc.). As we cannot observe all the characteristics of the alternatives, an error term is introduced in the model (Train, 2003). The nested logit model has the advantage of overcoming the Independence of Irrelevant Alternatives (IIA) problem, which arises when, among a set of alternatives, odds of choosing A over B does not depend on whether some other alternative C is present or absent. Contrary to a multinomial logit model, the nested logit model groups together alternatives suspected of sharing unobserved effects into nests, which sets up the disturbance term correlation that violates the assumption. In other words, alternatives are gathered by groups in which the IIA assumption holds, but it does not hold across groups. These nested logit models can be estimated only if there is a limited number of alternatives. Moreover, a reference alternative needs to be set and all interpretations are relative to this alternative.

2.1. The Binary Logit Model

Consider N individuals indexed by i that are confronted with two mutually exclusive alternatives. Let y_i denote the response variable of individual i, with for instance:

$$y_i = \begin{cases} 0 & \text{if individual } i \text{ has the intention to move to a rural area} \\ 1 & \text{if individual } i \text{ has the intention to move to an urban area} \end{cases}$$

The discrete choice model is:

$$y_i = x_i'\beta + \mu_i \quad (1)$$

with x_i the vector of explanatory variables, β the vector of parameters and μ_i the error term.

The conditional probability that the dependent variable y_i takes the value 1 is modeled as:

$$p_i = P(y_i = 1|x_i) = F(x_i'\beta) \quad (2)$$

After the logistic transformation of the function F that maps $x_i'\beta$ into the interval [0,1], we get the response probabilities:

$$P\left(y_i = 1|x_i\right) = \frac{e^{x_i'\beta}}{1+e^{x_i'\beta}} = \frac{1}{1+e^{-x_i'\beta}} \quad (3)$$

We estimate this logit model with maximum likelihood.

Since the parameters β cannot directly be interpreted as marginal effects on the dependent variable y_i, we calculate the marginal effect of a change in x_{ik} for every explanatory variable x_k on the expected value of the response variable y_i:

$$\frac{\partial E(y_i|x_i)}{\partial x_{ik}} = \frac{\partial P\left(y_i = 1|x_i\right)}{\partial x_{ik}} = \frac{e^{x_i'\beta}}{\left(1+e^{x_i'\beta}\right)^2}\beta_k \quad (4)$$

2.2. The Nested Logit Model

We then estimate a nested logit model, which has the advantage of allowing for dependence across responses by grouping alternatives into groups called nests (Thurston *et al.*, 2009). It allows for some correlation in the error terms in the same nest, while still assuming that error terms of different nests are uncorrelated. In other words, the assumption of independence of irrelevant alternatives holds within each nest. The choice of the location is such that each individual first chooses among the two limbs that represent the choice of intending to stay in the same catchment area or to change to another one and, conditionally on it, the choice of a rural or an urban municipality is made (Figure I).

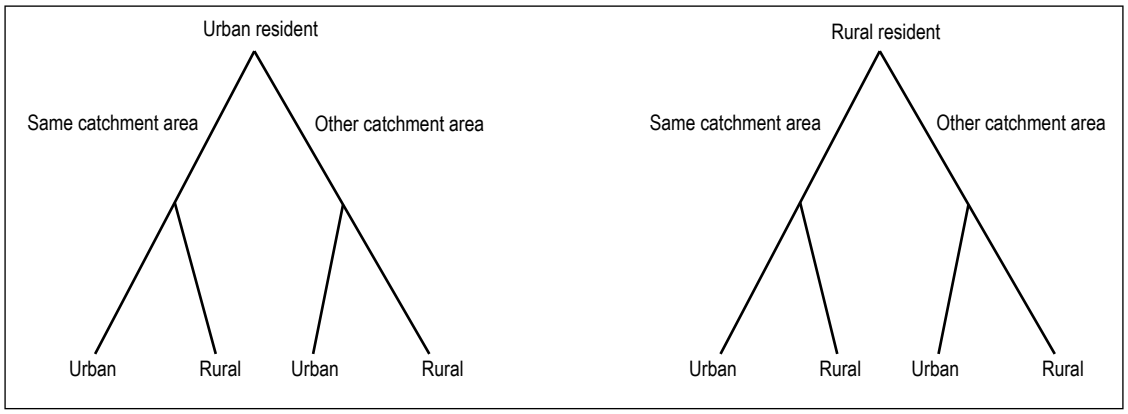
In a general framework (Cameron & Trivedi, 2005), with J limbs indexed by j and K_j branches indexed by k in each limb j, the joint probability p_{jk} of being on limb j and branch k amounts to the probability p_j of choosing limb j multiplied by the probability $p_{k|j}$ of choosing branch k conditional on being on limb j, i.e.: $p_{jk} = p_j * p_{k|j}$.

Using the generalized extreme value (GEV) distribution, we get:

$$p_{jk} = p_j * p_{k|j} = \frac{e^{z_j'\alpha+\rho_j\rho I_j}}{\sum_{m=1}^{J} e^{z_m'\alpha+\rho_m I_m}} * \frac{e^{x_k'\beta_j/\rho_j}}{\sum_{l=1}^{K_j} e^{x_l'\beta_j/\rho_j}} \quad (5)$$

where the vector of explanatory variables $\mathbf{z_j}$ varies only over limbs and the vector of explanatory variables $\mathbf{x_{jk}}$ varies over both limbs and branches. The respective vectors of parameters are α and β_j. Finally, ρ_j is a scale parameter equal to $\sqrt{1-Cor\left[\varepsilon_{jk},\varepsilon_{lk}\right]}$. In the case $\rho_j = 1$, which corresponds to independence of ε_{jk} and ε_{lk}, we obtain a multinomial logit model.

Figure I – **Decision tree**



3. Results

We first analyze the intention to move to another catchment area ("*Aire d'attraction des villes*"). Our dependent variable is a binary variable reflecting a change of "state" (i.e. from one catchment area to another one) so that the estimated coefficients capture the impact of the variables on the probability of this change of state. The control of numerous characteristics of the origin and destination cities enables a precise understanding of the structural and locational characteristics of housing that households look for in another catchment area. Most intentions to move, i.e. two-thirds, target the same catchment area, as shown by descriptive statistics over the whole period, which reflects a strong attachment to the territory of origin because of family, friends or work.

Table 6 reports the estimation results (odds ratios) for the main variables of interest of binary logit models where the dependent variable is equal to 1 when residents have the intention to stay in the same catchment area and 0 if they have the intention to move to another one.

Table 6 – **Probability of staying in the same catchment area. Binary logit model (Odds Ratios)**

	Urban origin			Rural origin		
	(1)	(2)	(3)	(4)	(5)	(6)
Search since March 12 2020	0.870*** (0.019)	0.815*** (0.033)		0.892*** (0.035)	1.296 (0.222)	
Search during 1st lockdown			0.924 (0.059)			0.917 (0.098)
Search between lockdowns 1 and 2			0.929*** (0.026)			0.905** (0.048)
Search during 2nd lockdown			0.886*** (0.045)			0.818** (0.085)
Search between lockdowns 2 and 3			0.883*** (0.029)			0.958 (0.053)
Search during 3rd lockdown			0.910*** (0.046)			0.876 (0.083)
Search after 3rd lockdown			0.776*** (0.027)			0.846*** (0.049)
Origin:						
commune du pôle	1.275*** (0.044)	1.221*** (0.053)	1.257*** (0.043)	1.129 (0.295)	2.763** (0.434)	1.134 (0.295)
commune du pôle secondaire	1.195** (0.086)	1.218 (0.136)	1.179* (0.085)			
couronne	1.522*** (0.047)	1.437*** (0.057)	1.508*** (0.046)	3.545*** (0.122)	4.433*** (0.178)	3.552*** (0.122)
hors attraction des pôles	0.343** (0.430)	0.200** (0.719)	0.347** (0.430)	1.646*** (0.127)	1.863*** (0.190)	1.649*** (0.127)
Destination:						
commune du pôle	2.525*** (0.043)	2.495*** (0.053)	2.513*** (0.043)	1.472*** (0.082)	1.445*** (0.113)	1.478*** (0.082)
commune du pôle secondaire	2.406*** (0.091)	2.416*** (0.142)	2.399*** (0.091)	2.316*** (0.190)	1.811** (0.287)	2.317*** (0.190)
couronne	2.295*** (0.044)	2.239*** (0.052)	2.287*** (0.043)	2.464*** (0.069)	2.480*** (0.087)	2.470*** (0.069)
hors attraction des pôles	0.022*** (0.338)	0.021*** (0.583)	0.022*** (0.338)	2.013*** (0.087)	2.237*** (0.122)	2.019*** (0.087)
Interaction Search since March 12 2020 × Origin						
commune du pôle		1.073 (0.046)			0.209*** (0.599)	
commune du pôle secondaire		0.970 (0.169)				
couronne		1.100* (0.053)			0.679* (0.219)	
hors attraction des pôles		2.416 (0.893)			0.798 (0.237)	
Interaction Search since March 12 2020 × Destination						
commune du pôle		1.022 (0.051)			1.027 (0.128)	
commune du pôle secondaire		0.995 (0.174)			1.522 (0.368)	
couronne		1.042 (0.047)			0.994 (0.086)	
hors attraction des pôles		1.120 (0.712)			0.853 (0.134)	
Controls[a]	Yes	Yes	Yes	Yes	Yes	Yes
Observations	83,991	83,991	83,991	16,202	16,202	16,202
Log Likelihood	−37.496	−37.492	−10.105	−10.091	−10.085	−10.088
AIC	75.113	75.121	20.332	20.256	20.258	20.260

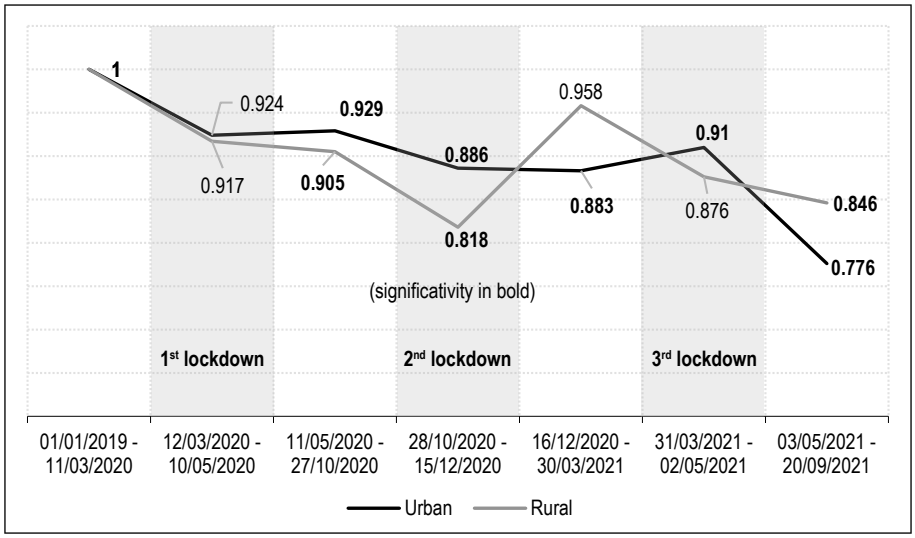
[a] The full results with all control variables selected by elastic net are available from the authors upon request.
Note: *p<0.1; **p<0.05; ***p<0.01.

The models are estimated for the sub-sample of urban residents (columns 1 to 3) and for the sample of rural residents (columns 4 to 6). For each sub-sample, we estimate the effect of the COVID-19 crisis first since March 2020 overall, then detailing the sub-periods defined by the lockdowns.

For urban residents, the results show that, since the beginning of the crisis, the odds of searching for a residence in the same catchment area rather than in another one is 0.87 times lower (column 1). The pandemic has thus led to a greater desire to move out of the initial catchment area. The category of the municipality of origin or destination has highly significant effects on the intention to stay in the same catchment area, with suburban residents (origin: "*couronne*") being the most attached to their catchment area, but almost no role on the intensity of the COVID-19 effect, as shown by the interaction terms (see column 2). The detailed timing of the crisis shows that the effect of the pandemic is strongly significant in all sub-periods (column 3), except during the first lockdown, which appears as a period of inaction, where people may either have had difficulties projecting into the future or been waiting for the end of the lockdown to start a real estate project, probably due to the possibility to visit properties again.

As shown in Figure II, the probability of intending to stay in the same catchment area decreases over time, the coefficient dropping from 0.929 between the first two lockdowns to 0.776 after the end of the third lockdown. The

Figure II – **Probability of staying in the same catchment area (Odds ratios)**



continuing crisis results in a reinforced desire for mobility for urban residents.

For the residents of rural municipalities (col. 4 to 6 of Table 6), the decrease in the probability to stay in the same area is less pronounced in the period since March 2020 overall. We estimate that since the beginning of the crisis, the odds for a rural resident to search for a dwelling in the same catchment area rather than in another one is 0.892 times lower. This effect is essentially driven by searches made after the end of the third lockdown, the only period for which the associated coefficient is significant at the 1% threshold.

We complete the analysis by estimating logit models where the binary dependent variable is the intention to move to an urban *vs* a rural city, still separately for the urban and rural sub-samples. Table 7 reports the results for the variables of interest related to COVID-19 and the category of the municipality of origin or destination (the detailed results are available from the authors).

For urban residents, the odds to search for a residence in an urban rather than a rural city is 0.923 times lower since the beginning of the pandemic (Table 7, col. 1); it drops to 0.644 for a resident from a *pôle* searching for a residence in the *pôle* also when interactions are introduced between the COVID-19 dummy variable and the category of the municipality of origin or destination (col. 2). This appeal for rural areas is more pronounced since the end of the second lockdown (col. 3), as reflected by the decrease in the odds ratios (Figure III).

By contrast, the crisis has no impact on the probability of choosing urban over rural

Figure III – **Probability of choosing urban over rural (Odds ratios)**

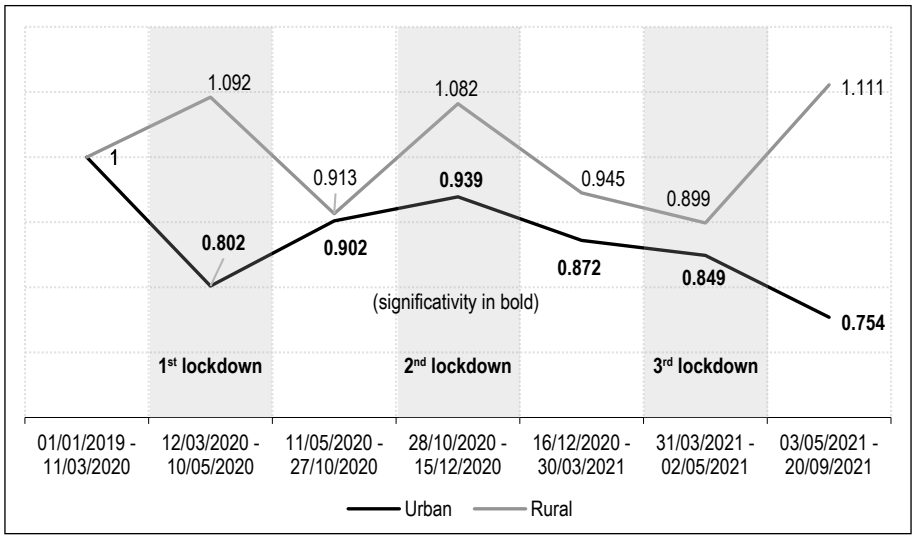


Table 7 – **Probability of choosing urban over rural. Binary logit (Odds Ratios)**

	Urban origin						Rural origin					
	(1)		(2)		(3)		(4)		(5)		(6)	
Search since March 12 2020	0.923*	(0.045)	0.644***	(0.167)			0.991	(0.071)	1.016	(0.412)		
Search during 1st lockdown					0.802**	(0.094)					1.092	(0.196)
Search between lockdowns 1 and 2					0.902**	(0.042)					0.913	(0.101)
Search during 2nd lockdown					0.939	(0.076)					1.082	(0.171)
Search between lockdowns 2 and 3					0.872***	(0.047)					0.945	(0.108)
Search during 3rd lockdown					0.849**	(0.074)					0.899	(0.160)
Search after 3rd lockdown					0.754***	(0.044)					1.111	(0.102)
Origin:												
commune du pôle	1.128	(0.077)	0.965	(0.107)	1.246***	(0.055)	0.186***	(0.560)	0.241*	(0.773)	0.187***	(0.560)
commune du pôle secondaire	1.425*	(0.186)	1.426	(0.301)	1.347**	(0.134)						
couronne	1.366***	(0.085)	1.331***	(0.109)	1.949***	(0.059)	0.962	(0.225)	1.361	(0.333)	0.962	(0.225)
hors attraction des pôles	3.056**	(0.565)	25.277***	(1.065)	3.187**	(0.579)	0.837	(0.244)	0.971	(0.368)	0.834	(0.245)
Destination:												
commune du pôle	10.069***	(0.181)	8.163***	(0.306)	3.822***	(0.148)	13.705***	(0.281)	7.431***	(0.417)	13.529***	(0.282)
couronne	0.378***	(0.100)	0.311***	(0.149)	0.023***	(0.063)	0.493***	(0.159)	0.348***	(0.220)	0.490***	(0.160)
hors attraction des pôles	0.033***	(0.203)	0.023***	(0.364)	0.0001***	(0.202)	0.047***	(0.380)	0.039***	(0.573)	0.047***	(0.381)
Interaction Search since March 12 2020 × Origin												
commune du pôle			1.282	(0.116)					0.819	(1.122)		
commune du pôle secondaire			1.011	(0.376)								
couronne			1.047	(0.110)					0.560	(0.411)		
hors attraction des pôles			0.044**	(1.265)					0.773	(0.458)		
Interaction Search since March 12 2020 × Destination												
commune du pôle			1.383	(0.368)					2.786*	(0.542)		
commune du pôle secondaire			0.962	(6.676)					0.0001	(0.243)		
couronne			1.339*	(0.165)					1.735**	(0.242)		
hors attraction des pôles			1.583	(0.431)					1.375	(0.745)		
Controls	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	83,991		83,991		83,991		16,202		16,202		16,202	
Log Likelihood	−6.956		−6.949		−13.902		−2.735		−2.730		−2.733	
AIC	13.994		13.996		27.873		5.546		5.551		5.552	

Note: *p<0.1; **p<0.05; ***p<0.01.

municipalities for rural residents (Table 7, col. 4 to 6). This strong result thus establishes that the COVID-19 crisis generated a change in preferences of location, but only for urban residents.

To complete the analysis, we have also estimated a multinomial logit model detailing the category of the city of destination (centre, periurban area – *couronne* – and rural zone – *hors attraction des pôles*) to explore whether it influences the intention to move (the results, not presented here, are available from the authors). The interaction of the category of city with the COVID-19 dummy appears significant only for the subsample of urban residents, for periurban areas (*couronne*) *vs* centre. This means that, since the COVID-19 crisis, urban residents living in city centres are more inclined to move than those living in periurban areas.

Finally, we analyze the estimation results of the nested logit model. The first level choice is between staying in the same catchment area or moving to another one. Conditionally to the choice of catchment area, the choice is then between moving to an urban or to a rural municipality. In other words, residents decide whether to stay close to their job and conditionally position themselves on the urban-rural gradient. The reference category is moving from the initial catchment area to a rural area. Table 8 reports the results for the variables of interest related to COVID-19 and the category of municipality of origin or destination (the detailed results with

Table 8 – **Probability of staying in the same catchment area and choosing urban over rural. Nested logit estimation results (Odds Ratios)**

	Urban origin		Rural origin	
	(1)	(2)	(3)	(4)
Search since March 12 2020				
× in urban city in another catchment area	0.979 (0.081)		0.937 (0.068)	
× in rural city in the same catchment area	0.887*** (0.056)		0.901** (0.048)	
× in urban city in the same catchment area	0.861* (0.079)		0.813*** (0.07)	
Search during 1st lockdown				
× in urban city in another catchment area		1.161 (0.277)		1.13 (0.177)
× in rural city in the same catchment area		1.035 (0.165)		1.042 (0.132)
× in urban city in the same catchment area		1.043 (0.267)		0.781 (0.194)
Search between lockdowns 1 and 2				
× in urban city in another catchment area		1.045 (0.127)		0.852 (0.096)
× in rural city in the same catchment area		0.885 (0.078)		0.882* (0.065)
× in urban city in the same catchment area		0.978 (0.123)		0.764*** (0.098)
Search during 2nd lockdown				
× in urban city in another catchment area		1.168 (0.223)		0.949 (0.16)
× in rural city in the same catchment area		0.816 (0.143)		0.766** (0.113)
× in urban city in the same catchment area		1.05 (0.215)		0.83 (0.163)
Search between lockdowns 2 and 3				
× in urban city in another catchment area		0.91 (0.141)		0.844 (0.104)
× in rural city in the same catchment area		0.896 (0.086)		0.91 (0.072)
× in urban city in the same catchment area		0.809 (0.136)		0.846 (0.108)
Search during 3rd lockdown				
× in urban city in another catchment area		0.936 (0.216)		0.967 (0.153)
× in rural city in the same catchment area		1.028 (0.132)		0.933 (0.11)
× in urban city in the same catchment area		0.838 (0.208)		0.806 (0.165)
Search after 3rd lockdown				
× in urban city in another catchment area		0.941 (0.129)		1.075 (0.096)
× in rural city in the same catchment area		0.837 (0.079)		0.919 (0.067)
× in urban city in the same catchment area		0.737* (0.125)		0.838* (0.101)
Controls	Yes	Yes	Yes	Yes
Observations	83,991	83,991	16,202	16,202
R^2	0.4	0.394	0.361	0.362
Log Likelihood	48.395	48.91	14.23	14.221
LR Test	64.631*** (df = 86)	63.600*** (df = 86)	16.093*** (df = 107)	16.112*** (df = 122)

Note: *p<0.1; **p<0.05; ***p<0.01.

all control variables selected by elastic net are available from the authors).

Since the beginning of the crisis, the odds that a resident from an urban area searches for a residence in the same catchment area rather than in a rural city in another catchment area is 0.887 times lower for a rural destination and even lower for an urban destination, with an odds ratio of 0.861 (Table 8, col. 1). In other words, since the beginning of the crisis, urban residents are less likely to intend to stay in the same catchment area, especially to buy in an urban area, rather than change catchment area to buy in a rural area. These changes are mainly driven by searches after the third lockdown (Table 8, col. 2). Indeed, the only significant and low coefficient appears for the joint choice of moving to an urban city in the same catchment area. The strongest effect after the third lockdown could be explained by the increased awareness that the sanitary crisis and the associated restrictions could settle durably. Another explanation could be that there was less compliance with the restrictions related to the second and third lockdowns than during the first lockdown, which may have questioned the authorities' ability to manage the health crisis and generated a feeling of anxiety about the future, and in turn, a greater desire for change.

The results are less significant for rural residents, although they still show a reduction in the probability of intentions to stay in the same catchment area since the COVID-19 crisis, even more pronounced after the end of the last lockdown.

* *
*

Using owner and buyer estimates from the MeilleursAgents platform, we were able to reconstruct migration intentions over the period from January 2019 to September 2021, and thus to analyze how the COVID-19 crisis has changed the location preferences in France. Descriptive statistics show that after a time of shock during the first lockdown, the number of buyer estimates exceeded the pre-COVID level and has continued to grow afterwards, which might reveal more intentions to move. The demand for houses and real estate located in secondary locations ("*pôles*", "*couronnes*") and outside of the attraction poles has increased relatively significantly since the beginning of the pandemic while it is the reverse for city centres that may appear less attractive. Our estimations of logit and nested logit models make it possible to isolate the post-COVID effect on both the intention to change one's catchment area and to move to rural areas. We indeed observe a clear trend towards an urban exodus, as the odds that an urban resident searches for a residence in an urban city rather than in a rural city is 0.644 times lower since the beginning of the pandemic for households coming from a pole and searching for a residence in a pole. Both urban and rural residents are also more inclined to leave their catchment area to relocate further away, which may have been facilitated by the development of telework. Finally, we show that since the beginning of the crisis, urban residents are more likely to seek housing in a rural city in a different catchment area.

While our data provide advanced information on migration intentions in real time, they provide no information about users and reflect an activity on the website mainly driven by the Paris area and areas of other big cities. Our sample is reasonably representative, but the analysis could also be extended to renters and first home buyers, who were not included in this analysis. Next steps would also consist in carrying out an inference causal analysis of COVID-19 and better characterizing migrations using a gravity model. Finally, we could use the catchment area zoning in greater detail in order to test whether the results from Ramani & Bloom (2021) hold in the case of France. □

Link to the Online Appendix:
www.insee.fr/en/statistiques/fichier/6667537/ES536-37_Breuille-et-al_Online-Appendix.pdf

BIBLIOGRAPHY

Artle, R. & Varaiya, P. (1978). Life Cycle Consumption and Homeownership. *Journal of Economic Theory*, 18(1), 38–58. https://doi.org/10.1016/0022-0531(78)90041-8

Bayoh, I., Irwin, E. G. & Haab, T. (2006). Determinants of Residential Location Choice: How Important Are Local Public Goods in Attracting Homeowners to Central City Locations? *Journal of Regional Science*, 46, 97–120. https://doi.org/10.1111/j.0022-4146.2006.00434.x

Brueckner, J., Kahn, M. E. & Lin, G. C. (2021). A New Spatial Hedonic Equilibrium in the Emerging Work-from-Home Economy? NBER *Working Paper* N° 28526. https://www.nber.org/papers/w28526

Cameron, A. C. & Trivedi, P. K. (2005). *Microeconometrics: Methods and Applications*. New York: Cambridge University Press.

Cornelis, E., Barthelemy, J., Pauly, X. & Walle, F. (2012). Modélisation de la mobilité résidentielle en vue d'une micro-simulation des évolutions de population. *Les Cahiers Scientifiques du Transport*, 62, 65–84.

D'Alessandro, C., Levy, D. & Regnier, T. (2021). Une nouvelle définition du rural pour mieux rendre compte des réalites des territoires et de leurs transformations. In: Insee, *La France et ses territoires, coll. Références - Édition 2021*, pp. 61–72. https://www.insee.fr/fr/statistiques/fichier/5039991/FET2021-D4.pdf

Delance, P. & Vignolles, B. (2017). Ca déménage ? la mobilité résidentielle et ses déterminants. In : Insee, *Les conditions de logement en France*, *coll. Références - Édition 2017,* pp. 55–76. https://www.insee.fr/fr/statistiques/2586010

De Palma, A., Motamedi, K., Picard, N. & Waddell, P. (2005). A model of local residential choice with endogeneous housing price and traffic for the Paris region. *European Transport*, 31, 67–82.

De Palma, A., Picard, N. & Waddell, P. (2007). Discrete choice models with capacity constraints: An empirical analysis of the housing market of the greater Paris region. *Journal of Urban Economics*, 62, 204–230. https://doi.org/10.1016/j.jue.2007.02.007

Ettema, D. (2010). The impact of telecommuting on residential relocation and residential preferences. *The Journal of Transport and Land Use*, 3, 7–24. https://www.jtlu.org/index.php/jtlu/article/view/61

Filion, P., Bunting, T. & Warriner, K. (1999). The Entrenchment of Urban Dispersion: Residential Preferences and Location Patterns in the Dispersed City. *Urban Studies*, 36(8), 1317–1347. https://doi.org/10.1080/0042098993015

Goffette-Nagot, F. & Schaeffer, Y. (2013). Accessibilité ou voisinage ? Une analyse des sources de la ségrégation résidentielle au sein des aires urbaines françaises. *Revue économique*, 64(5), 857–882. https://www.cairn.info/revue-economique-2013-5-page-857.htm

Gueymard, S. (2006). Facteurs environnementaux de proximité et choix résidentiels. Le rôle de l'ancrage communal, des représentations et des pratiques des espaces verts. *Développement durable et territoires*, Dossier 7. https://doi.org/10.4000/developpementdurable.2716

Habib, M. A. & Miller, E. J. (2007). Modeling Residential and Spatial Search Behaviour: Evidence from the Greater Toronto Area. *Paper presented at the Sixth Triennial Symposium on Transportation Analysis*, Phuket Island-Thailand.

Habib, M. A. & Miller, E. J. (2009). Reference-Dependent Residential Location Choice Model within a Relocation Context. *Transportation Research Record*, 2133(1), 92–99. https://doi.org/10.3141/2133-10

Hilal, M., Moret, D., Piguet, V., Bouscasse, H., Cavailhes, J., Diallo, A., Drut, M., Le Gallo, J. & Legras, S. (2020). Centralités : comment les identifier et quels rôles dans les dynamiques locales et intercommunales? for Agence nationale de la cohésion des territoires. https://hal.archives-ouvertes.fr/hal-03064655/

INSEE (2017). *Les conditions de logement en France, édition 2017.* Insee Références. https://www.insee.fr/fr/statistiques/2586377

Kim, J. H., Pagliara, F. & Preston, J. (2005). The Intention to Move and Residential Location Choice Behaviour. *Urban Studies*, 42(9), 1621–1636. https://doi.org/10.1080/00420980500185611

Lee, B. H. L., Waddell, P., Wang, L. & Pendyala, R. M. (2010). Reexamining the Influence of Work and Nonwork Accessibility on Residential Location Choices with a Microanalytic Framework. *Environment and Planning A: Economy and Space*, 42(4), 913–930. https://journals.sagepub.com/doi/abs/10.1068/a4291

Li, W. & Su, Y. (2021). The Great Reshuffle: Residential Sorting during the COVID-19 Pandemic and Its Welfare Implications. Available at SSRN 3997810. http://dx.doi.org/10.2139/ssrn.3997810

McFadden, D. (1978). Modelling the Choice of Residential Location. In: A. Karlqvist, L. Lundqvist, F. Snickars & J. Weibull (Eds.). *Spatial Interaction Theory and Planning Models*, pp. 75–96. North-Holland, Amsterdam.

Observatoire des Territoires (2018). Les mobilités résidentielles en France - Tendances et impacts territoriaux. Rapport.https://www.observatoire-des-territoires.gouv.fr/kiosque/rapport-2018-les-mobilites-residentielles-en-france-tendances-et-impacts-territoriaux

Piazzesi, M., Schneider, M. & Stroebel, J. (2020). Segmented Housing Search. *American Economic Review*, 110(3), 720–759. https://doi.org/10.1257/aer.20141772

Pinjari, A., Bhat, C. & Hensher, D. (2009). Residential Self-Selection Effects in an Activity Time-Use Behavior Model. *Transportation Research Part B: Methodological*, 43(7), 729–748. https://doi.org/10.1016/j.trb.2009.02.002

Rae, A. & Sener, E. (2016). How website users segment a city: The geography of housing search in London. *Cities*, 52, 140–147. https://doi.org/10.1016/j.cities.2015.12.002

Ramani, A. & Bloom, N. (2021). The Donut Effect of Covid-19 on Cities. NBER *Working Paper* N° 28876. https://www.nber.org/papers/w28876

Rivera, M. A. I & Tiglao, N. C. C. (2005). Modeling Residential Location Choice, Workplace Location Choice and Mode Choice of Two-Worker Households in Metro Manila. *Proceedings of Eastern Asia Society for Transportation Studies*, 5, 1167–1178.

Schirmer, P. M., van Eggermond, M. A. B. & Axhausen, K. W. (2014). The role of location in residential location choice models: A review of literature. *Journal of Transport and Land Use*, 7(2), 3–21. https://www.jtlu.org/index.php/jtlu/article/view/740

Srour, I. M., Kockelman, K. M. & Dunn, T. P. (2002). Accessibility Indices: Connection to Residential Land Prices and Location Choices. *Journal of the Transportation Research Board*, 1805(1), 25–34. https://doi.org/10.3141/1805-04

Thurston, S. W., Ruppert, D. & Davidson, P. W. (2009). Bayesian Models for Multiple Outcomes Nested in Domains. *Biometrics*, 65(4), 1078–1086. https://doi.org/10.1111/j.1541-0420.2009.01224.x

Train, K. E. (2003). *Discrete Choice Methods with Simulations*. New York: Cambridge University Press.

Van Dijk, D. & Francke, M. K. (2018). Internet Search Behavior, Liquidity and Prices in the Housing Market. *Real Estate Economics*, 46(2), 368–403. https://doi.org/10.1111/1540-6229.12187

Vidal, P. (2021). Mécanismes d'appariement et de formation des prix sur le marché immobilier. Trois études empiriques basées sur les données d'une plate-fome numérique. Université Cergy Paris. https://hal-cyu.archives-ouvertes.fr/THESES_CERGY/tel-03456764v1

Waddell, P. (1993). Exogenous Workplace Choice in Residential Location Models: Is the Assumption Valid? *Geographical Analysis*, 25(1), 65–82. https://doi.org/10.1111/j.1538-4632.1993.tb00280.x

Waddell, P. (1996). Accessibility and Residential Location: the Interaction of Workplace, Housing Tenure, Residential Mobiltity and Location Choice. *Paper presented at the Lincoln Land Institute TRED conference*, Cambridge.

Walker, J. L. & Li, J. (2007). Latent lifestyle preferences and household location decisions. *Journal of Geographical Systems*, 9, 77–101. https://link.springer.com/article/10.1007/s10109-006-0030-0

Zondag, B. & Pieters, M. (2005). Influence of Accessibility on Residential Location Choice. *Transportation Research Record*, 1902(1), 63–70. https://doi.org/10.1177/0361198105190200108

Zou, H. & Hastie, T. (2005). Regularization and variable selection via the elastic net. *Journal of the Royal Statistical Society: Series B (Statistical Methodology),* 67(2), 301–320. https://doi.org/10.1111/j.1467-9868.2005.00503.x

APPENDIX

1 – Key dates – Sequence of lockdowns since the start of COVID-19 and associated restrictions.

- "Before" from 01/01/2019 to 11/03/2020: No restrictions, except ban on gatherings from 5/03/2020
- "Lockdown 1" from 12/03/2020 to 10/05/2020. On 12/03/2020, announcement of closure of nurseries, schools, colleges, high schools and universities until further notice. On 16/03/202, announcement of the first national lockdown. Closure of all non-essential public places. From 17/03/2020, ban on all travels except for professional activity, buying essential goods, health or family reasons or exercise for less than one hour. Requirement to carry identification and signed and dated declaration for any travel.
- "Intermediate 1" from 11/05/2020 to 27/10/2020: Progressive lifting of most restrictions. Extension of mask-wearing rules. From 17/10/2020, overnight curfew in Paris and suburbs, Marseille, Lyon, Lille, Saint-Etienne, Rouen, Toulouse, Grenoble and Montpellier. From 24/10/2020, overnight curfews extended to 38 French departments.
- "Lockdown 2" from 28/10/2020 (announcement) to 15/12/2020: Second national lockdown, which was similar to the first one in terms of restrictions, except that primary and secondary schools were open.
- "Intermediate 2" from 16/12/2020 to 30/03/2021: Lifting of most restrictions. Curfew hours nationally. From 20/03/2021, daily lockdowns imposed in 16 departments.
- "Lockdown 3" from 31/03/2021 (announcement) to 02/05/2021: Third national lockdown with daily lockdown rules extended to Metropolitan France.
- "After" from 03/05/2021 to 20/09/2021: Lifting of most restrictions. From 21/07/2021, all people over 12 require a health pass to access some places.

2 – List of variables

Variable	Modalities / (Unit)
Search since March 12 2020	1 if yes; 0 if No
Search before the 1st lockdown	1 if search between 01/01/2019 and 11/03/2020; 0 if No
Search during 1st lockdown	1 if search between 12/03/2020 and 10/05/2020; 0 if No
Search during the first period between two lockdowns	1 if search between 11/05/2020 and 27/10/2020; 0 if No
Search during 2nd lockdown	1 if search between 28/10/2020 and 15/12/2020; 0 if No
Search during the second period between two lockdowns	1 if search between 16/12/2020 and 30/03/2020; 0 if No
Search during 3rd lockdown	1 if search between 31/03/2021 and 02/05/2021; 0 if No
Search after the 3rd lockdown	1 if search between 03/05/2021 and 20/09/2021; 0 if No
Search in the same catchment area	1 = yes; 2 = No
Search in urban area	1 = yes; 2 = No
City category	11=*commune centre*; 12=*commune du pôle*; 13=*commune du pôle secondaire*; 20=*couronne*; 30=*hors attraction des pôles*
Housing type	1 = Apartment; 2 = House
Property surface	(Square meters)
Number of rooms	
The property has a swimming-pool	1 if yes; 0 if No
The property has shared walls	1 if yes; 0 if No
The property has a terrace or a balcony	1 if yes; 0 if No
The property has a parking	1 if yes; 0 if No
The property has a ground garden	1 if yes; 0 if No
Value of the property at the time of the search	(Thousands €)
Difference in number of rooms between wanted dwelling and the property	
Share of vacant dwellings	(%)
Share of second homes	(%)
Share of multi-unit housing	(%)
Share of dwellings built before 1946	(%)
Share of owners	(%)
Share of renters	(%)
Share of foreigners	(%)

➔

(contd.)

Variable	Modalities / (Unit)
Residential surface	(Ha)
Surface dedicated to economic activities	(Ha)
Number of inhabitants	
Population density	(Inhabitants/residential surface)
Share aged 65+ in the total population	(%)
Share aged 18-24 in the total population	(%)
Share aged 11-17 in the total population	(%)
Share aged 0-10 in the total population	(%)
Unemployment rate of population aged 15-64	(%)
Number of jobs per inhabitant	
Share aged 15+ not in school holding a 2nd degree diploma (CAP or BEP)	
Share aged 15+ not in school holding a baccalaureate	
Median income (by consumption units)	(Thousand €)
Spending in amenities of the agglomeration	(€/Inhabitant)
Number of amenities to find a job	
Number of educational facilities other than schools	
Number of health facilities	
Number of childcare centres	
Number of facilities for disabled persons	
Number of facilities for elderly persons	
Number of social facilities	
Number of sport, culture and leisure amenities	
Number of universities/higher education facilities	
Number of security stations (police and *gendarmerie*)	
Number of back-to-work assistance facilities	
Distance to closest *centre d'équipement local / intermédiaire / structurant majeur*	(km)
Difference in shares of foreigners destination *vs* origin	(%)
Difference in number of childcare facilities destination *vs* origin	(%)

COVID-19 and Dynamics of Residential Property Markets in France: An Exploration

Sylvain Chareyron*, Camille Régnier and Florent Sari*****

Abstract – In this article, we analyse the effects of the COVID-19 crisis on the French residential property markets. More precisely, we explore whether household demand for residential properties has been impacted by this crisis. Based on data on property transactions recorded between 2016 and 2021, we compare the evolution of prices before and after the crisis. The comparison is done between municipalities within urban areas on one hand, between urban areas on the other. Within urban areas, we show that the less dense municipalities that are farthest from the centre are also those where prices have risen the most. This reflects the desire among households for more spacious properties on the outskirts of urban centres. The results of the analysis of the evolution of prices between urban areas suggest, in line with urban economics theory, that a change in dynamics has occurred in favour of the least productive agglomerations.

JEL: R14, R21, R31, R41
Keywords: COVID-19, housing prices, property markets

**Université Paris-Est Créteil, ERUDITE (EA 437) and TEPP-CNRS (FR 2042); **Université Paris-Est Créteil, ERUDITE (EA 437); Université Paris-Est Créteil, ERUDITE (EA 437), CEET and TEPP-CNRS (FR 2042).* Correspondence: *florent.sari@u-pec.fr*

This work benefited from comments of the participants to the Laboratoire d'Économie de Dijon seminar (LEDi, May 2022) and the Journées de Microéconomie Appliquée (JMA) in Rennes (2022). We would also like to thank two anonymous reviewers for their constructive comments. Finally, we would like to thank ADISP for providing data from the population census.

Received in October 2021, accepted in June 2022. Translated from: "Covid-19 et dynamique des marchés de l'immobilier résidentiel en France : une exploration".
The views and opinions expressed by the authors are their own and do not necessarily reflect those of the institutions to which they belong or of INSEE itself.

Citation: Chareyron, S., Régnier, C. & Sari, F. (2022). COVID-19 and Dynamics of Residential Property Markets in France: An Exploration. *Economie et Statistique / Economics and Statistics*, 536-37, 75–93. doi: 10.24187/ecostat.2022.536.2085

The health crisis caused by the emergence of COVID-19 in March 2020 in France has affected all activities. For households, the lockdowns and the development of teleworking, which have had an impact on both the professional and private spheres, have in particular led to a reconsideration of the choice of residential location and/or the characteristics of desired housing. On this latter point, the Qualitel 2020 Barometer[1] on the aspirations of French people in terms of space and interior design shows for example that households living in an apartment would like to have a house (58%), a garden (82%), a terrace or balcony (79%), larger rooms or a greater number of rooms. However, these characteristics are more often those of housing located outside urban centres, where property prices are relatively more affordable, but which may be further away from jobs. In this respect, the health may have modified or reinforced aspirations already present, as working remotely made the need of proximity between housing and work more flexible.

On the one hand, the continued confinement during the first lockdown from March to May 2020 highlighted (or reinforced) the need for space, both inside and outside, as well as a certain degree of dislike for large cities. Breuillé *et al*. (2022) thus show an increase in intentions to relocate to rural areas and purchase a house, of +5 points and +7.4 points, respectively, during the first lockdown compared to the pre-COVID period. Google geolocation data collected during the first lockdown also showed that the usual places frequented in large agglomerations were deserted, while some departments in rural France saw their shops gain visitors.[2]

On the other hand, since McFadden (1977), the economic literature has been in consensus about the major role of workplace accessibility in household location choice. Working remotely, which was introduced on a large scale during the first lockdown (involving 40% of companies), led to a reconsideration of the link between place of residence and place of work. It also seems to be a lasting change in working conditions: at the end of the first lockdown, nearly 26% of employers said they wanted to continue the practice (Duc & Souquet, 2020). More than a year after the start of the pandemic in the summer of 2021, the proportion of people regularly working remotely in the Paris region was 42%, which is twice the figure for 2019 according to a study by the Institut Paris Région (Brajon & Leroi, 2022). On average, the same trend is observed in OECD countries, although with strong differences across countries, as shown by a recent study based on job advertisement data (Adrjan *et al*., 2021); in particular, their results show that restrictions related to the management of the health crisis increased the prevalence of working remotely in job offers more than the relaxation of those restrictions has reduced it.

These different elements lead us to questions on the effects that the COVID-19 crisis may have on the location choice of household and, consequently, on property markets and territorial and urban dynamics. Household preferences were directly affected, with an adjustment of the trade-offs between different types of amenities and the increased flexibility of the link between area of residence and area of employment. However, the COVID-19 crisis also acted to accelerate location choices that were already evolving following deeper societal questions relating to the climate crisis or work-life balance, for example. The question is therefore whether these changes have "crystallised" due to the health crisis in terms of location choices and whether they are discernible in property markets in France.

There is already a relatively large body of work in the economic literature, particularly based on Chinese and American data. However, at the time of writing this article, we did not find work analysing the effects of the COVID-19 crisis on the French residential property market.[3] In this article, we therefore seek to explore the potential changes in the dynamics of the French residential property market after the emergence of COVID-19 in March 2020: has household residential demand been affected by the shock caused by COVID-19 and is it reflected by changes in property prices?

Relying on urban economics theories, we consider that the pandemic may have had two main effects: on the one hand, within agglomerations, an increase in the demand for space and a decrease in transport costs, which should lead to a change in the land rent gradient throughout urban areas (decrease in the gradients associated with distance and density in absolute values). On the other hand, an increase in the prices in urban areas where productivity is the lowest and in those with the most amenities.

We empirically test these hypotheses by studying the dynamics of residential property prices

1. *https://www.qualitel.org/barometre-qualitel/resultats-2020/*
2. *https://www.google.com/covid19/mobility/.*
3. *Since then, we can cite Breuillé* et al. *(2022) in this same issue, and France Stratégie (2022) on the evolution of residential property since the emergence of COVID-19, and Bergeaud* et al. *(2021) on the dynamics of corporate property.*

in France before and after the start of the health crisis. To do this, we use property valuation applications (*Demandes de Valeurs Foncières* – DVF) from 2016 to 2021. Identification is carried out using a difference-in-differences estimation, as in various works (Brueckner *et al*., 2021; Huang *et al*., 2021; Liu & Su, 2021), but we propose a strategy that allows potential differences in trends depending on the level of treatment to be taken into account, as in Dustmann *et al*. (2022). To the best of our knowledge, this is the first time that this method is applied to studying the effects of the pandemic on property prices.[4]

Our results indicate a change in price dynamics within large French agglomerations: the municipalities farthest from the centre and with a low population density experienced a price increase following the crisis. In the short term, reconfiguration effects appear to be less significant between urban areas than between municipalities within urban areas. However, in line with theoretical expectations, there appears to be a reduction in the income-related gradient, with a relative increase in the attractiveness of less productive urban areas compared to more productive ones.

The rest of the article is structured as follows: after a review of the empirical literature in Section 1, we present in Section 2 the elements of the theories of urban economics on the basis of which we formulate hypotheses to be tested, then we present the data and the empirical approach of the study. The results are set out in Section 3; we discuss the results and set out our conclusions in a final section.

1. Review of Empirical Literature

The effects of the COVID-19 crisis on household location behaviour have resulted in a variety of work, notably in China and the United States.

For China, the study by Cheung *et al.* (2021) on the city of Wuhan uses property transaction data from nine districts between January 2019 and July 2020 to identify the impact of the crisis on housing prices and household behaviour. The results, based on hedonic price models, reveal that housing prices fell by 5% to 7% after the outbreak of the pandemic and recovered after the lockdown. However, the authors show that the price gradient from the centre to the outskirts of urban areas has flattened. Recent work by Bricongne *et al*. (2021) reveals a similar trend in the United Kingdom. Based on data grouping together sale prices in online property advertisements and final prices recorded by notaries, they show a decrease of around 80% in property market activity during the COVID-19 crisis. In addition, property prices have increased in rural areas, and decreased near London. These results suggest a change in household behaviour, and a preference for low-density residential areas.

Huang *et al.* (2021) extend the previous analysis on China by studying property transactions in sixty cities between January 2019 and September 2020. The results of a difference-in-differences analysis show a negative and moderate effect on property prices but a strong negative effect on transaction volumes, which collapsed just after the emergence of COVID-19. Housing prices fell by about 2% on average, but the price of apartments near city centres has fallen more sharply; the authors conclude that the crisis has changed household preferences with regard to their location choices. Finally, Qian *et al*. (2021) also examine the impact of COVID-19 on property prices. Using difference-in-differences models, they find that property prices in regions where COVID-19 cases are confirmed would have dropped by 2.5%. This effect persisted for three months and its extent increased over time. However, this effect seems to be observed only in the regions the most affected by the pandemic.

For the United States, Gupta *et al.* (2021) study the variations in prices and rents following the pandemic in the thirty largest agglomerations. They estimate a model in which price is a function of distance to the city centre, of local and temporal fixed effects and of various control variables measured before the pandemic. They show that prices have continued to rise despite the COVID-19 crisis, but more strongly in neighbourhoods located away from the centre than in central neighbourhoods, leading to a significant flattening of the land rent gradient.

Ramani & Bloom (2021) also examine the effects of the COVID-19 crisis on property markets and migration patterns in major American cities. To that end, they estimate models in which the change in prices (or population) between February 2020 and February 2021 is explained by changes in population density during the previous period, distance to the centre and fixed effects. Two major facts emerge. First, they highlight a shift in the demand for property (from both households and companies) from the centre to the outskirts of major cities. This is the so-called "doughnut effect", which reflects a decline in city-centre activity and a shift to the peri-urban ring. This effect seems particularly

4. *And on differences-in-differences with continuous treatment.*

prominent in larger cities, while it is absent in smaller ones. Next, no movement of this type appears between the major cities considered. The existence of an 'intra' effect, but not an 'inter' effect suggests that the development of working remotely now makes it possible to move away from one's workplace, but that the persistence of hybrid forms of work (combining working on site and at home) limits the possibility of living too far away and, therefore, in another major city.

However, work by Brueckner *et al*. (2021) appears to lead to different results. Focusing on inter-agglomeration effects, and concentrating particularly on the effect of the COVID-19 crisis on working remotely, they decompose the variations in property prices according to the potential telework of urban areas in the United States. Based on estimates that combine telecommuting potential and a measure of city productivity, their analysis shows that cities with high productivity and high potential for telework have seen prices fall since the onset of the health crisis. However, no significant price change is observable for agglomerations with few amenities and high telecommuting potential.

Finally, Liu & Su (2021) also examine the impact of the pandemic on demand for housing on the US market by combining a temporal indicator (pre- or post-COVID) with different characteristics, such as population density or distance to the centre. Their main results confirm a change in behaviour following the pandemic: it would have led to a large shift in the demand for housing away from city centres and dense neighbourhoods to suburbs and neighbourhoods with a lower population density. The authors also note a significant shift in housing demand outside the major cities, although this is not as significant as the shift from city centres to the suburbs.

2. Methodology: Assumptions, Data and Variables and Empirical Strategy

In urban economics, two major categories of theoretical models make it possible to analyse the market at different levels. Firstly, the basic residential choice model, developed in particular by Alonso (1964), Mills (1967) and Muth (1969), based on the mechanisms behind the formation of property prices within an agglomeration. Secondly, the Rosen-Roback model (Rosen, 1979; Roback, 1982) based on the determining factors behind price differences between agglomerations. We draw from these models four hypotheses that we aim to test. We then present our data and variables, then our empirical approach.

2.1. Hypotheses

2.1.1. Within an Urban Agglomeration

According to the basic residential choice model, there is a trade-off between housing size and distance to the central business district (CBD). At the equilibrium, increased transport costs must be exactly offset by a decrease in the amount spent on property. Under these conditions, property prices decrease continuously with distance to the CBD, while the size of housing per individual increases with the distance. In addition, since housing size increases with distance to the centre, population density decreases across urban space.

Based on the conclusions of the Alonso-Muth-Mills model, it is easy to understand how the COVID-19 crisis can change the existing urban equilibrium. Indeed, the possibility to work from home can alter two major parameters of the Alonso model. On the one hand, it decreases the cost of transport to the CBD. Since it is no longer necessary to go to the workplace every day, the cost of transport is reduced at any point in the urban area. Locations close to the centre, which were sought after due to low transport costs, therefore become relatively less advantageous. In other words, the lower the transport cost, the lower the price difference between central and peripheral locations.

On the other hand, the increased need for residential space, in particular the need for a garden or an additional room in which to work, changes households' utility function. This phenomenon is increased due to changes in household preference in relation to housing size following successive lockdowns. All else being equal, a unit of space then provides a higher utility than before. As housing sizes are fixed in the short or medium term, households will choose to relocate where housing sizes correspond to their demand. This results in valuing locations where space is accessible. Thus, bid-rents will increase in sparsely populated locations. There should then be an increase in prices and population in the areas where space is most accessible, i.e. areas that were originally sparsely populated.

On this basis, we retain two initial hypotheses:

- *Hypothesis 1:* Property prices fall near the CBD and rise in more distant locations.
- *Hypothesis 2:* Demand increases in sparsely populated locations, leading to higher prices and populations in these locations.

2.1.2. Between Agglomerations

The Alonso model focuses on the mechanisms underlying the formation of property prices within an agglomeration. The work of Rosen (1979) and Roback (1982) is better able to account for potential price dynamics between agglomerations following the crisis. This work models the trade-offs made by households between the wage they can obtain, the level of amenities they can enjoy and the property price they have to pay in a given region. The wage is set exogenously by the level of productivity of the region and the level of amenities is also assumed exogenous. With a constant level of amenities, the regions with the highest wages must also have high property prices. Conversely, with a constant level of productivity (i.e. equal wages), the spatial equilibrium will be achieved by higher property prices in regions with more amenities.

The development of remote working, which is one of the consequences of the COVID-19 crisis, has the effect of making the relationship between the place of work and the place of residence more flexible, revealing new spatial trade-offs within the framework of the model set out above. Brueckner *et al*. (2021) explicitly incorporate the possibility of working remotely in this model, considering that an individual can work in any city without the need to reside there. They show that if cities differ only in their level of productivity, the implementation of remote working will allow a part of the population to move to the least productive city, where the price of property is lower, while continuing to work for a company in the most productive city and benefitting from higher wages. In the end, these migrations will lower property prices in the most productive city, with a loss of population, and will increase them in the less productive city.

Then, they examine what happens with constant productivity levels, but different amenity levels. The development of telework allows a part of the population to move to the most attractive city in terms of amenities, while keeping their job in the city with fewer amenities. In this case, there will be an increase in price differences between cities. Another mechanism can reinforce this effect: the lockdowns increased the value attached to certain amenities, for example natural spaces.

We thus retain two other hypotheses:

- *Hypothesis 3:* Prices fall in high-productivity agglomerations and rise in low-productivity agglomerations.

- *Hypothesis 4:* Prices rise in agglomerations with a high level of amenities and fall in agglomerations with a low level of amenities.

2.2. Data and Variables

Our data are based on real estate transactions listed in the property valuation applications (*Demandes de valeurs foncières* – DVF) from 2016 to July 2021 (the most recent data available when this study was conducted). These data, provided by the Directorate-General for Public Finance (*Direction Générale des Finances Publiques* – DGFIP), relate to the property sales published in the mortgage records, supplemented by the description of the property from the land register, over a maximum period of five years. For each registered sale, the nature of the property, its address and surface area, the date of transfer and the declared property value[5] are specified. We do not take into account industrial and commercial real estate.

The intra-urban area analysis only retains municipalities belonging to urban areas of more than 500,000 inhabitants (which gives 16 urban areas) and the inter-urban area analysis excludes urban areas grouping together multi-pole municipalities (i.e. linked to several urban areas) or isolated municipalities. We also exclude municipalities with extreme average price values.[6] Ultimately, the sample of municipalities contains 4,537 different municipalities spread over 16 urban areas and the sample of urban areas contains 736 different urban areas. The study focuses only on metropolitan France. Table 1 provides an overview of the construction of the samples.

The DVF are used to calculate the logarithm of the average price in municipalities (for intra-urban area analysis) and in urban areas (for inter-urban area analysis).

For explanatory variables, multiple sources are used:

- The distance to the centre of the urban area is calculated for each municipality using the projection systems of the French national geographic institute (*Institut géographique national* – IGN). The centre corresponds to the central business district in each of the urban areas chosen[7] and the distance is a Euclidean distance calculated from

5. https://www.data.gouv.fr/fr/datasets/demandes-de-valeurs-foncieres-geolocalisees/.
6. Average prices of more than €10 million or less than €20,000.
7. It is the economic centre of each area and not the geographical centre. In the case of polycentric urban areas such as Aix-Marseille, a choice had to be made, and we chose Marseille, the largest of the two. However, areas with this type of configuration are rare in France.

Table 1 – **Samples of municipalities and urban areas**

Initial sample	
Number of municipalities	**Number of urban areas (UAs)**
35,454	739
Exclusion of municipalities from UAs with fewer than 500,000 inhabitants	Exclusion of multi-pole municipalities from UAs
Number of municipalities / Number of urban areas	
4,539 / 16	736
Suppression of extreme values	
Number of municipalities / Number of urban areas	
4,537 / 16	

Notes: The number of municipalities and urban areas per sample corresponds to the number of different municipalities and urban areas present in the sample. The 16 urban areas of the intra-urban area analysis are: Avignon, Douai-Lens, Bordeaux, Grenoble, Lille, Lyon, Marseille-Aix-en-Provence, Montpellier, Nantes, Nice, Paris, Rennes, Rouen, Saint-Etienne, Toulon and Toulouse.

the geographical coordinates of a municipality *i* and the centre *j* of the area. This first indicator is used in relation to H1: "property prices fall near the central business district".

- The population density in the municipalities is calculated from the data from the INSEE population census (for the year 2017). This indicator allows us to test H2: "demand rises in sparsely populated locations". The median incomes of urban areas are determined using the localised social and tax file (*Fichier Localisé Social et Fiscal* – Filosofi) for the year 2017. Median incomes will be used as a proxy for the productivity in the urban area[8] and thus allow us to test H3, according to which "prices fall in high-productivity agglomerations".

- We also use indicators of natural amenities in the territories, in relation with H4 according to which "prices increase in agglomerations with a high level of amenities".[9] The amenities of the urban area are determined using the Corine Land Cover database, which provides a biophysical inventory of land use and its evolution, produced by visual interpretation of satellite images according to a 44-item classification.[10] On this basis, for the year 2018, we calculate the proportion of municipalities with natural areas and/or traversed by water courses (rivers and major tributaries) in the urban area. Specifically, we identify the municipalities that have one of these natural amenities and calculate the proportion they represent in the total number of municipalities in the urban area.

Table 2 presents descriptive statistics for the sample of municipalities and the sample of urban areas. They show that prices increase over time in both samples. Prices also appear higher on average in the sample of municipalities than in the sample of urban areas. This is due to the exclusion of the municipalities in urban areas with fewer than 500,000 inhabitants. The population density measured across the sample of municipalities is higher than that measured for France as a whole (105.5 inhabitants/km^2 in 2018). This is also due to the exclusion of municipalities from small urban areas, where the population density is much lower. Finally, the proportion of houses in the transactions is lower at urban area level than at municipality level because of the restriction to these more densely populated areas where apartments are more frequent.

2.3. Empirical Strategy

Our approach consists in estimating difference-in-differences models as presented by Angrist & Pischke (2008, p. 175). We estimate the prices of transactions that occurred from 2016 to 2021 to explore the effect of the emergence of the pandemic on the link between price and population density, between price and distance from the centre at municipality level within large urban areas, between prices and incomes, and between prices and amenities at urban area level.

As in the majority of recent studies on the subject (Brueckner *et al*., 2021; Ramani & Bloom, 2021), prices are used at an aggregate level (i.e. the municipality or the urban area).[11] However, we control for the composition of sales in terms of property type (apartments or houses). The loss of precision compared to the use of hedonic regressions is low in our case, for two reasons. Firstly, the DVF contain little information on housing characteristics. However, the hedonic price method applied to housing is first

8. Data available via https://www.insee.fr/fr/statistiques/4291712
9. For reasons relating to data access, the test focuses on a restricted version of H4, considering only natural amenities. Other amenities, such as cultural amenities, are also important in the choice of location by households, even though it is conceivable that the crisis may have led to placing particular value on natural amenities.
10. Data available at the following address: https://www.statistiques.developpement-durable.gouv.fr/corine-land-cover-0
11. The number of municipalities per urban area (278 on average) and the average price differences between municipalities in the same urban area are important because of the restriction to municipalities in the largest agglomerations.

Table 2 – **Descriptive statistics**

	Mean	Standard error	Min.	Max.
Municipalities				
Property prices (€):				
2021	263,888	137,595	20,000	3,514,152
2020	252,464	117,911	20,000	2,410,636
2019	241,939	124,607	20,000	2,819,515
2018	233,688	106,570	20,000	1,854,240
2017	226,217	105,642	20,500	2,912,882
2016	218,230	105,302	21,000	2,968,701
Proportion of houses (%)	81.5	30.8	0.0	100.0
Population density (inhabitants per km^2)	634.5	1861.8	0.5	26,602.9
Distance to the centre of the urban area (km)	34.1	19.5	0.2	92.1
Urban areas				
Property prices (€):				
2021	161,575	115,271	32,000	2,114,600
2020	151,609	80,914	20,000	1,112,869
2019	143,872	79,855	54,929	1,474,643
2018	142,048	86,356	49,308	1,813,649
2017	138,396	70,086	49,408	1,245,500
2016	135,139	68,198	46,968	1,289,067
Proportion of houses (%)	69.6	24.4	0.0	100.0
Median income (€)	19,636	1892	12,390	31,860
Proportion of natural spaces (%)	26.1	21.6	0.0	91.3
Proportion of tributaries and rivers (%)	0.4	1.1	0.0	9.8

Sources: DVF 2016–2021; INSEE 2017 population census; Corine Land Cover 2018.

and foremost used to obtain implicit prices for these characteristics. The lack of information therefore makes this method less essential. Secondly, we are more interested in the valuation of the characteristics of the municipality (or urban area) in which the property is located. Reasoning at aggregate level therefore seems more appropriate.

The difference-in-differences method is based on the assumption of "parallel trends" according to which price developments, in the absence of COVID-19, would have been the same in the different categories of municipalities considered. To verify this, a standard test consists in comparing the trends observed over periods prior to the event in question. If these prior trends are similar, it can be assumed that they would have been in the absence of COVID-19. However, it is possible to take into account the existence of a linear trend difference in our estimation strategy, by including annual linear trends by municipality (see 2.3.1 below) or by removing from the data a linear trend from the coefficients estimated in an initial step (see 2.3.2 below).

In addition, two distinct but complementary levels of analysis are developed: one at intra-urban area level, between municipalities, the other at inter-urban area level, between urban areas.

2.3.1. Specifications for Intra-Urban Area and Inter-Urban Area Analysis

In order to explain price differentials at intra-urban area level, the estimated model is as follows:

$$\begin{aligned}\ln price_{cat} = {} & \alpha + \beta Density_c + \delta Distance_c + \gamma Covid_t \\ & \times Density_c + \tau Covid_t \times Distance_c \\ & + \rho X_{ct} + \phi_{at} + \vartheta_{cm} + \theta_c Year_t + \varepsilon_{cat}\end{aligned} \quad (1)$$

where $price_{cat}$ is the average price of housing in municipality c in urban area a as of date t, $Density_c$ is the population density in the municipality and $Distance_c$ is the distance between municipality c and the centre of the urban area, with these two variables being measured before COVID-19 and constant over time. $Covid_t$ is a dichotomous variable indicating the COVID-19 period (after March 2020). γ and τ respectively measure the variation of gradients associated with distance to the centre and population density after the emergence of COVID-19. We control for the proportion of houses in property transactions (X_{ct}). It is important to take this into account when explaining the variations in property prices, since the average price per square metre varies according to the type of property and the demand for houses is likely to have changed after the COVID-19

crisis, which may have led to changes in the composition of sales. ϕ_{at} are "date×urban area" fixed effects that reflect macroeconomic factors assumed to be unchanging between municipalities, as well as possible shocks affecting price dynamics in specific urban areas. ϑ_{cm} are "municipality×month" fixed effects: in addition to controlling for unobserved characteristics of the municipality that do not vary over time, they take into account possible differences in price seasonality between municipalities. In general, these fixed effects have the function of taking into account local characteristics that could explain a preference among households for certain territories, such as the presence of large infrastructures (universities, hospitals, TGV stations, etc.) and/or good Internet coverage, which vary little or not at all over time.

To take into account potential pre-existing differences in the evolution of prices, we introduce annual linear trends, $\theta_c Year_t$, into the model for each municipality. This allows controlling for differences in linear trends between the prices in municipalities observed before the emergence of COVID-19. Such a strategy thus allows to relax this assumption of "parallel trends" in the absence of the emergence of COVID-19 (Mora & Reggio, 2019; Egami & Yamauchi, 2021). In other words, it becomes possible to identify an exogenous effect of COVID-19, under the assumption that any pre-existing trend in prices between densely and sparsely populated municipalities (or between municipalities that are distant and close from the centre) is linear and would have continued at the same rate in the absence of the emergence of COVID-19.

At inter-urban area level, the model is estimated as follows:

$$\begin{aligned}\ln price_{at} = {} & \alpha + \beta Prod_a + \delta Amenities_a + \gamma Covid_t \\ & \times Prod_a + \tau Covid_t \times Amenities_a + \rho X_{at} \\ & + \phi_t + \vartheta_{am} + \theta_a Year_t + \varepsilon_{at} \end{aligned} \quad (2)$$

where $price_{at}$ is the average price of housing in urban area a as of date t. $Prod_a$ is the productivity (proxied by the median income) in urban area a and $Amenities_a$ are the natural amenities of urban area a. γ and τ measure the variation in gradients associated with productivity and amenities after the emergence of COVID-19. X_{at} here measures the proportion of houses in the transactions carried out in the urban area. ϕ_t are fixed temporal "month×year" effects and ϑ_{am} are fixed "urban area×month" effects that make it possible to control these differences between urban areas that do not vary over time as well as differences in price seasonality between urban areas. In the same way as before, annual linear trends by urban area, $\theta_a Year_t$, make it possible to control any potential differences in prices linear trends between urban areas.

The estimated coefficients related to level variables may be affected by the omission of certain variables. But, as indicated by Brueckner *et al*. (2020), since the coefficients of interest are related to interactions between variables and the post-COVID-19 period, the risk of bias related to their omission is relatively limited.[12] Nevertheless, for the intra-urban area analysis, although we use a wide range of fixed effects, identification is based on the assumption that no shock other than COVID-19 affects differently housing prices in municipalities depending on their population density or distance to the centre of the area. Our results remain subject to the assumption of the absence of other shocks alongside COVID-19 that would differently affect municipalities within areas on a non-seasonal basis. For example, it could be that the results of the municipal elections at the end of June 2020 led to variations between municipalities, with the establishment of moratoriums on construction in some cities. However, for this to create a bias in estimates, the establishment of these moratoriums would have to be systematically correlated with the distance from the centre or the population density of the municipalities, which seems unlikely. Likewise, for inter-urban areas analysis, the assumption is that no shock other than COVID-19 affects housing prices in urban areas differently depending on their income or amenity levels.

2.3.2. Dynamic Specifications

To estimate annual gradient variations at the intra-urban area level, we estimate:

$$\begin{aligned}\ln price_{ct} = {} & \alpha + \beta Density_c + \delta Distance_c \\ & + \sum_{\substack{l=-3 \\ l\neq 0}}^{2} \gamma^l Covid_{t+l} \times Density_c + \sum_{\substack{l=-3 \\ l\neq 0}}^{2} \tau^l Covid_{t+l} \\ & \times Distance_c + \rho X_{ct} + \phi_{at} + \vartheta_{cm} + \varepsilon_{ct} \end{aligned} \quad (3)$$

The dichotomous variables $Covid_{t+1}$ are defined in relation to the emergence of Covid. For example, $Covid_{t+2}$ equals 1 for the average price of a municipality observed two years after

12. Our modelling does not allow taking into account potential spatial autocorrelation in the determination of property prices. This phenomenon appears limited in the case of inter-urban areas analysis, since the sample consists of the largest urban areas, each of which represents a specific property market and which are relatively distant from each other. It is more likely in intra-urban area analysis because the setting of prices in one municipality can effectively impacts prices in neighbouring municipalities. Nevertheless, we group together the standard errors for the municipality (or urban area), which allows taking into account a potential serial correlation of the error term.

the emergence of COVID-19, i.e. in 2021, and otherwise it equals 0. As COVID-19 appeared in France in 2020, the reference period is the year 2019.[13] The coefficients γ^l and τ^l flexibly reflect the evolution of the distance from centre and population density gradients around the year 2019 (i.e. from 2016 to 2021).

This specification also makes it possible to test the assumption of parallel trends of prices between municipalities of different population densities and at different distances from the centre of the area before COVID-19. Indeed, the coefficients γ^l and τ^l for the periods before the pandemic inform us about the potential presence of prior trends in the evolution of the gradients associated with population density and distance from centre.

To take into account the possibility that prices will evolve differently in densely and sparsely populated municipalities (respectively municipalities distant and not far from the centre of the urban area) before the emergence of COVID-19, we use our estimates of γ^l (respectively τ^l for the preceding years (2016 to 2019) to adjust a linear temporal trend. We then remove this linear trend from our data, in the same manner as Monras (2018).[14] Specifically, this method consists of estimating a linear trend for the coefficients before COVID and removing this trend from the price variable data (or performing a projection for the post-COVID period and calculating the effect based on the difference between the estimated post- COVID coefficients and this projection). Next, we re-estimate equation (3) using the new trend-free price variable.

For the inter-urban area analysis, we estimate:

$$\begin{aligned}\ln price_{at} = {} & \alpha + \beta Prod_a + \delta Amenities_a \\ & + \sum_{\substack{l=-3 \\ l\neq 0}}^{2} \gamma^l Covid_{t+l} \times Prod_a + \sum_{\substack{l=-3 \\ l\neq 0}}^{2} \tau^l Covid_t \\ & \times Amenities_a + \rho X_{at} + \phi_t + \vartheta_{am} + \varepsilon_{at}\end{aligned} \quad (4)$$

where $price_{at}$ is the average price of housing in urban area a as of date t. As before, the dichotomous variables $Covid_{t+l}$ take the value 1 when an urban area is $t+l$ years after the date when the COVID appeared. $Prod_a$ is our measurement of productivity and $Amenities_a$ are the natural amenities in urban area a. γ and τ measure the variation in the gradients associated with productivity and amenities after the emergence of COVID. The coefficients γ^l and τ^l flexibly reflect the evolution of the gradients for productivity and the presence of natural amenities.

3. Results

3.1. First Descriptive Approach to the Evolution of Prices

Figure 1 presents the quarterly evolution of prices in municipalities within urban areas according to distance to the centre of the urban area and the population density of the municipality. This representation allows an initial exploration of H1 and H2, according to which property prices fall near the central business district and in densely populated municipalities and increase in others. We calculate an average, weighted by population in 2017, of price indices at municipality level and we compare the price evolution between municipalities according to distance to the centre (with a threshold of 25 km corresponding to the median distance) on the one hand, and according to population density (with a threshold of 279 inhabitants/km^2 corresponding to the median population density), on the other.

The evolution of prices is quite close in both groups of municipalities, whether before or after the appearance of COVID (Figure I-A). In contrast, a change is evident in the evolution of prices according to population density (Figure I-B): they rise more sharply in the most densely populated municipalities over the period 2017-2020, then more quickly in the least densely populated municipalities from March 2020 onwards.

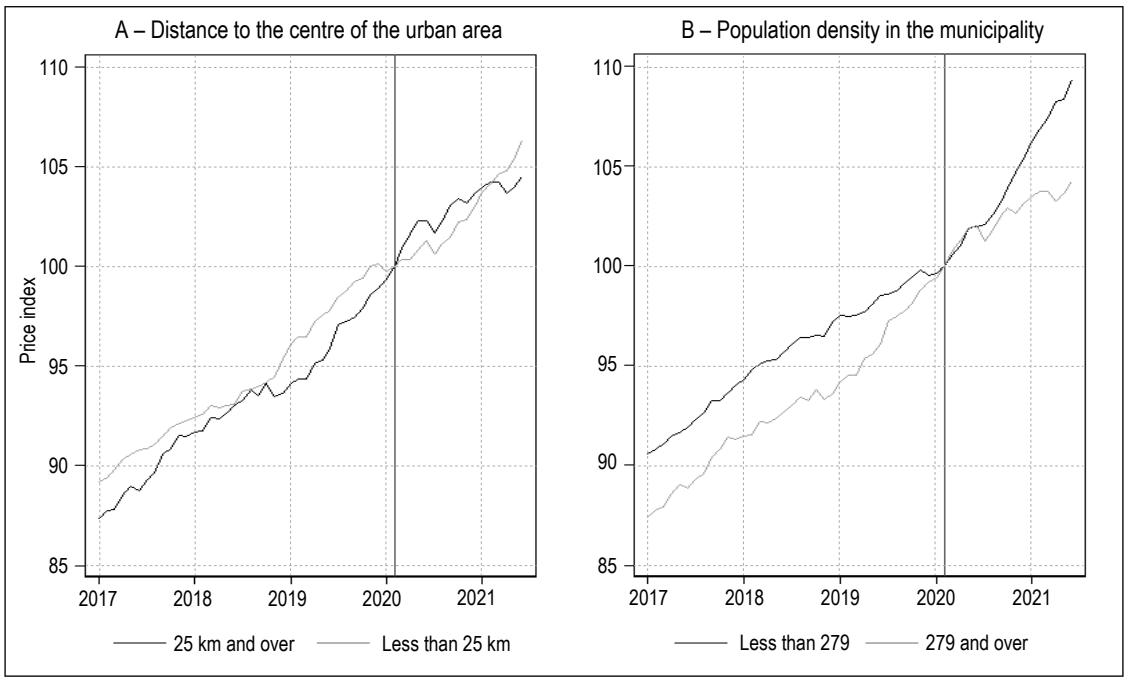
Figure II shows the variation in property prices according to the median income of the urban area, which is used as a proxy for productivity. In this way, we explore H3, according to which "prices fall in high-productivity agglomerations". Two groups of urban areas are distinguished according to median income (on either side of the national annual median income in 2017). Between 2017 and 2020, prices rose the most in urban areas with the highest median income, reflecting their overall attractiveness and the dynamism of the property market. From March 2020 onwards, price rises slowed down in those areas and accelerated in urban areas where the median income is less than €19,500.

Finally, we compare the variation of prices between urban areas according to level of

13. The observations corresponding to the first three months of 2020 are removed, as the prices cannot have been affected by the COVID crisis at this time.

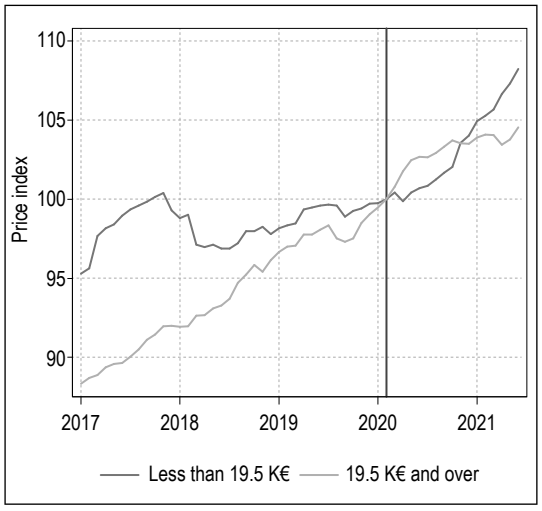
14. This method is similar to that used by Dustmann et al. *(2022) or Ahlfeldt* et al. *(2018) who then plot the differences between the estimates of γ^1 (respectively τ^1 and the linear temporal trend predicted for the years after the implementation of a policy.*

Figure I – **Price variation in municipalities of large urban areas according to the distance to the centre of the urban area and population density**



Notes: The price index is the population-weighted average calculated for all municipalities in each group. Each aggregated index is normalised so that March 2020 = 100. The moving average of prices in each group over the last 12 months is then calculated.
Sources: DVF 2016-2021; INSEE, 2017 population census; French national geographic institute (IGN).

Figure II – **Evolution of prices of urban areas according to median income**



Sources: DVF 2016-2021; INSEE, 2017 population census.

natural amenities (proportion of natural spaces and presence of large tributaries or rivers), in relation to H4 according to which "prices increase in agglomerations with a high level of natural amenities". The price trend remained of the same order of magnitude both before and since the beginning of the crisis in urban areas where the proportion of natural spaces is above the median, while it has fallen slightly for other urban areas (Figure III-A). In contrast, the price increase is slightly higher in urban areas with a watercourse between 2017 and 2020 and then, from March 2020 onwards, prices seem to stabilise in urban areas with such an amenity, while they continue to increase sharply in the other areas (Figure III-B).

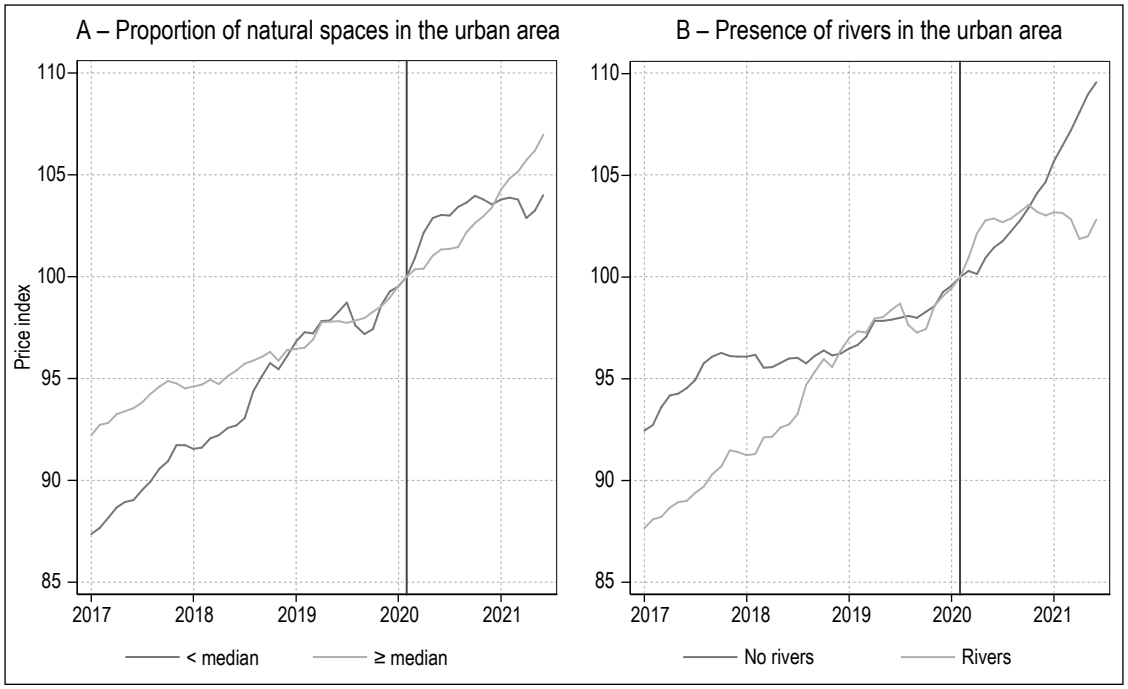
3.2. Estimation Results

3.2.1. Intra-Urban Area Analyses

To analyse the changes in the evolution of prices that occurred after the emergence of COVID-19 between the municipalities of large agglomerations, we estimate equation (1). Fixed municipality effects are introduced to control for possible differences in unobserved characteristics between municipalities, then "date×urban area" and "month×municipality" fixed effects are added to control, respectively, for potential shocks altering price dynamics in certain urban areas, and seasonal variations in prices specific to each municipality. We finally introduce annual linear trends for each municipality, to control for differences in prior linear trends in the evolution of prices. The results are shown in Table 3.

First of all, Table 3, column 1 shows that property prices are negatively associated with the distance to the centre of the urban area, which is a classic result in urban economics. They are also positively associated with population density, which is also as expected. The inclusion of municipality fixed effects has little effect on outcomes. In

Figure III – **Evolution of prices in urban areas according to natural amenities**



Sources: DVF 2016-2021; Corine Land Cover 2018.

Table 3 – **Regressions at municipality level**

Variables	(1)	(2)	(3)	(4)	(5)
Population density (inhabitants/km²)	0.0016***				
	(0.0003)				
Distance to the centre of the UA (km)	−1.1544***				
	(0.0326)				
COVID × Population density	−0.0003***	−0.0004***	−0.0002**	−0.0002*	−0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVID × Distance to the UA centre	0.0044	0.0008	0.0283*	0.0328**	0.0522**
	(0.0128)	(0.0120)	(0.0156)	(0.0163)	(0.0238)
Fixed urban area effects	Yes	No	No	No	No
Fixed Month × Year effects	Yes	Yes	Yes	Yes	Yes
Fixed municipality effects	No	Yes	Yes	Yes	Yes
Date × Urban area	No	No	Yes	Yes	Yes
Month × Municipality	No	No	No	Yes	Yes
Municipality linear trend	No	No	No	No	Yes
Observations	193,173	193,162	193,162	187,031	187,031
R^2	0.2255	0.5083	0.5121	0.6352	0.6522

Notes: *** p<0.01; ** p<0.05; * p<0.1. Standard errors grouped with the municipality in brackets. The estimated coefficients are multiplied by 100 to make them easier to read. The proportion of houses in the municipality is controlled.
Reading note: Each additional 1 kilometre of distance to the centre of the urban area is associated with a 1.15% drop in prices in the municipality. After March 2020, the drop in prices is 1.11% (−1.15+0.04).
Sources: DVF 2016-2021; INSEE, 2017 population census.

contrast, the range of the estimated coefficients is affected more by the addition of the fixed effects "date×urban area" (column 3) and "month×municipality" (col. 4) and by the linear temporal trends by municipality (col. 5). Taking the latter into account tends to increase the significance and range of the estimated coefficients. This is an expected result since price trends before COVID-19 were sometimes different depending on population density and distance to the centre of the urban area (cf. Figure I). The results ultimately show a relative increase in prices in municipalities which have a lower population density and are farther from the centre.

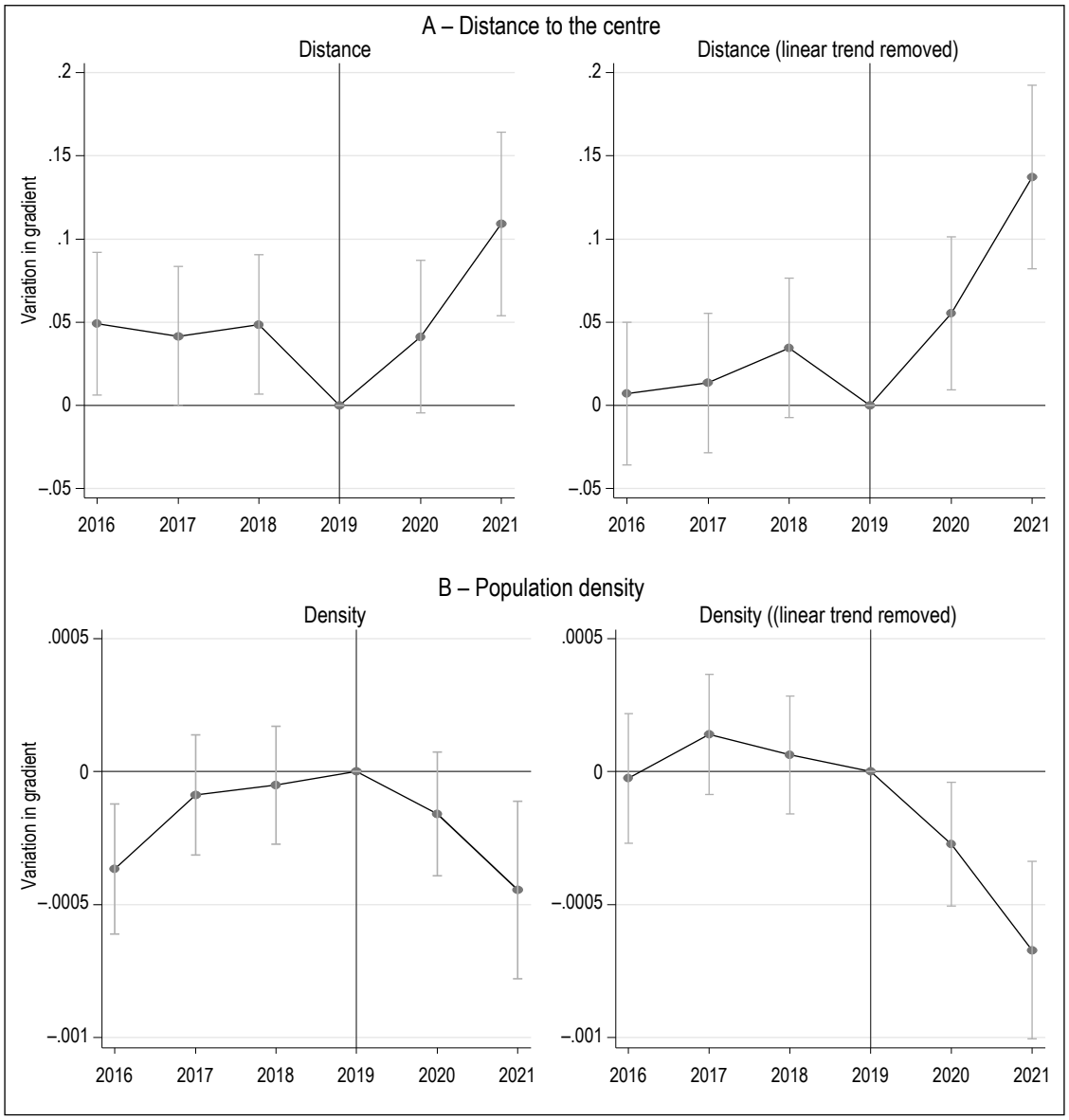
As the analysis of Figure 1 suggested, the difference in prices between densely populated municipalities and more sparsely populated municipalities narrowed after March 2020. The estimation shows that the increase in population

density by one additional inhabitant/km^2 was associated with a price increase of 0.0016% in a municipality between 2016 and March 2020 (Table 3, col. 1). Applying the post-COVID change (col. 5), the same increase in population density was associated with a price increase of only 0.0011% (0.0016−0.0005). This suggests that the attractiveness of purely urban amenities, present in densely populated areas, has lessened in favour of greater demand for space.

There is also a change in relation to the distance from the municipality to the centre of the urban area. The price gradient associated with distance changed from −1.15% for each additional kilometre farther away from the centre to a gradient of −1.10% (−1.15+ 0.05) after March 2020. The distance to the centre of the area, which represents a point of interest for households, therefore remains a factor of lower prices, but less of a factor since the start of the pandemic than it was previously. While proximity to the centre is still sought after in the demand for property, it now seems less valued.

The results obtained with the flexible specifications (equation 3) are presented in Figure IV, first with the same controls as in column 4 of Table 3, then in a version where their (linear) price trends before COVID are removed, i.e. the flexible version of the results presented in column 5 of Table 3. The coefficients correspond to the estimated gradient variations compared to the reference period of 2019.

Figure IV – **Variation in price gradients associated with distance to the centre and population density in the municipality**



Notes: The vertical bars represent the 95% confidence intervals. The first three months of 2020 have been removed.
Sources: DVF 2016-2021; INSEE, 2017 population census; IGN.

As the previous results suggest, even if the coefficients estimated before the emergence of COVID-19 are not always significant, we observe a downward linear trend in the variation of the gradient related to distance (Figure IV-A): before 2020, the distance-related price gradient was lower in absolute value in 2016 than in 2019 and appears to have increased in a fairly linear manner between these two periods; there seems to have been a trend towards concentration around city centres. The year 2020 marks a clear break and a reversal of the trend evidenced by a decrease in the gradient in absolute value. The presence of a trend prior to COVID-19 would therefore tend to cause an underestimation of the effects of the pandemic on the distance-related price gradient. When the previous trend is removed (Figure IV-B), the effects of the pandemic appear even more clearly.

The analysis is substantially identical with respect to the evolution of the population density-related gradient. Here too, there is a clear break in 2020: the trend towards rising prices in densely populated municipalities compared to less densely populated municipalities before the emergence of COVID-19 is followed by a clear relative decrease in prices in densely populated municipalities.

3.2.2. Inter-Urban Areas Analyses

Table 4 presents the results of the estimations for the inter-urban areas specification (equation 2), introducing first the "urban areas" fixed effects, then the "urban areas×month" fixed effects and, finally, the linear trends by urban area.

In line with the predictions of the Rosen-Roback model, we see the positive association between income (and therefore productivity) and property prices. When all controls are included (column 5), we see, after the appearance of the COVID crisis, a relative decrease in prices in urban areas where incomes are high, compared to urban areas where they are lower. While urban areas that show strong economic dynamism (measured by household income) remain very attractive and are therefore subject to strong demand for property, these phenomena are less pronounced after the appearance of COVID. This suggests a possible inflection in preferences, with urban areas with more modest dynamics having new appeal. It is likely that initially lower property prices will generate greater demand, which will ultimately contribute to higher prices in these markets.

In contrast, our results do not show price variations following the emergence of COVID-19 that would be explained by natural amenity variables. The "proportion of tributaries and rivers" variable is never significant and the significant effect of the "COVID×proportion of natural spaces" variable disappears when linear price trends are included. The presence of these natural amenities does not appear to be a particularly decisive feature in the choice of location of households after the crisis and H4 does not seem to be empirically validated in relation to the French property markets.

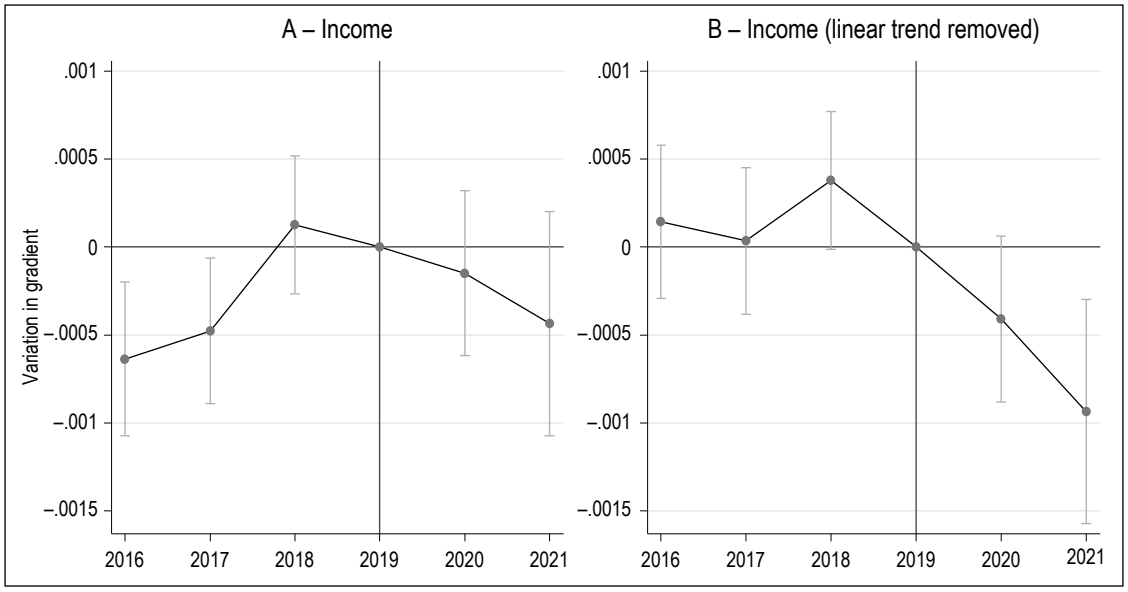
The results obtained from the flexible specifications (equation 4) are shown in Figure V (incomes) and Figure VI (natural amenities). As for the intra-urban area analysis, the model is estimated first without and then with control of (linear) price trends before COVID, which corresponds, respectively, to the controls of columns 3 and 4 of Table 4.

Table 4 – **Regressions at urban area level**

Variables	(1)	(2)	(3)	(4)
Median income (€)	0.0110*** (0.0008)			
Proportion of tributaries and rivers (%)	1.1918 (0.9562)			
Proportion of natural spaces (%)	0.0053 (0.0538)			
COVID × Median income	0.0002 (0.0002)	−0.0000 (0.0002)	−0.0000 (0.0002)	−0.0006** (0.0003)
COVID × Proportion of rivers and tributaries	0.2528 (0.4148)	0.0699 (0.3080)	0.0787 (0.3065)	0.5717 (0.4539)
COVID × Proportion of natural spaces	−0.0248 (0.0244)	−0.0704*** (0.0186)	−0.0662*** (0.0183)	−0.0019 (0.0227)
Fixed Month × Year effects	Yes	Yes	Yes	Yes
Fixed urban area effects	No	Yes	Yes	Yes
Fixed Urban area × Month effects	No	No	Yes	Yes
Urban area linear trend	No	No	No	Yes
Observations	46,976	46,976	46,973	46,973
R^2	0.2477	0.6671	0.7264	0.7352

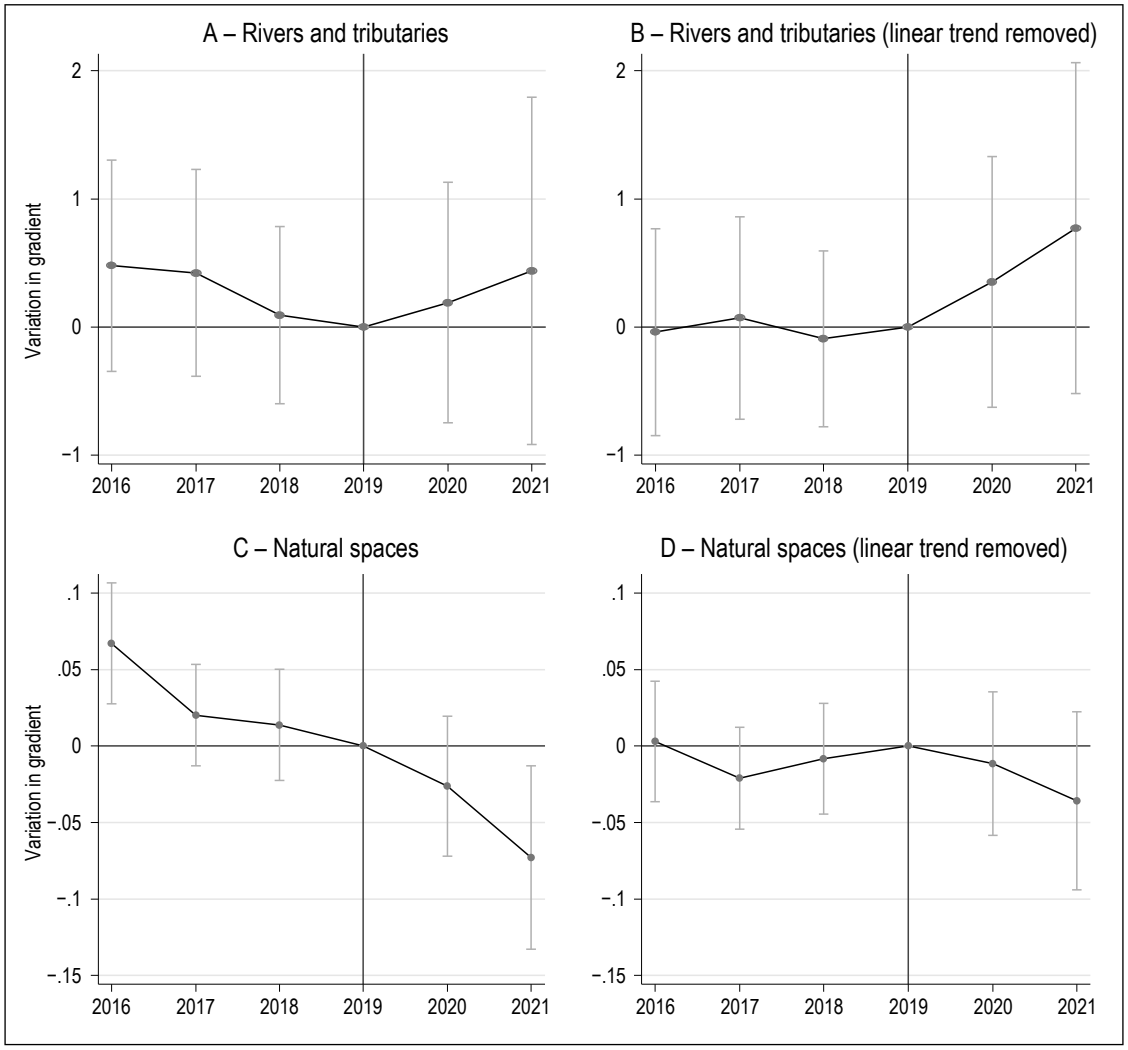
Notes: *** p<0.01; ** p<0.05; * p<0.1. Standard errors grouped with the urban area in brackets. The estimated coefficients are multiplied by 100 to make them easier to read. The proportion of houses in the urban area is controlled.
Reading Note: An increase in median income of €1,000 in the urban area is associated with a price increase of 11%.
Sources: DVF 2016-2021; INSEE, 2017 population census; Corine Land Cover.

Figure V – **Variation in price gradients associated with income**



Notes: The vertical bars represent the 95% confidence intervals. The first 3 months of 2020 have been removed.
Sources: DVF 2016-2021; INSEE, 2017 population census.

Figure VI – **Variation in price gradients associated with the proportion of rivers and tributaries and of natural spaces in the urban area**



Notes: The vertical bars represent the 95% confidence intervals. The first 3 months of 2020 have been removed.
Sources: DVF 2016-2021; Corine Land Cover 2018.

We first see that the gradient positively associating prices and incomes tended to increase in a quite linear way until 2018, stabilised between 2018 and 2019 and decreased sharply after that date (Figure V). Once the previous linear trend has been removed, the gradient decrease from 2020 onwards is even sharper. This confirms the previous results in relation to H3.

In contrast, we do not see any break in the gradients associated with the natural amenities of the urban area (Figure VI): the downward trend of the gradient associated with the proportion of natural spaces continues after 2020 and the gradient associated with the proportion of rivers appears relatively constant throughout the period. As suggested by the results of previous estimations, the evolution of prices according to the presence of these natural amenities within the urban area does not change substantially after the appearance of COVID.

3.3. Robustness

In the analyses conducted so far, we have examined the potential effects of the COVID crisis after March 2020, i.e. the beginning of the first lockdown. However, the effect of COVID on property prices is unlikely to have materialised in the first two months of the period, due to both the lockdown and the delays in completing property transactions. Nevertheless, we estimate an average effect over the period up to July 2021, which does not necessarily imply that the effect started as early as April. Moreover, prices are unlikely to be influenced by the inclusion or non-inclusion of transactions that occurred during lockdown, as there were few such transactions: the average number of transactions per municipality decreased by 53% in April 2020 compared to April 2019. Nonetheless, to check the robustness of the results to the exclusion of transactions unlikely to have been affected by the pandemic, we re-estimate our equations by delaying the start of the COVID period to June 2020, which corresponds to the month following the end of the first lockdown. The results, which are presented in the appendix, show that this change of date does not change the results.

We also carry out "placebo" tests. These tests consist in evaluating the effect of fictitious pandemics that would have occurred in 2017, 2018 and 2019 and considering only transactions that occurred before 2020. The idea is that these fictitious pandemics should not have a significant effect on price dynamics. We estimate the same specifications as those presented in column 5 of Table 3 for municipalities, and column 4 of Table 4 for urban areas, varying the start date of the pandemic between 2017 and 2019. The results (see Appendix) show – reassuringly – no significant change at the 5% threshold in price dynamics after these fictitious pandemics.

* *
*

In this article, we have sought to explore how the pandemic has affected household location choices and residential property markets in France. The results show that, at the intra-urban area level, prices increased relatively more in the least densely populated areas as well as in the areas located farthest from urban centres after the emergence of COVID-19, suggesting that households are seeking more space and place less value on the positive externalities that can be produced by a high population density. At the inter-urban areas level, the level of productivity, reflected by the level of income, also partly explains the differences in price variations. In contrast, we do not find any significant effect related to the level of amenities.

Our results therefore support the expectations of hypotheses 1 and 2, according to which property prices decrease in the centre and increase in the periphery of urban areas, where population densities are lower. They join the results of Gupta *et al*. (2021) and Ramani & Bloom (2021) based on American data. The former show that the crisis has indeed led to lower property prices and rents in city centres and higher prices in areas away from the centre (flattening this relationship between distance to the centre and prices in most US metropolitan areas). The latter show, in major American cities, a shift (the "donut effect") in household demand for property from densely populated city centres towards more sparsely populated suburban locations.

Our estimates also support hypothesis 3, according to which prices rise in agglomerations with low productivity. This result is in line with those obtained by Brueckner *et al*. (2021) which show, on the basis of US data, downward pressure on property prices in high-productivity cities following the health crisis and the development of working remotely. In contrast, hypothesis 4, according to which prices would tend to increase in agglomerations with a certain level of natural amenities, is not verified in our estimates. On this point, our results therefore differ from those obtained by Brueckner *et al*. (2021) showing that property prices have increased in cities with high

levels of amenities and decreased in cities with low levels of amenities. However, for natural amenities, the authors use a richer set of indicators (differences in temperature, precipitation, proximity to the oceans, etc.), some of these not being available at the level of analysis carried out here. We therefore cannot rule out that the amenities that we take into consideration are not necessarily those for which the value placed on them has changed the most.

Our exploration also has other limitations that we must emphasise. In particular, we considered that the pandemic was able to affect the demand for property mainly through two factors: the increased use of telework and changes in preferences related to successive lockdowns. This allowed us to identify a limited number of hypotheses that could then be tested. However, this does not exclude other effects that the pandemic may have had on behaviour related to demand for property: for example, fear of contagion may have increased the psychological costs of transport. In this case, households would opt for locations close to the centre or would give preference to the use of a private vehicle, with an additional cost. This could then mitigate changes in the price gradient across the urban space. It is also not possible for us to distinguish between the respective effects of the two potential factors, or to say that they are precisely the ones that explain the observed evolutions of prices. Deeper societal changes, particularly in relation to work-life balance, may contribute to some of the changes just as much as changes directly caused by the crisis. If this is the case, the health crisis may have acted as an accelerator, leading households to concretise mobility projects they already considered before COVID.

Keeping these limitations in mind, it would nevertheless seem that, at intra-urban area level, we are witnessing a strengthening of the phenomenon of peri-urbanisation that has already been under way for several decades. The effect observed on the prices of the residential property markets of distant and sparsely populated municipalities suggests that it is primarily individuals who can work remotely, who are often executives and have strong economic and cultural capital, that have flocked to peri-urban municipalities. Therefore, in addition to an effect on property prices, these potential changes in the social composition of the inhabitants can ultimately have consequences on the overall economic dynamics of the municipalities. This can lead to gentrification processes, with increased inequality and greater exclusion of the most fragile social categories. Nevertheless, if relatively wealthy populations arrive in municipalities where less affluent populations can remain despite rising price dynamics, for example through social housing, this could foster social diversity.

At inter-urban areas level, the fact that property prices in cities with the lowest productivity are catching up suggests a broader economic and social rebalancing: territories that could have been losing economic impetus could be revitalised by the arrival of a new population. Nevertheless, at this stage, our analysis does not allow us to observe the effects of a social recomposition of municipalities or urban areas at granular level. In addition, it is difficult to determine whether the changes observed over the study period will be confirmed in the longer term or whether they are only temporary: our data stopped in July 2021, at a time when the pandemic was not over and government recommendations on working remotely were still in place. It is therefore necessary to question whether the changes observed will last beyond the pandemic and whether they will affect the dynamics of socio-spatial inequalities. □

BIBLIOGRAPHY

Ahlfeldt, G., Roth, D. & Seidel, T. (2018). The Regional Effects of Germany's National Minimum Wage. *Economics Letters*, 172, 127–130. https://doi.org/10.1016/j.econlet.2018.08.032

Angrist, J. & Pischke, J. (2008). *Mostly Harmless Econometrics*. Princeton University Press.

Alonso, W. (1964). *Location and Land Use. Toward a General Theory of Land Rent*. Cambridge: Harvard University Press.

Bergeaud, A., Eyméoud, J.-B., Garcia, T. & Henricot, D. (2022). Working From Home and Corporate Real Estate. *LIEPP Working Paper*. https://hal-sciencespo.archives-ouvertes.fr/hal-03548889

Brajon, D. & Leroi, P. (2022). Le télétravail s'installe durablement. L'Institut Paris Région, *Note rapide* N° 930. https://www.institutparisregion.fr/fileadmin/NewEtudes/000pack2/Etude_2728/NR_930_web.pdf

Breuillé, M., Le Gallo, J., & Verlhiac, A. (2022). Residential Migration and the COVID-19 Crisis: Towards an Urban Exodus in France? *Economie & Statistique / Economics and Statistics*, 536-37, 57–73 (ce numéro).

Bricongne, J.-C., Meunier, B. & Pouget, S. (2021). Web Scraping Housing Prices in Real-time: the Covid-19 Crisis in the UK. Banque de France*, Working Paper* N° 827. http://dx.doi.org/10.2139/ssrn.3916196

Brueckner, J., Kahn, M. & Lin, G. (2021). A New Spatial Hedonic Equilibrium in the Emerging Work-from-Home Economy. NBER *Working Paper* N° 28526. https://doi.org/10.3386/w28526

Cheung, K., Yiu, E. & Xiong, C. (2021). Housing Market in the Time of Pandemic: A Price Gradient Analysis from the COVID-19 Epicentre in China. *Journal of Risk and Financial Management*, 14(3), 1–17. https://doi.org/10.3390/jrfm14030108

Duc, C. & Souquet, C. (2020). L'impact de la crise sanitaire sur l'organisation et l'activité des sociétés. *Insee Première* N° 1830, décembre. https://www.insee.fr/fr/statistiques/4994488

Dustmann, C., Lindner, A., Schönberg, U., Umkehrer, M. & vom Berge, P. (2022). Reallocation Effects of the Minimum Wage. *Quarterly Journal of Economics*, 137(1), 267–328. https://doi.org/10.1093/qje/qjab028

Egami, N. & Yamauchi, S. (2021). Using Multiple Pre-treatment Periods to Improve Difference-in-Differences and Staggered Adoption Designs. *Working Paper*. https://doi.org/10.48550/arXiv.2102.09948

France Stratégie (2022). Les villes moyennes, un pilier durable de l'aménagement du territoire ? *La note d'analyse,* janvier 2022. https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2022-na107-villes-moyennes-janvier.pdf

Gupta, A., Mittal, V., Peters, J. & Van Nieuwerburgh, S. (2022). Flattening the Curve: Pandemic Induced Revaluation of Urban Real Estate. *Journal of Financial Economics*, 146(2), 594–636. https://doi.org/10.1016/j.jfineco.2021.10.008

Huang, N., Pang, J. & Yang, Y. (2021). COVID-19 and the Urban Housing Market in China. *Working Paper SSRN*. http://dx.doi.org/10.2139/ssrn.3642444

Liu, S. & Su, Y. (2021). The Impact of the COVID-19 Pandemic on the Demand for Density: Evidence from the U.S. Housing Market. *Economics Letters*, 207, 110010. https://doi.org/10.1016/j.econlet.2021.110010

McFadden, D. (1977). Modeling the Choice of Residential Location. *Transportation Research Record*. https://onlinepubs.trb.org/Onlinepubs/trr/1978/673/673-012.pdf

Mills, E. S. (1967). An Aggregative Model of Resource Allocation in a Metropolitan Area. *American Economic Review*, 57, 97–210. https://www.jstor.org/stable/1821621

Monras, J. (2019). Minimum Wages and Spatial Equilibrium: Theory and Evidence. *Journal of Labor Economics*, 37(3), 853–904. https://doi.org/10.1086/702650

Mora, R. & Reggio, I. (2019). Alternative Diff-in-Diffs Estimators with Several Pretreatment Periods. *Econometric Reviews*, 38(5), 465–486. https://doi.org/10.1080/07474938.2017.1348683

Muth, R. F. (1969). *Cities and Housing. The Spatial Pattern of Urban Residential Land Use*. Chicago and London: The University of Chicago Press.

Qian, X., Qiu, S., Zhang, G. (2021). The impact of COVID-19 on housing price: Evidence from China. *Finance Research Letter*, 43, 101944. https://doi.org/10.1016/j.frl.2021.101944

Ramani, A. & Bloom, N. (2021). The Donut Effect of Covid-19 on Cities. NBER *Working Paper* N° 28876. https://doi.org/10.3386/w28876

Roback, J. (1982). Wages, Rents, and the Quality of Life. *Journal of Political Economy*, 90(6), 1257–1278. https://www.jstor.org/stable/1830947

Rosen, K. T. (1979). A Regional Model of Multifamily Housing Starts. *Real Estate Economics*, 7, 63–76. https://doi.org/10.1111/1540-6229.00195

APPENDIX

ROBUSTNESS ANALYSES

Table A1 – **Regression at municipality level (start June 2020)**

Variables	(1)	(2)	(4)	(5)	(6)
Population density	0.0016***				
	(0.0003)				
Distance to the UA centre	−1.1553***				
	(0.0326)				
COVID × Population density	−0.0004***	−0.0004***	−0.0002**	−0.0002**	−0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVID × Distance to the UA centre	0.0093	0.0062	0.0337**	0.0434***	0.0699***
	(0.0133)	(0.0125)	(0.0164)	(0.0168)	(0.0236)
Fixed Month × Year effects	Yes	Yes	Yes	Yes	Yes
Fixed municipality effects	No	Yes	Yes	Yes	Yes
Date × Urban area	No	No	Yes	Yes	Yes
Month × Municipality	No	No	No	Yes	Yes
Municipality linear trend	No	No	No	No	Yes
Observations	193,173	193,162	193,162	187,031	187,031
R^2	0.2255	0.5083	0.5121	0.6352	0.6522

Notes: *** p<0.01; ** p<0.05; * p<0.1. Standard errors grouped with the municipality in brackets. The estimated coefficients are multiplied by 100 to make them easier to read. The proportion of houses in the municipality is controlled.
Sources: DVF 2016-2021; INSEE, 2017 population census.

Table A2 – **Regression at urban area level (start June 2020)**

Variables	(1)		(2)		(3)		(4)	
Median income (€)	0.0111***	(0.0008)						
Proportion of tributaries and rivers (%)	1.2033	(0.9582)						
Proportion of natural spaces (%)	0.0041	(0.0538)						
COVID × Median income	−0.0001	(0.0003)	−0.0002	(0.0002)	−0.0002	(0.0002)	−0.0009***	(0.0003)
COVID × Proportion of tributaries and rivers	0.2292	(0.4689)	0.1459	(0.3552)	0.2183	(0.3590)	0.7554	(0.4792)
COVID × Proportion of natural spaces	−0.0216	(0.0263)	−0.0768***	(0.0200)	−0.0757***	(0.0198)	−0.0192	(0.0236)
Fixed Month × Year effects	Yes		Yes		Yes		Yes	
Fixed urban area effects	No		Yes		Yes		Yes	
Fixed Urban area × Month effects	No		No		Yes		Yes	
Urban area linear trend	No		No		No		Yes	
Observations	46,976		46,976		46,973		46,973	
R^2	0.2477		0.6671		0.7264		0.7353	

Notes: *** p<0.01; ** p<0.05; * p<0.1. Standard errors grouped with the urban area in brackets. The estimated coefficients are multiplied by 100 to make them easier to read. The proportion of houses in the urban area is controlled.
Sources: DVF 2016-2021; INSEE, 2017 population census; Corine Land Cover.

Table A3 – **Placebo tests**

	Municipalities		
	2019	2018	2017
Period × Population density	−0.0001 (0.0001)	−0.0002 (0.0002)	0.0002 (0.0001)
Period × Distance to the centre	−0.0364 (0.0283)	0.0268 (0.0343)	0.0184 (0.0282)
Observations	136,607	136,607	136,607
R^2	0.6862	0.6862	0.6862
	Urban areas		
	2019	2018	2017
Period × Median income	−0.0004 (0.0003)	0.0006* (0.0003)	0.0000 (0.0003)
Period × Proportion of rivers and tributaries (%)	0.0602 (0.4041)	−0.2532 (0.5066)	0.1060 (0.4426)
Period × Proportion of natural spaces (%)	0.0185 (0.0256)	0.0250 (0.0288)	−0.0353 (0.0238)
Observations	34,937	34,937	34,937
R^2	0.7649	0.7649	0.7649

Notes: *** p<0.01; ** p<0.05; * p<0.1. Standard errors grouped with the municipality for municipality level estimates and with the urban area for urban area level estimates, in brackets. The estimated coefficients are multiplied by 100 to make them easier to interpret. The control variables correspond to those in column (4) of Table 3 (or 4) for estimates at municipality (urban area) level. Transactions after 31 December 2019 are removed. The "period" variable corresponds to a fictitious processing date starting at the beginning of the year, indicated at the top of each column.
Sources: DVF 2016-2021; INSEE, 2017 population census; Corine Land Cover.

Regional Analysis of the Impact of the 2020 Health Crisis on the Private-Sector Wage Bill: Structural and Local Effects

Mallory Bedel-Mattmuller*, Fadia El Kadiri* and Lorraine Felder Zentz*

Abstract – In metropolitan France, the private sector was severely affected by the health crisis: despite the widely deployed partial activity scheme, the wage bill fell on average by 5.3% in 2020. However, this overall drop conceals regional disparities. The aim of this article is to study the heterogeneous impact of the health crisis on the private-sector wage bill by employment zones. The analysis shows that the sectoral employment structure is the key factor: it explains 60% of the variation in the shock broken down by region. However, there are also other effects that appear to be significant in certain zones: the labour force qualification level, the level of concentration of companies and the role played by commuters. The latter show that the presence of a neighbouring residential zone has a negative impact on the change in the private-sector wage bill in the region under consideration. Furthermore, they cause the shock-absorbing effect of temporary employment to spill over into several multiple zones, especially within one cluster identified in Brittany.

JEL: E24, R11, R15, J31, C31, G01
Keywords: crisis, employment, employment zones, business sectors, shift-share analysis, spatial autocorrelation, spatial econometrics model

**AGIRC-ARRCO.* Correspondence: *felkadiri@agirc-arrco.fr*

The authors would like to thank the entire AGIRC-ARRCO Technical Department for their availability and advice. The authors would also like to express their sincere thanks to Romane Beaufort, Mélina Ramos-Gorand, and to two anonymous reviewers for their careful reading, advice and insightful comments, which contributed to improve the article. The authors would also like to thank Doriane Mattmuller for her invaluable help with the maps.

Received in October 2021, accepted in July 2022. Translated from: "Une analyse territoriale de l'impact de la crise sanitaire de 2020 sur la masse salariale privée : effets structurels et effets locaux".

Citation: Bedel-Mattmuller, M., El Kadiri, F. & Felder Zentz, L. (2022). Regional Analysis of the Impact of the 2020 Health Crisis on the Private-Sector Wage Bill: Structural and Local Effects. *Economie et Statistique / Economics and Statistics*, 536-37, 95–114. doi: 10.24187/ecostat.2022.536.2082

The year 2020 was marked by an exceptional health crisis due to the COVID-19 pandemic. To stop the spread of the virus, governments took unprecedented action: administrative closures of establishments, strict population lockdowns, curfews, etc. This had an unavoidable impact on the economy: at global level, GDP fell by 3.3% in 2020 (International Monetary Fund, 2021). In France in 2020, business suffered a historic decline, with a 7.9% drop in GDP in constant euro terms (Amoureux *et al.*, 2021). The private sector in particular was very severely impacted by the health crisis: the Urssaf Caisse nationale estimate identified 275,800 salaried job losses (Boulliung & Amoros, 2021). Temporary employment in particular levelled out, matching the different restriction measures in the short term. However, job losses in France were avoided thanks to the partial activity scheme and the various aid schemes and arrangements offered by the State (solidarity funds, state-guaranteed loans, direct tax remittances, etc.).

The business sectors are split heterogeneously over French territory, which is why the regions were not affected to the same extent by the economic crisis. As such, departments specialising in tourism or industry were affected first: for example Corsica or Savoie, or even Ain and Pas-de-Calais (Charton & Durieux, 2021). Conversely, regions in which the use of remote working is more common, such as Île-de-France, were relatively more resistant to the health crisis (OECD, 2020).

To better understand the heterogeneous impacts of the health crisis on employment in France, regional analyses have been carried out in order to isolate the effect associated with the sectoral structure of local employment. They are based on the shift-share method, which makes it possible to break down a change or a rate associated with employment (for example, changes in the number of jobs or the rate of use of the partial activity scheme) into a structural effect reflecting the sectoral breakdown of local employment and a local residual effect obtained by difference (Kubrak, 2018). The first analyses of the health crisis show that, although the sectoral employment structure is a significant component in explaining the variability of the shock between the regions, it alone is not sufficient to explain this entirely. For example, works studying the impact of the health crisis based on the change in the number of jobs (Bouvart *et al.*, 2021) or based on the change in the private-sector wage bill (Barrot, 2021) show that these are the local effects that had a determining impact. The regions identified as having best withstood the health crisis thanks to significant local effects are primarily situated in Brittany and Nouvelle-Aquitaine (DATAR, 2021).

In addition to the sectoral structure of local jobs, the issue of the location of the companies therefore appears to play a central role in assessing the local impact of the health crisis. Since the work of Paul Krugman on geographic economy (Krugman, 1991), it is generally recognised that the economic agents are dependent on the local context. Accordingly, companies appear to set up in dense areas as they are looking for clustering economies, which can lead to different ripple effects. As these are associated with the location of the agents, we more often talk of geographic spillover effects (Baumont *et al.*, 2000). These mechanisms could even be the "key driver of performance in regions" and neighbouring regions (Carré *et al.*, 2019; Yang & Wong, 2012). In France, significant spillover effects have been highlighted, in relation to company creations in metropolitan areas (Brunetto & Levratto, 2017) and, in employment areas, in the number of jobs between 2009 and 2015 (Carré *et al.*, 2019).

Can we identify the factors that explain the heterogeneity of the impact of the health crisis accross territories? Are local sectoral structures a key factor? In this article, we study the territorial impact of the health crisis based on the evolution of the wage bill in the private sector, using data from the Agirc-Arrco (the fund for supplementary pensions in the private sector) wage database. We place at the centre of the analysis the concepts of structural effect and local effect, *via* a spatial analysis.

Studying the change in the private wage bill has a double advantage: this indicator makes it possible to account for the effect of the health crisis on the number of jobs, and it also integrates its impact on wages and, thereby, the massive reliance on the partial activity scheme.

We look more deeply into the concept of local effect with spatial econometric methods. Indeed, it appears to be important to gain a better understanding of the local effect, shown in the literature as essentiel, to explaining the heterogeneous impact of the health crisis in France. To account in greater detail for the role played by neighbouring effects, the concept of spatial autocorrelation is used to study the influence of neighbouring regions; it is defined

as the correlation, positive or negative, between a variable for a given zone and the same variable calculated in the neighbouring regions (Loonis & Bellefon, 2018).

After a brief presentation of the data used in section 1, section 2 presents the heterogeneous impact of the 2020 health crisis on the private-sector wage bill at employment zone level. The link between local sectoral composition and the change in private-sector wage bill is analysed using the shift-share method. In section 3, we explore the other factors that explain the differentiated impact of the health crisis by region.

1. Data and Methodology

The scope of the article covers private-sector employees, more specifically AGIRC-ARRCO contributors. In France, private-sector employees and their employers make obligatory contributions to the *Caisse nationale d'assurance vieillesse* (CNAV, the French National Old-Age Pension Fund) or the *Mutualité sociale agricole* (MSA, for the agricultural sector) for their basic retirement pension and to AGIRC-ARRCO for their supplementary pension. AGIRC-ARRCO had 18.9 million contributors at 31 December 2020. The scope of the study does not include employees of private individuals (1.3 million in 2020), those under the MSA scheme (around 1.4 million employees in 2020) or private-sector teachers (around 115,000 employees in 2020).

The database used for the study is the *base individuelle salaires* (individual salaries database). It is constructed based on the 2018 Annual Social Data Declarations (DADS) and monthly data from Nominative Social Declarations (DSN). It is aggregated at job level: individual-establishment identifier (Siret) pair. The available data relate to the employees (age, address, etc.), their employment contract (permanent, fixed-term, full-time, part-time, category status, etc.), gross salary received and the period to which that salary relates. The other information available in the database relates to the employer's establishment: NAF code, address (in particular so as to define the employment zone and whether this is a residential zone or not, etc.) and a potential use of the partial activity scheme.

The 2018 salary database has 30.1 million entries. The 2019 and 2020 salary databases are constructed using DSN data only and comprise 30.6 and 28.5 million entries, respectively. The only external data source used is the unemployment rate in 2019 taken from INSEE data.

The business sectors were studied at level 2 of the French Classification of Activities (NAF), which contains 82 sectors, excluding agricultural subsectors and activities of households as employers. At this aggregation level, specific subsectors that were relatively unaffected by the health crisis are sometimes associated with other sectors that were heavily affected. For example, the "other manufacturing industries" sector includes the medical and dental supplies and instrument manufacturing subgroup, as well as the specific jewellery, games and toys, musical instruments and sporting goods manufacturing subsectors. Furthermore, temporary workers (employment-related activities sector employees) are not classified into the sector in which their contract is performed. However, this form of employment is heavily concentrated in certain sectors (manufacturing industry, construction, transport and storage): the effect of the health crisis on employment may therefore be underestimated in these sectors.

The analysis is restricted to metropolitan France, as French overseas departments and territories were affected differently by the measures seeking to curb the pandemic. The territorial grid used in the study is the employment zone, defined as "a group of municipalities in which most of the active population live and work" (Lévy *et al.*, 2020). This breakdown seems to be the most appropriate for analysing the dynamics of local employment. This zoning, updated in 2020 by INSEE using a detailed analysis of home-work commutes, gives 287 employment zones in metropolitan France.

Unless otherwise specified, the study examines, for all indicators, the year 2020 in its entirety; it does not take an infra-annual approach as is the case for other analyses on this subject. The 2019-2020 annual change ("health crisis" effect) may also be compared to the 2018-2019 annual change.

The key indicator in the study is the average change in the private-sector wage bill between 2019 and 2020 excluding partial activity compensation.[1]

1. Partial activity compensation is not subject to social security contributions and is therefore not included in a private-sector wage bill.

2. Heterogeneity of the Impact of the Health Crisis by Region and Sectoral Employment Structure

2.1. Pronounced Heterogeneity by Specialisation

The repercussions of the 2020 health crisis on private-sector salaried employment are many: drop in the number of employees over the year (−2%), drop in the number of positions (−6.9%), and drop in the private-sector wage bill (−5.3%). The changes were, however, very different depending on the employment zone, ranging from −21% to +0.7% in the case of the private-sector wage bill. The map (Figure I) shows these local changes, highlighting the heterogeneous impact of the health crisis in metropolitan France.

This heterogeneity seems to be linked to local sector-based specific features. One underlying element was the use of the partial activity scheme, which was very unequal across business sectors (see Appendix 1).

To report on the sectoral specialisation of the regions, we created a specificity index. It is calculated for each zone z and each sector s as follows (Kubrak, 2013):

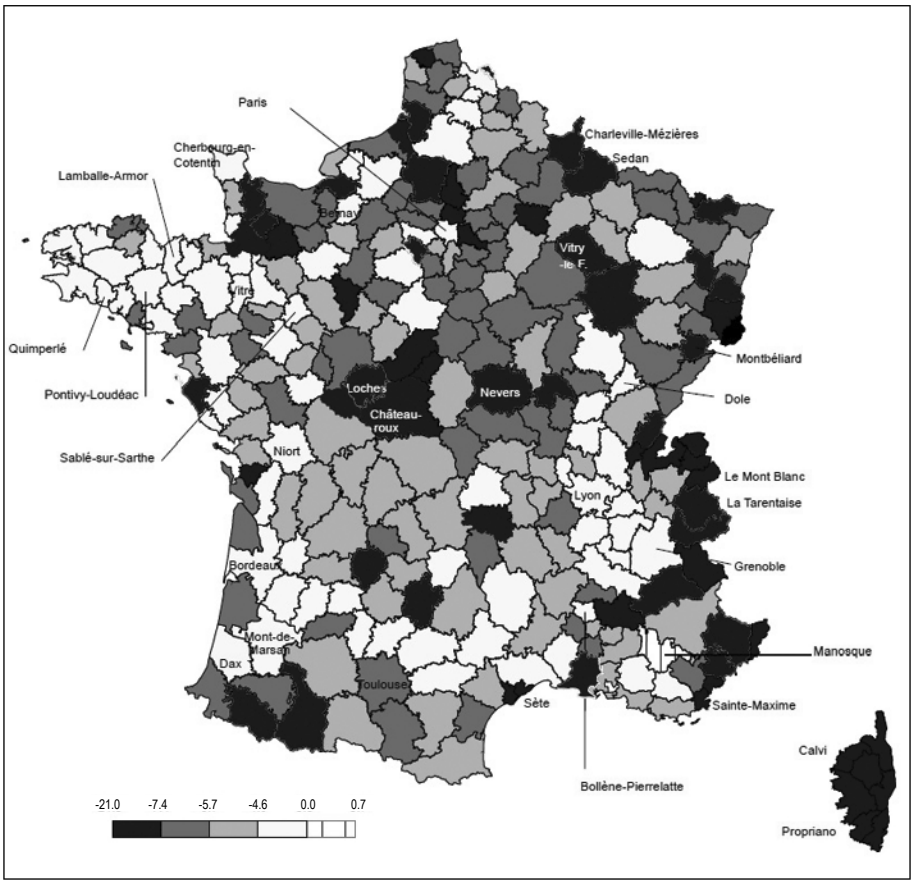
$$Specificity\,index_{sz} = \frac{Empl._{sz} / Empl._{z}}{\left(Empl._{s} - Empl._{sz}\right) / \left(Total\,empl - Empl._{z}\right)}$$

(with *Empl.* the number of employments).

The index is 0 or higher; when the index is above 1, we estimate that the region is more specialised than the average in the sector under examination (Appendix 2 presents several sectoral specificity indices calculated for 2019 in order to report on the sectoral specialisation of the regions before the health crisis). Some sectoral specificity indices are strongly correlated (Pearson correlation coefficients significantly different from zero) to the change in the 2020 private-sector wage bill (Table 1).

The regions most affected by the health crisis include, in particular, Corsica (Calvi,

Figure I – **Average change in private-sector wage bill by employment zone between 2019 and 2020**



Notes: The categories correspond to the quartiles of the average change in the private-sector wage bill between 2019 and 2020; an additional category relates to the one employment zone (Manosque) that experienced positive growth.
Reading note: In the Calvi employment zone, the private-sector wage bill fell, on average, by 21% between 2019 and 2020.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

Table 1 – **Correlation coefficients between the change in the private-sector wage bill in 2020 and the sectoral specificity indices**

Business sector	Correlation coefficients
Hospitality	–0.60***
Construction	–0.21***
Metalworking	–0.13**
Metal product manufacture	–0.12**
Manufacture of motor vehicles	–0.10*
Manufacture of food products	0.23***
Insurance	0.17***
Chemical industry	0.17***
Scientific research and development	0.13**

Notes: The values are different from zero at significance levels alpha=0.01***; alpha=0.05**, alpha=0.1*.
Reading note: The correlation coefficient between the specificity index of the hospitality sector and the change in the wage bill in 2020 is −0.60.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

for example, with an average change in the private-sector wage bill of −21%) and employment zones situated on the Côte d'Azur or in the Alps. These regions share a high degree of specialisation in the hospitality sector, associated with their tourist appeal (this sector is at least 3.5 times larger in these regions than in the rest of France), and the construction sector, to a lesser extent. However, these specialisations appear to be negatively correlated to the local change in the private-sector wage bill, with the highest specificity index values associated with the lowest wage-bill variation values.

The more industrialised regions belong to the group of zones most impacted by the health crisis. Some regions particularly affected are situated in the north and north-east of France, with employment zones specialising in the automotive industry (specificity indices above 5, see Appendix 2), metalworking (specificity indices above 14) and metal product manufacture (specificity indices above 2.5). This metal specialisation is also found in central France. The changes here are highlighted by Chausse *et al.* (2021).

Conversely, the employment zones least affected by the health crisis are primarily found in the west and south-west of France. This relates firstly to the Breton and western regions as well as employment zones situated further south. These regions specialise in the food industries; as also shown by Bouvart *et al.* (2021), this sector is at least six times larger in these employment zones than in the rest of France. In the west, some regions specialising in the insurance sector were relatively resistant to the health crisis (for example Niort: −1.5%), as were some zones specialising in the manufacture of chemicals and chemical products. This confirms the resilience of the chemical industry, as also shown by Boisbras (2021). Lastly, some regions in the east were affected to a relatively lesser extent, these regions also specialising in the manufacture of chemicals products (specificity indices above 10), or in scientific research and development (specificity indices above 8).

2.2. Decomposition of Structural and Local Effects

In order to more clearly isolate the effects of the health crisis linked to business sectors, the change in the 2020 private-sector wage bill is broken down into a structural effect, reflecting the sectoral component of the jobs, and a residual effect, which can be interpreted as a local effect.[2] This method is called a shift-share analysis (Kubrak, 2018).

The structural effect is calculated as the difference, for each employment zone z, between the expected change in the private-sector wage bill (MS)[3] and the change at national level:

$$Structural\ effect_z = Expected\ variation\ MS_z - National\ variation\ MS$$

It corresponds to the part of the deviation from the national variation that is explained by the

2. The local effect calculated using the shift-share method depends on the level of aggregation used to define the business sectors, as specific subsectors relatively untouched by the health crisis may be associated with other severely affected sectors.

3. For each employment zone z, the expected change in the private-sector wage bill between 2019 and 2020 is defined as the change that would have been seen in the region if the wage bill of each business sector s of the zone had changed in line with the variation seen for metropolitan France. It is therefore calculated by applying the national changes in the wage bill observed in each sector to the structure of the region's private-sector wage bill:

$$Expected\ variation\ \mathrm{MS}_z = \sum_s \frac{\mathrm{MS}_{sz}}{\mathrm{MS}_z} \times National\ variation\ \mathrm{MS}_s.$$

sectoral employment structure specific to the region. If, all other things being equal, the region is more specialised than the average (i.e. metropolitan France) in the sectors generally spared from the health crisis, its structural effect will be positive.

The difference, for each employment zone z, between the change observed and the change expected forms the local effect: $Local\ effect_z = Variation\ MS_z - Expected\ variation\ MS_z$. It can be interpreted as the gap between the sector-based private-sector wage bill changes at regional and national level, weighted by the wage bill structure by business sector in the zone.

The difference between the change observed at regional level and the national variation allows us to define two groups of regions: if the difference is positive (or negative), this means that the region experienced a higher (lower) variation in the private-sector wage bill than the national change. The employment zone is therefore more (less) dynamic and fared relatively better (worse) in terms of withstanding the health crisis. Furthermore, the difference between the change observed at regional level and the national variation is the same as the sum of the structural and local effects:

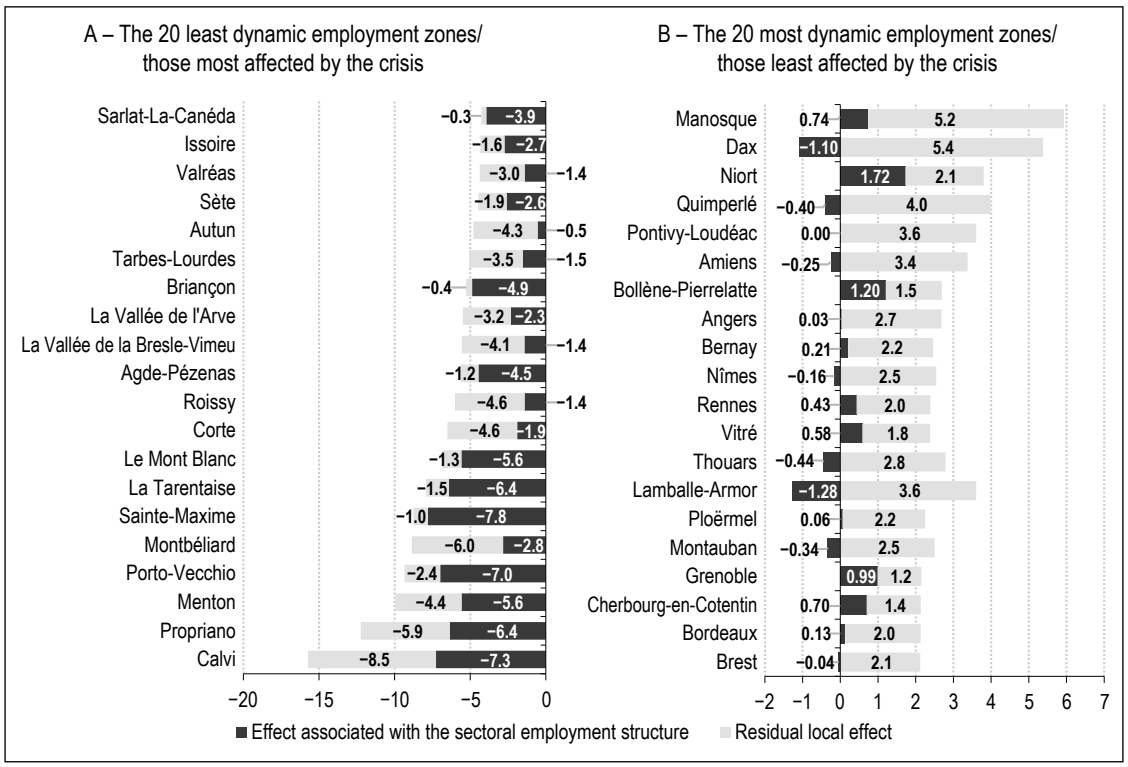
$$Variation\ MS_z - National\ variation\ MS = Structural\ effect_z + Local\ effect_z$$

This is why the effects of the health crisis that are explained by the sectoral component of jobs can easily be separated from those associated with a local effect.

The map showing the results of this analysis can be found in Appendix 3 and the regional typology based on this method is presented in Appendix 4. We also provide a particularly focused look at the 20 regions that were most/least affected by the health crisis, the results of which are similar to those obtained by Bouvart *et al.* (2021) in terms of the rate of use of partial activity. This is explained by the choice to examine the change in the private-sector wage bill as it includes the effects backed by the use of the partial activity scheme.[4] For example, regions specialising in sectors heavily impacted by the health crisis are characterised by a strongly negative structural effect (Figure II-A). This is the case for predominantly tourist-based employment zones, which

4. The Pearson correlation coefficient between the change in the private-sector wage bill between 2019 and 2020 and the proportion of days spent in partial activity in 2020 is −0.7. It is significant.

Figure II – **Breakdown of the change in the private-sector wage bill in 2020, as a deviation from the national average according to the shift-share analysis**



Reading note: In the Calvi employment zone, the deviation from the 2020 national average variation in the wage bill is −15.7%. 7.3% of this deviation is due to the sectoral employment structure and 8.5% is due to the residual local effect.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

have many jobs in hospitality: Calvi, Propriano, Menton, Porto-Vecchio, Sainte-Maxime, La Tarentaise, Mont-Blanc, Corte, Agde-Pézenas. The least dynamic regions also include industrial zones, such as Roissy (air transport) and Montbéliard (automobile industry and metallurgy). In these zones, the local effect is also negative, and accentuates the sectoral shock associated with the health crisis.

Conversely, in the most dynamic regions (Figure II-B), two positive effects combine. On the one hand, the effect associated with the sectoral employment structure is either negative but weak, or positive. This is explained by the presence of sectors that withstood the health crisis particularly well, such as the food industries (Rennes and Vitré employment zones), the chemicals industry (Bollène-Pierrelatte) or the insurance sector (Niort). On the other hand, the local effect is positive. It therefore seems to be essential to examine the phenomena perceived here.

The shift-share breakdown makes it possible to say that the structural effect associated with the change in the private-sector wage bill is a decisive factor in explaining the heterogeneous impact of the health crisis in the employment zones.[5] However, local effects remain prominent in numerous zones (see Appendix 4: in the regions of group 1 of the typology, the local effect represents, on average, 60% of the deviation from the national average variation). Furthermore, other analyses estimate that it is these local effects that prevail if the impact of the health crisis is examined on the basis of the change in the number of jobs (Bouvart *et al.*, 2021). Therefore, dimensions other than the business sectors must be taken into consideration.

3. The Heterogeneity of the Impact of the Health Crisis by Region Is also Due to Other Local Characteristics

3.1. The Spatial Autocorrelation Is Significant for 2020

Given the literature and recent studies carried out on similar issues, the study of the location of companies and the inclusion of interactions between neighbouring regions seem to be interesting dimensions to analyse. To examine the influences between neighbouring regions, it is necessary to define the concept of proximity. An initial possibility is to base the definition of proximity on the notion of distance between regions. This distance could itself be defined in several ways, using geometric concepts[6] or based on the closest neighbours. Another possibility, which we have used here, is to take into consideration common borders between regions, i.e. the notion of contiguity. The study data are calculated at employment zone level: these are surface area data, which sometimes correspond to administrative borders. In this case, proximity in the sense of contiguity is commonly used. The concept of proximity is shown statistically by a weighting matrix, W, for which each element defines the proximity link between one region i and another region j. As the primary definition used for proximity is contiguity, the elements of the associated weighting matrix are therefore defined as:

$$w_{ij} = \begin{cases} 1 \text{ if the employment zones } i \text{ and } j \\ \text{have a common border} \\ 0 \text{ otherwise} \end{cases}$$

There are two statistical tests that can be used to test the presence of spatial autocorrelation, incorporating the proximity relationships defined in W: Moran's I test and Geary's C test – the first being generally preferred in the literature due to its stability. They make it possible to check whether the value obtained in the given region is close to the values obtained for the same variable in the neighbouring zones (Loonis & Bellefon, 2018).

The study of the local variations in the private-sector wage bill in 2020 shows that the spatial autocorrelation is positive and significant: similar values are pooled in neighbouring regions.[7] This result is in line with those of other analyses that highlight the positive spatial autocorrelation of various indicators associated with the labour market (the number of jobs in Levratto *et al.*, 2017; the change in the number of jobs in Carré *et al.*, 2020; the unemployment rate, the rate of informal employment and real salaries in Koike Quintanar, 2019).

---

5. Indeed, the correlation between the deviation from the national average variation and the structural effect increased significantly in 2020 (Dunn and Clark test, Dunn & Clark, 1969). Moreover, a study released by the CDC Institute for Research shows that this relationship was stronger in 2020 than it was at the time of the 2008-2009 financial crisis (Pacini et al.*, 2021). This finding is due to the fact that the change in the private-sector wage bill includes the use of the partial activity scheme, which was more widespread during the 2020 health crisis than during the 2008-2009 crisis, and which differs greatly by business sector (see Appendix 1).*

6. "Delaunay triangulation is a geometric method that connects the points in the form of triangles so as to maximise the minimum of all the angles of the triangles (this triangulation tends to avoid sliver triangles). […]. The sphere of influence graph links two points if their 'circles from the nearest neighbour' intersect. […]. The Gabriel graph links two points p_i *and* p_j *if and only if all other points are outside the circle with diameter* $[p_i ; p_j]$ *[…]. The graph of relative neighbours considers two points* p_i *and* p_j *to be neighbours if* $d(p_i, p_j) \leq \max[d(p_i, p_k), d(p_j, p_k)] \; \forall \; k = 1,\ldots,n \; k \neq i, j$ *with* $d(p_i, p_j)$ *the distance between* p_i *and* p_j*." (Loonis & Bellefon, 2018).*

7. This conclusion is robust as the results are significant irrespective of the concept of proximity used.

The spatial autocorrelation at employment zone level calculated for the 2018-2019 variation is also significant, though to a lesser extent. Moran's index I[8] is 0.2 when calculated for the change in the private-sector wage bill by employment zone between 2018 and 2019 and 0.34 between 2019 and 2020 (Table 2): this suggests that the health crisis has accentuated the overall spatial autocorrelation.

The analysis of the spatial autocorrelation indicators may also be carried out on the structural effects and local effects from the shift-share breakdown (Levratto *et al.*, 2017). As these two variables are correlated to the change in the private-sector wage bill, the tests also conclude that there is a positive and significant spatial autocorrelation. Conversely, the spatial autocorrelation of the structural effects is almost unchanged between 2019 and 2020 (0.29 compared with 0.28), in contrast to the spatial autocorrelation of the local effects (0.15 compared to 0.32). It would therefore seem that the increase in the spatial autocorrelation of the change in the private-sector wage bill is due to an increase in the spatial autocorrelation of local effects during the health crisis. In other words, the more intensive link between neighbouring regions in 2020 is not linked to the regions' sectoral specialisations, but to local effects. Specifying a spatial model will make it possible to clarify these different relationships.

3.2. Estimation of the Impact of the Health Crisis on the Private-Sector Wage Bill with Spatial Econometric Models

3.2.1. Model Specification

A simplified model with the structural effect as the only explanatory variable is tested as part of the initial approach; the model's error term is therefore assimilated to the local effect of the region. Specifying the model in this way makes it possible to test the relationship between the change in the private-sector wage bill in 2020 and the structural effect, on the one hand, and the local (residual) effect, on the other.

For this, and as the spatial autocorrelation of the variation in the private-sector wage bill has been proven, it is possible to introduce the proximity matrix W into the model. As the relationship of proximity may operate on several levels, there are different ways of specifying a spatial model.

Spatial correlation may be present in unobserved characteristics, in which case W intervenes in the model error: this is the SEM (Spatial Error Model), which is formulated as follows: $Y = X\beta + u$, where $u = \lambda Wu + \varepsilon$. Starting from the principle that the change in the private-sector wage bill for a given region depends on that of its neighbouring regions, the model, which in this case is a spatial autoregressive model (SAR), also known as an endogenous interaction model, is formulated as follows: $Y = \rho WY + X\beta + \varepsilon$. The change in the private-sector wage bill of a given region can also depend on the structural effects of its neighbouring regions: $Y = X\beta + WX\theta + \varepsilon$, this is the exogenous interaction model (spatial lag X, SLX). Lastly, the spatial Durbin model (SDM) involves both endogenous and exogenous interactions: $Y = \rho WY + X\beta + WX\theta + \varepsilon$[9] (Loonis & Bellefon, 2018). The idea behind this initial approach is twofold: to estimate the variability in the changes in the private-sector wage bill explained by the variability in the structural effects (and therefore to measure the extent to which the sectoral structure is a key factor in explaining the heterogeneous impact of the health crisis), and to identify the level at which the spatial autocorrelation operates when the specified model contains the structural effect as the only explanatory variable. This is why these four models are estimated.

Once the estimates have been carried out for 2020, the different practical approaches[10] lead

8. *Moran's index is defined for any variable* y *as:*

$$I = \frac{n}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_i (y_i - \bar{y})^2} \quad i \neq j$$

where n *is the number of regions and* w_{ij} *is the relationship of proximity between the zones* i *and* j*. The Moran* I *is between −1 and 1; it is interpreted as a correlation coefficient.*

9. *The SDM model is currently used in the literature, as it is more robust against poor specification choices (Loonis & Bellefon, 2018).*

10. *Several approaches coexist for choosing the most appropriate model. The bottom-up approach consists in starting by testing an OLS model, then carrying out Lagrange multiplier tests on* λ *and* ρ *(Anselin* et al.*, 1996). The top-down approach consists in starting the other way round, by testing an SDM model (LeSage & Pace, 2009). The mixed approach takes the start of the bottom-up approach, and, in the case of spatial interactions, suggests testing an SDM model (Elhorst, 2010). The summary of these approaches is taken from Loonis & Bellefon (2018).*

Table 2 – **Overall Moran's *I* values in 2019 and 2020 associated with the change in the private-sector wage bill, structural effects and local effects**

	Average change in the wage bill	Structural effects	Local effects
2019	0.20	0.29	0.15
2020	0.34	0.28	0.32

Notes: The values are different from zero at significance level alpha=0.01. Contiguity matrix.
Reading note: The Moran index is 0.29 when it is calculated for the 2019 structural effect and 0.28 when calculated for the 2020 structural change.

us to choose the SEM model as the most robust. With an adjusted R^2 of 0.60 (in other words, 60% of the variability in local changes in the private-sector wage bill is due to the variability in structural effects), the local sectoral structure is therefore the first factor explaining the heterogeneous impact of the health crisis on the private-sector wage bill.

The results of estimating an SEM model also confirm the results presented previously: the change in the private-sector wage bill in 2020 also depends on other unobserved characteristics with a spatial autocorrelation ($\hat{\lambda}$ significantly different from 0), and incorporating the local effect. With the aim of clarifying the local effects, namely variability which is still to be explained, a model containing the structural effect (expressed as the deviation from the average national private-sector wage bill variation between 2019 and 2020) and additional explanatory variables representing other aspects of the local pre-health crisis context (calculated in 2019) is tested as part of the second approach.

There are many determining factors of local effects. The local effect could incorporate other characteristics of the local labour market, such as "the size of the companies established in the local area or the level of qualification of the labour force" (Bouvart *et al.*, 2021), the "contraction in local demand linked to the drop in activity" or even the "development of remote working" but also, given the nature of the 2020 crisis, the potential effect of the local "epidemic intensity" (Barrot, 2021). It is also useful to assimilate the local effect to the more global concept of regional attractiveness (Zaninetti, 2016). Lastly, Levratto & Carré (2013) associate it more with geographic and/or political concepts: "geographic situation in the national economic space, measures taken in favour of or to the detriment of the region, the region's own dynamism, etc.". The Herfindahl index[11] is introduced into the model to represent the size of establishments, and the proportion of executives[12] is selected to reflect the level of qualification of the workforce. The unemployment rate, used as a proxy for the economic situation, is also added.

Furthermore, following other spatial studies on employment (Carré *et al.*, 2020; Brunetto & Levratto, 2017; Levratto *et al.*, 2017), we also introduced the number of jobs per km² (i.e. the job density), which captures clustering effects, and an indicator of the region's predominantly residential nature that represents the openness of the employment zone's activities to the outside.[13] Lastly, given the specific nature of the employment-related activities sector (temporary employment) during the health crisis, in particular with regard to the partial activity scheme (see Appendix 1), we also introduced the proportion of jobs in this sector.[14]

As for the simplified model, several models (OLS and spatial) are estimated (see Table A5-2 in appendix, and Table A5-1 for comparison with 2019). The different practical approaches this time lead us to choose the SDM model as the most robust; this is also the one that gives the best performance of all the models tested (highest R^2, lowest AIC[15]). The formulation of this model suggests that the spatial autocorrelation no longer functions in the error term – as was the case in the first approach with the structural effect as the sole explanatory variable; the addition of further variables therefore seems to allow for a greater understanding of the local effect that presents a spatial autocorrelation. As the SDM model contains spatially offset variables *WY* and *WX*, the interpretation of the relationships between the change in the private-sector wage bill and the different explanatory variables must still take into consideration interactions and feedback between regions, which is why the direct and indirect effects are generally used to break down these different relationships (Loonis & Bellefon, 2018). The direct effect corresponds to the impact of a change in an explanatory variable in this region on the change in the private-sector wage bill in employment zone *z*. This indicator takes into consideration the feedback effects observed between employment zones: an explanatory

11. For each employment zone, the Herfindahl-Hirschman (HHI) index is equal to the sum of the squares of the shares of the region's establishments in its employment. It is a measure of local market concentration.

12. The concept of executive is defined here as belonging to the categories laid down in Articles 4&4 bis or 36 of the French National Collective Agreement on Retirement and Insurance for Executives of 14 March 1947, on the creation of the AGIRC (General Association of Pension Institutions for Executives) scheme. The definition of "executive" within the meaning of the AGIRC does not exactly match that of the INSEE socio-professional nomenclature.

13. The "residential zone" indicator is taken from the employment zone typology given in Lévy et al. *(2020). It is built around the concept of presential sphere, which "covers activities implemented locally for the production of goods and services aiming at the satisfaction of the needs of persons present in the zone".*

14. Other variables could have been tested, but they were not ultimately included as they are strongly correlated with the variables selected above. This is the case for the proportion of new jobs in total jobs in 2019, the proportion of permanent contracts in 2019, the decile ratio of salaries in 2019 and the proportion of days spent in partial activity in 2020. As a result, the absence of correlation was verified for all explanatory variables selected (structural effect, Herfindahl index, proportion of executives, unemployment rate, job density, residential zone, and proportion of jobs in the employment-related activities sector).

15. The adjusted R^2 *of the SDM model is 0.67, whereas it was 0.60 when the structural effect was the only explanatory variable. This result suggests that the structural effect is the predominant factor explaining the heterogeneous impact of the health crisis on the private-sector wage bill, to a much greater extent than the other local characteristics.*

variable for a given region *z* can have an effect on the change in the private-sector wage bill in region *z*, but also on that of its neighbouring regions, which, in return, impacts region *z*. Symmetrically, the indirect effect corresponds to the impact of a change of explanatory variable in all employment zones other than employment zone *z* on that latter zone. It therefore represents the spillover effect.

3.2.2. Results

Table 3 presents the results of the estimate of the direct and indirect effects of each explanatory variable.

The local context in 2019, taken from the perspective of the unemployment rate and job density, seems not to have an impact on the change in the private-sector wage bill during the 2020 health crisis; these two variables do not appear significant in terms of either direct effect or indirect effect. This result (also obtained in 2019) is different from that obtained by Carré *et al.* (2020) in relation to the variation in salaried employment. This suggests that the private-sector wage bill (which incorporates the simultaneous effects on workforce and wages) is less sensitive to the economic context and the agglomeration effects than the salaried workforce when considered on its own.

The variables associated with the business sectors (the structural effect and the share of temporary employment in salaried jobs in 2019) have a direct positive effect that is significantly different from zero. The relationship between the change in the private-sector wage bill and the structural effect is therefore again verified using this specification: if, all other things being equal, the region is more specialised than the average (metropolitan France) in sectors heavily impacted by the health crisis, it belongs to the group of regions for which the private-sector wage bill fell the most. This result suggests that this relationship does not depend on the location of the region and its neighbours. Furthermore, the temporary employment sector (employment-related activities) plays a determining factor in the local variation of the private-sector wage bill. Temporary jobs, characterised by lower wage levels (−23% compared with the average salary per capita in metropolitan France in 2019[16]), are the first to be lost in the event of a crisis, forming a sort of "safety valve" (Pérez *et al.*, 2015). The regions with the highest levels of temporary employment therefore benefitted from a favourable composition effect: their private-sector wage bill fell by less than their workforce numbers.[17] This is particularly prevalent in Brittany, and especially in seven employment zones forming a cluster (Box). For example, in the Pontivy-Loudéac employment zone where 29.1% of jobs in 2019 were held by temporary workers, the number of employees fell by 5.2% and the wage bill by 1.7% in 2020, and in the neighbouring zone of Lamballe-Armor (25.4% temporary jobs in 2019), the number of employees fell by 4.9% while the wage bill fell by 3%. Moreover, due to temporary workers commuting from one employment zone to another (the "commuters"), the temporary employment effect spills over

16. By way of comparison, Urssaf Caisse nationale estimates that the average salary per capita of temporary workers is 15% lower than the total average salary per capita in 2020 over a wider scope: metropolitan France and overseas departments and territories (Boulliung & Amoros, 2021).

17. This categorises them in the employment zones having best withstood the health crisis, in the sense of the change in their private-sector wage bill between 2019 and 2020. Conversely, the regions characterised by lower temporary employment (for example, Corsica, see Box) directly accessed the partial activity scheme to withstand the health crisis, which has an immediate effect on their private-sector wage bill (see Appendix 1), an effect accentuated by the salary levels of jobs accessing the partial activity scheme in 2020 (on average 15% higher than the average salary per position in metropolitan France).

Table 3 – **Direct and indirect effects**

Explanatory variables	Direct effects		Indirect effects	
Structural effect (2019-2020 change)	1.430	[1.248,1.611]	−0.013	[−0.518,0.489]
Proportion of executives (2019)	−0.072	[−0.121,−0.021]	0.031	[−0.120,0.187]
Job density (2019)	0.000	[−0.000,0.000]	0.000	[−0.000,0.000]
Unemployment rate (2019)	−0.090	[−0.219,0.031]	0.072	[−0.187,0.330]
Residential zone (2020)	−0.004	[−0.010,0.001]	−0.024	[−0.041,−0.009]
Proportion of jobs in the temporary employment sector (2019)	0.087	[0.045,0.131]	0.148	[0.037,0.267]
Concentration (Herfindahl index – 2019)	−1.349	[−1.913,−0.775]	−0.282	[−1.986,1.499]

Notes: Empirical confidence intervals (2.5% and 97.5% quantiles of 1,000 Bayesian Markov Chain Monte Carlo simulations - MCMC) are given in brackets; if 0 is included in the confidence interval, the effect is not significant.
Reading note: The direct and indirect effects of the proportion of jobs in the temporary employment sector in 2019 are 0.087 and 0.148, respectively. If, other things being equal, the proportion of temporary jobs falls by 10% in an employment zone, its private-sector wage bill falls on average by 0.87%. If, other things being equal, all the neighbouring employment zones of a region see their proportion of temporary jobs fall by 10%, the private-sector wage bill of this region falls on average by 1.48%.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

Box – **Clusters and Spillover Effects**

To go further in the spatial analysis of the local effect, local Moran's *I* values can be calculated. These are part of the LISA indicators (Local Indicators of Spatial Association) developed by Anselin (1995) and make it possible to detect groupings of similar values, known as clusters. These clusters could reveal potential spillover effects, i.e. spillover mechanisms between regions could influence the local effect and, ultimately, the change in the local wage bill.

Calculating the LISA associated with the local effect identifies two clusters. For almost all employment zones in Corsica, low values for the local effect are associated with equally low values in neighbouring territories (low-low) – which is a sign of a positive local spatial autocorrelation, and has a significant upward influence on the overall spatial autocorrelation process at the level of metropolitan France. In Brittany, in seven employment zones (previously identified as those that best withstood the health crisis), high local effect values are associated with equally high values in neighbouring regions (high-high).

The significant spillover effects (but in this case, in the other direction) highlighted in Corsica and Brittany confirm that the concept of local effect partly overlaps with the specific characteristics of the temporary employment sector, a result that is also suggested by the significance of its indirect effect. In Brittany, the spillover effect probably flows through commuters: in 2019, 37.4% of temporary jobs in the Breton cluster were held by commuters, compared with 31.4% on average.

Table – **Local effects and proportion of temporary jobs (%) in 2019 in the employment zones identified in the clusters**

Region	Employment zone	Local effects in 2020	Proportion of temporary jobs in 2019
Brittany	Auray	2.4	11.3
	Carhaix-Plouguer	0.4	10.2
	Dinan	2.1	29.8
	Lamballe-Armor	3.6	25.4
	Lorient	2.5	15.5
	Ploërmel	2.2	22.6
	Pontivy-Loudéac	3.6	29.1
Corsica	Ajaccio	−2.0	3.3
	Bastia	−3.1	4.6
	Calvi	−8.5	0.0
	Corte	−4.6	0.0
	Ghisonaccia	−1.7	0.0
	Porto-Vecchio	−2.4	1.4
Metropolitan France		-	13.0

into neighbouring regions, hence a significant indirect effect.

The labour market concentration has a negative and significant direct effect on the private-sector wage bill variation. This result, for 2019, confirms the concentration effect shown by Arquié & Bertin (2021), who highlight the fact that "a higher concentration, due to the increased weighting of large employers on the labour market, is accompanied […] by lower salaries, especially for lower paid employees". Furthermore, the effect is accentuated during the health crisis (coefficient −1.330 in 2020 compared with −0.513 in 2019 for SDM models) via an effect on the workforce: Carré *et al.* (2019) suggest that large companies have a greater tendency to reduce their workforce in periods of economic crisis. Moreover, it appears that the labour force qualification level is linked to activity concentration. Indeed, small and medium-sized enterprises (with fewer than 250 employees) have a lower rate of executives than companies with 250 employees or more: 17% compared with 20%. However, the former experienced a smaller drop in their private-sector wage bill than the latter: −4.8% compared with −6.4%. In addition, the estimate shows that the proportion of executives also had a significant and negative direct impact on the change in the private-sector wage bill in 2020.[18] This result, which may seem, at first glance, to be unexpected, is in line with those of Levratto & Garsaa (2016), who also highlight the link with company size, and with the industrial specialisation of certain regions that employ few executives. This would seem to help explain why the Breton regions (average rate of executives of 11.4%) withstood the health crisis particularly well.

Lastly, the residential zone indicator turns out to be non-significant in terms of the direct effect

18. *The variable was not, however, significant in 2019.*

but significant in terms of the indirect effect. The residential employment zones have more working employees than the number of jobs available in the region, with many of these therefore working in neighbouring regions. While this variable does not have a determining effect on the local variation of the private-sector wage bill, it may, conversely, have an indirect effect via proximity relationships; the location of certain employment zones close to residential zones therefore has a negative effect on the change in their private-sector wage bill. This negative effect seems to be linked to the health crisis as the variable was not significant in 2019. In the Lyon employment zone (Figure III), where the private-sector wage bill fell by 3.6% in 2020 on average, we see a more marked drop in the wage bill of workers commuting from a residential zone (for example, Bourgoin-Jallieu: −4.9%) than among commuters from a non-residential zone (Saint-Etienne: −2.6%) or even than non-commuters (living and working in the Lyon employment zone: −3.7%). This result suggests that the variation in the private-sector wage bill has been detrimentally impacted to a greater extent due to the profile of the commuters coming from residential zones than by that of other employees. Commuters are overrepresented among executives and highly qualified professions (40% of positions in 2019, compared with 32% on average, nationally[19]), who are more likely to have kept their salaries during the 2020 lockdowns due to the use of remote working (Jauneau & Vidalenc, 2020). However, the use of remote working was more difficult to implement in certain situations, such as for people with children to look after.[20] There are more households with children in residential areas, such as Bourgoin-Jallieu (42.5% of households in the employment zone had children in 2018), than in non-residential areas (for example, 35.5% in Lyon in 2018[21]). This result suggests that households with children had a greater tendency to reduce their professional activities than other households due to the closure of schools during the first lockdown (Pailhé *et al*., 2022).

19. This result is consistent with other studies on the subject (Coudène & Lévy, 2016; IAU Île-de-France, 2016).
20. Work stoppages were authorised during the first lockdown for parents who had to look after their children due to school closures.
21. Source: INSEE. See also Urbalyon (2022).

Figure III – **Change in 2020 in the private-sector wage bill associated with the jobs of the Lyon employment zone by employment zone in which the employees live**

Notes: The change in the private-sector wage bill of the Lyon employment zone was −3.6% in 2020.
Reading note: The private-sector wage bill of employees working in the Lyon employment zone and residing in the Lyon employment zone fell by 3.7% on average in 2020. The private-sector wage bill for employees working in the Lyon employment zone and residing in the neighbouring residential employment zone of Bourgoin-Jallieu fell by 4.9% on average in 2020.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

* *
*

The article examines the question surrounding the impact of the health crisis in France, broken down into locally established business sectors. It confirms the very clear correlation between the change in the private-sector wage bill and the sectoral composition of local jobs, a result already obtained in other estimations made on the subject. Furthermore, the temporary employment sector played a significant role as a shock-absorber of the effects of the health crisis. The article identifies two other factors associated with the local labour market that explain the different impact of the health crisis on the regions: the labour force qualification level and the concentration of activities. Lastly, the results shows that, for a given region, its neighbouring regions have an influence on the variation in the private-sector wage bill: on the one hand, the shock-absorbing role of the temporary employment sector spills over into neighbouring zones through commuters, especially in Brittany. On the other hand, the regions neighbouring a residential zone, primarily Paris and Lyon, would have withstood the health crisis more successfully if they had not suffered a shock due to their employees commuting from neighbouring residential zones.

It would be interesting to extend the study to 2021, a year which could be said to be "hybrid": the beginning of the year was still deeply marked by the economic crisis (in April 2021, 2.5 million employees were still in partial activity), the economic recovery began in the second half. Finally, it will certainly be interesting to study, at employment zone level, the link between the characteristics of the local labour markets and the epidemic intensity: the works carried out by Levratto *et al.* (2020), which began at the start of the COVID-19 pandemic, highlight a significant link between the socio-economic factors and the number of hospitalisations and deaths at department level in France, although such a link has not been verified in Italy (Cerqua & Letta, 2021). □

BIBLIOGRAPHY

Amoureux, V., Héam, J.-C. & Laurent, T. (2021). Les comptes de la Nation en 2020 – Baisse historique du PIB, mais résilience du pouvoir d'achat des ménages. *Insee Première* N° 1860.
https://www.insee.fr/fr/statistiques/fichier/version-html/5387891/ip1860.pdf

Anselin, L. (1995). Local Indicators of Spatial Association – LISA. *Geographical Analysis*, 27(2), 93–115.
https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1538-4632.1995.tb00338.x

Anselin, L, Bera, A.-K., Florax, R. & Yoon, M.-J. (1996). Simple diagnostic tests for spatial dependence. *Regional Science and Urban Economics*, 26(1), 77–104.
https://www.sciencedirect.com/science/article/abs/pii/0166046295021116

Arquié, A. & Bertin, J. (2021). La concentration des emplois, une source négligée de disparités territoriales et d'inégalités salariales. *La lettre du CEPII* N° 419, juillet-août.
http://www.cepii.fr/PDF_PUB/lettre/2021/let419.pdf

Barrot, J.-N. (2021). Accélérer le rebond économique des territoires. Rapport au Premier ministre, juin. m-006-
https://www.gouvernement.fr/sites/default/files/document/document/2021/06/m-006-03_2021-rapport_rebond_eco_territoires.pdf

Baumont, C., Ertur, C. & Le Gallo, J. (2000). Geographic spillover and growth (a spatial econometric analysis for european regions). Laboratoire d'analyse et de techniques économiques (LATEC), *Document de travail* N° 2000-07, juin. https://hal.archives-ouvertes.fr/hal-01526987/document

Boisbras, F. (2021). Diagnostic des impacts de la crise économique sur l'emploi industriel. OPCO 2i, juin.
https://www.opco2i.fr/wp-content/uploads/2021/05/OPCO2i-Etude-observatoire-diagnostic-impact-crise-economique-V2.pdf

Boulliung, A. & Amoros, P. (2021). La masse salariale du secteur privé soumise à cotisations sociales enregistre une baisse historique en 2020. Urssaf Caisse nationale, *Acoss Stat* N° 333.
https://www.urssaf.org/files/live/sites/urssaforg/files/Statistiques/Nos%20%c3%a9tudes%20et%20analyses/Employeurs/Nationale/2021/333/Stat_Ur_333.pdf

Bouvart, C., Flamand, J., Dherbécourt, C. & Le Hir, B. (2021). L'emploi en 2020 : géographie d'une crise. France Stratégie, *Note d'analyse* N° 100.
https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2021-na-100-emploi-2020-geographie-crise-avril_0.pdf

Brunetto, M. & Levratto, N. (2017). Analysis of the job creation process in metropolitan areas: a spatial perspective. EconomiX, *Working paper* N° 2017-36. https://economix.fr/pdf/dt/2017/WP_EcoX_2017-36.pdf

Carré, D. & Levratto, N. (2013). Les entreprises du secteur compétitif dans les territoires, les déterminants de la croissance. Étude AdCF-Institut CDC pour la recherche, juin.
https://www.adcf.org/files/ADCF-EtudeEconomix-130624-web-ok.pdf

Carré, D., Levratto, N. & Frocrain, P. (2019). *L'étonnante disparité des territoires industriels – Comprendre la performance et le déclin*. Paris: Presse des Mines.
https://www.la-fabrique.fr/wp-content/uploads/2019/10/LFI_note-30-web.pdf

Carré, D., Levratto, N., Amdaoud, M. & Tessier, L. (2020). Les performances contrastées des zones d'emploi : observation et modèles. Programme de recherche pour le CGET-Institut CDC pour la recherche, janvier.
https://www.caissedesdepots.fr/sites/default/files/2021-01/Lesperformancesdeszonesdemploi.pdf

Cerqua, A. & Letta, M. (2021). Local inequalities of the COVID-19 crisis. Department of Social Sciences and Economics, Sapienza University of Rome, *Regional Science and Urban Economics*, 92.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8585964/pdf/main.pdf

Charton, C. & Durieux, É. (2021). Confinement du printemps 2020 : un impact économique différencié selon les départements. Insee Références, *La France et ses territoires*, édition 2021, pp. 73–88.
https://www.insee.fr/fr/statistiques/fichier/5040030/FET2021.pdf

Chausse, M.-L., Gouyon, M. & Malard, L. (2021). Cinq trajectoires sectorielles à l'épreuve de la crise sanitaire en 2020. Insee Références, *Emploi, chômage, revenus du travail*, édition 2021, pp. 73–88.
https://www.insee.fr/fr/statistiques/fichier/5392036/ECRT2021-D4.pdf

Cœuré, B. (2021). Comité de suivi et d'évaluation des mesures de soutien financier aux entreprises confrontées à l'épidémie de COVID-19. Inspection générale des finances et France Stratégie, rapport au Premier ministre, juillet. https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs_-_rapport_final_-_comite_coeure_-_27-07-21_0.pdf

Coudène, M., & Lévy, D. (2016). De plus en en plus de personnes travaillent en dehors de leur commune de résidence. *Insee Première* N° 1605.
https://www.insee.fr/fr/statistiques/fichier/version-html/2019022/ip1605.pdf

DATAR (2021). L'impact économique de la crise sur les territoires de la Nouvelle-Aquitaine – Emploi : trajectoires et prévisions. DATAR de la région Nouvelle-Aquitaine, septembre.
https://fr.calameo.com/read/00600927185d8d7bd002e?page=1

Dunn, O. J., & Clark, V. A. (1969). Correlation Coefficients Measured on the Same Individuals. *Journal of the American Statistical Association*, 64, 366–377. https://doi.org/10.2307/2283746

Elhorst, J.-P. (2010). Applied Spatial Econometrics: Raising the Bar. *Spatial Economic Analysis*, 5(1), 9–28.
http://web.pdx.edu/~crkl/SEAUG/papers/Elhorst_SEA2010.pdf

IAU Île-de-France (2016). Nouveaux modes de travail et enjeux de mobilité.
https://www.institutparisregion.fr/fileadmin/NewEtudes/Etude_1284/ModesTravail_enjeuxMobilite.pdf

Jauneau, Y. & Vidalenc, J. (2020). Durée travaillée et travail à domicile pendant le confinement : des différences marquées selon les professions. *Insee Focus* N° 207. https://www.insee.fr/fr/statistiques/4801229.

International Monetary Fund (2021). *World Economic Outlook: Managing Divergent Recoveries*. Washington, DC. https://www.imf.org/-/media/Files/Publications/WEO/2021/April/English/text.ashx

Koike Quintanar, S. A. (2019). Spatial Dependence of Labor Market Outcomes: the Case of the Metropolitan Area of Mexico City. *Revue d'Économie Régionale et Urbaine*, 2, 317–354.
https://doi.org/10.3917/reru.192.0317

Krugman, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy*, 99(3), 483–499. https://pr.princeton.edu/pictures/g-k/krugman/krugman-increasing_returns_1991.pdf

Kubrak, C. (2013). Concentration et spécialisation des activités économiques : des outils pour analyser les tissus productifs locaux. Insee, *Document de travail* N° H2013/01.
https://www.insee.fr/fr/statistiques/fichier/1380950/h2013-01.pdf

Kubrak, C. (2018). Structurel, résiduel, géographique : principe et mise en œuvre des approches comptable et économétrique. Insee, *Document de travail* N° H2018/01.
https://www.insee.fr/fr/statistiques/fichier/version-html/3315027/H2018-01.pdf

LeSage, J. & Pace, R.-K. (2009). *Introduction to Spatial Econometrics*. New York: Chapman & Hall/CRC.
https://www.taylorfrancis.com/books/mono/10.1201/9781420064254/introduction-spatial-econometrics-james-lesage-robert-kelley-pace

Levratto, N. & Carré, D. (2013). La croissance des établissements industriels : une question de localisation. *Région et Développement* N° 38, 93–120.
https://regionetdeveloppement.univ-tln.fr/wp-content/uploads/5_Levratto.pdf

Levratto, N. & Garsaa, A. (2016). Does the employment growth rate depend on the local context? An analysis of French industrial establishments over the 2004-2010 period. *Revue d'économie industrielle*, 153, 47–89. https://doi.org/10.4000/rei.6285

Levratto, N., Brunetto, M., Carré, D. & Tessier, L. (2017). Analyse du lien entre les métropoles et les territoires avoisinants. EconomiX, France Stratégie, CGET et Institut CDC pour la recherche. https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/2017-01-23-rapport_complet-metropoles-final.pdf

Levratto, N., Arcuri, G. & Amdaoud, M. (2020). COVID-19 : analyse spatiale de l'influence des facteurs socio-économiques sur la prévalence et les conséquences de l'épidémie dans les départements français. EconomiX, *Working Paper* N° 2020-04. https://xtra.economix.fr/pdf/dt/2020/WP_EcoX_2020-4.pdf?1.0

Lévy, D., Dubois, M. & Lefebvre, M. (2020). L'orientation économique des zones d'emploi : entre spécialisation et diversification des économies locales. *Insee Première* N° 1814. https://www.insee.fr/fr/statistiques/fichier/version-html/4653582/ip1814.pdf

Loonis, V. & Bellefon, M.-P. (dir.) (2018). Manuel d'analyse spatiale. Théorie et mise en œuvre pratique avec R. Insee et Eurostat, *Insee Méthodes* N° 131. https://www.insee.fr/fr/statistiques/fichier/version-html/3635442/imet131.pdf

Nevoux, S. (2018). Trois essais sur l'activité partielle. Thèse de doctorat en sciences économiques, École Polytechnique, Université de Paris-Saclay. https://www.theses.fr/2018SACLX010

OFCE (2021). Soutenir et relancer l'économie française en période de crise sanitaire. OFCE *Policy brief N° 87*. https://www.ofce.sciences-po.fr/pdf/pbrief/2021/OFCEpbrief87.pdf

OCDE (2020). *OECD Regions and Cities at a Glance 2020*. Paris: Éditions OCDE. https://doi.org/10.1787/959d5ba0-en

Pacini, V., Portier, N. & Portier, O. (2021). Crise covid : une analyse des premiers impacts économiques dans les territoires comparée à la crise de 2008. *Les cahiers de recherche*, Institut CDC pour la recherche. https://www.caissedesdepots.fr/sites/default/files/2022-01/220125_CDD_CDR_COVID_WEB_PL.pdf

Pailhé, A., Solaz, A., Wilner, L. & l'équipe EpiCov (2022). Travail domestique et parental au fil des confinements : comment ont évolué les inégalités socio-économiques et de sexe ? *Economie et Statistique / Economics and Statistics* en ligne 25 juillet 2022. https://www.insee.fr/fr/statistiques/6477736

Perez, C., Thévenot, N., Berta, N., Brochard, D., Delahaie, N., Jallais, S., ... & Valentin, J. (2015). Modes d'ajustement par le travail en temps de crise : des relations professionnelles sous tension. *La Revue de l'Ires*, 84, 59–90. https://doi.org/10.3917/rdli.084.0059

Urbalyon (2022). Mobilité et COVID : l'avènement du télétravail, février. https://www.urbalyon.org/sites/default/storage_files/productions/2022-03/MOB_COVID.pdf

Yang, Y. & Wong, K. K. F. (2021). A Spatial Econometric Approach to Model Spillover Effects in Tourism Flows. *Journal of Travel Research*, 51(6), 768–778. https://doi.org/10.1177/0047287512437855.

Zaninetti, J.-M. (2016). La crise et l'attractivité des villes : Paris en recul. *Population & Avenir*, 730, 4–8. https://doi.org/10.3917/popav.730.0004

APPENDIX 1

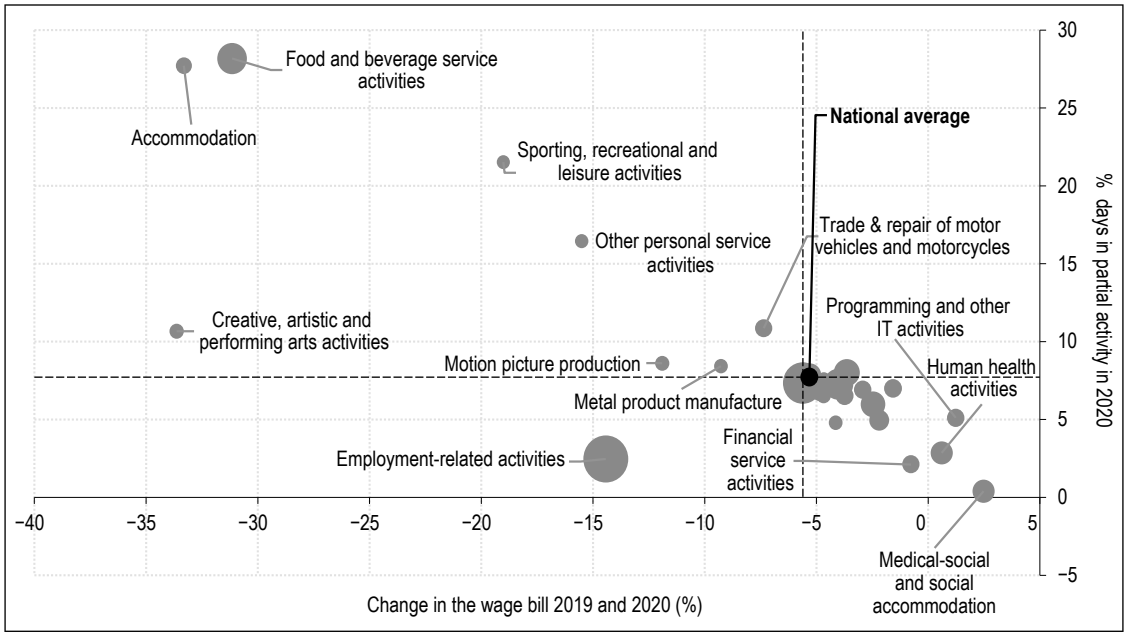
PARTIAL ACTIVITY

The partial activity scheme allows an employer to "receive a partial activity payment for its employees to address the drop in the company's activity" in specific cases. Partial activity may take two forms: either a "reduction in the duration of the working week", or a "temporary closure of all or part of the establishment". Between March and May 2020, the employer was compensated for 70% of the gross hourly remuneration, limited to 4.5 times the minimum wage (SMIC) hourly rate. On 1 June 2020, the compensation fell to 60%, except in sectors affected by the crisis (the S1 sectors, which include, in particular, the tourism, hotel, restaurant, sport, culture, air transport, and events sectors, as well as the S1bis and S2 sectors) in which it remained at 70%. (Sources: https://www.service-public.fr/professionnels-entreprises/vosdroits/F23503).

Use of the scheme rose significantly in 2009, linked to the 2008 economic crisis (Nevoux, 2018). It was shown that partial activity had a significant impact on safeguarding jobs in companies experiencing a decline in turnover due to the crisis. The safeguarded jobs are "permanent" jobs (permanent contracts), with partial activity having only a slight impact on "temporary" jobs (temporary employment, fixed-term contracts, etc.). This shock-absorbing role against the impact of the crisis on job losses is also confirmed by the initial analyses of the health crisis. The *Observatoire français des conjonctures économiques* (French Economic Observatory – OFCE) estimates that the partial activity scheme saved 1.4 million FTE jobs in 2020 (OFCE, 2021).

Use of the partial activity scheme is not equal among the business sectors. The sectors that made the greatest use of the partial activity scheme in 2020 are linked to tourism, culture and leisure (Figure A1). These sectors were affected by the two lockdowns in 2020, in spring and autumn (Chausse *et al.*, 2021). Conversely, four sectors used the scheme to a very limited extent: these were those whose activities were heavily required during the health crisis (medical-social and social accommodation, human health activities) as well as other sectors such as financial service activities, and computer programming, consultancy and related activities. These latter two sectors are characterised by a high rate of executives (52% and 76%, respectively, compared with the national average of 19%). The employment-related activities sector (temporary employment) stands out: although it experienced a 15% reduction in the wage bill, it had a lower rate of use of the partial activity scheme (2.5% of days worked in this sector fell under this scheme). Use of the partial activity scheme is also heterogeneous across the regions. Those making the greatest use of the scheme were Provence-Alpes-Côte-d'Azur and Corsica (Cœuré, 2021).

Figure A1 – **Business sectors by change in the private-sector wage bill between 2019 and 2020 and the proportion of days in partial activity in 2020**



Notes: The size of the circles is proportional to the weighting of the employment in the sector in 2020. For legibility reasons, sectors with a weighting of less than 1% are not represented.
Reading note: The food and beverage service sector represented 5.5% of all positions held in metropolitan France in 2020 in the private sector. Between 2019 and 2020, its wage bill fell by 31.2%; the number of days spent in partial activity in 2020 in this sector represented 28% of the number of days in employment.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

APPENDIX 2

Table A2 – **Sectoral specificity indices by employment zone in 2019 for certain business sectors**

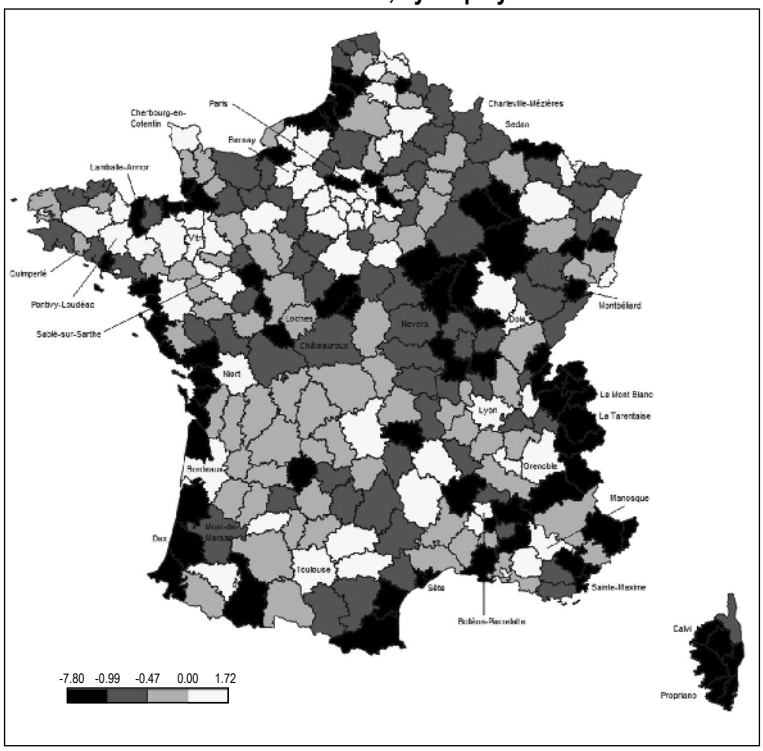
Employment zone	Hospitality	Construction	Manuf. cars	Empl-related activities	Manuf. agrifood	Manuf. chemicals	Insurance	Metal working	Manuf. metal equipment	Scientific R&D
Calvi	4.9	1.6	0.0	0.0	1.2	0.0	0.1	0.0	0.1	0.4
Propriano	4.1	2.7	0.0	0.0	0.9	0.0	0.1	0.0	0.6	0.0
Porto-Vecchio	4.3	2.1	0.0	0.1	1.1	0.0	0.0	0.0	0.2	0.0
Menton	3.6	1.0	0.0	0.3	1.1	0.1	0.2	0.1	0.1	0.0
Sainte-Maxime	4.4	1.4	0.0	0.3	1.0	0.0	0.0	0.0	0.1	0.0
La Tarentaise	4.4	1.0	0.0	0.4	0.7	0.7	0.0	7.1	0.8	0.0
Le Mont Blanc	3.9	1.1	0.0	0.5	0.8	0.1	0.1	0.0	1.3	0.1
Beauvais	0.7	1.2	5.0	1.3	1.2	1.7	0.6	1.8	2.1	0.4
Montbéliard	0.4	0.7	25.2	1.8	0.7	0.2	0.1	2.5	3.0	0.0
Mulhouse	0.8	1.2	5.2	1.1	1.1	2.5	0.5	0.3	1.1	0.2
Vitry-le-François Saint-Dizier	0.6	1.0	2.2	1.3	1.1	0.9	0.2	22.2	2.9	0.0
Charleville-Mézières	0.6	1.2	0.2	1.0	1.0	0.7	0.3	16.0	5.2	0.0
Sedan	0.6	1.1	0.2	1.2	1.8	1.2	0.1	14.5	6.2	0.0
Châtellerault	0.7	0.7	4.0	1.5	1.1	1.9	0.1	13.3	3.6	0.0
Loches	0.6	1.7	0.0	1.0	1.0	0.3	0.0	1.1	2.4	0.0
Châteauroux	0.7	0.9	0.1	1.3	1.1	0.5	0.3	5.6	1.5	0.0
Romorantin-Lanthenay	1.2	1.3	0.1	1.3	1.4	0.2	0.1	0.0	3.9	0.2
Nevers	0.8	1.1	2.1	1.0	0.5	0.7	0.3	7.3	2.3	0.3
Quimperlé	0.7	0.7	0.1	2.3	8.3	0.2	0.0	0.0	2.4	0.0
Lamballe-Armor	1.1	1.3	2.4	1.9	6.3	0.0	0.0	0.0	1.2	0.2
Vitré	0.4	1.0	0.0	1.7	6.2	2.6	0.0	0.2	0.6	0.1
Pontivy-Loudéac	0.5	0.9	0.3	2.2	5.8	0.9	0.1	0.4	1.0	0.0
Sablé-sur-Sarthe	0.4	0.5	8.1	2.2	8.9	0.5	0.0	1.8	2.6	0.0
Mayenne	0.4	1.1	3.6	1.4	5.7	0.4	0.1	3.6	2.6	0.0
Dax	1.6	1.2	0.2	1.2	3.2	4.0	0.1	0.3	0.6	0.2
Mont-de-Marsan	0.9	1.2	0.2	1.4	3.1	0.7	0.5	0.6	0.5	0.1
Niort	0.6	0.9	0.4	1.0	0.8	0.8	25.5	2.9	0.9	0.0
Rouen	0.8	1.1	2.2	1.1	0.9	1.6	2.9	1.0	1.0	0.1
Bernay	0.5	1.3	0.0	1.8	1.8	5.6	0.1	1.2	2.2	3.3
Cherbourg-en-Cotentin	0.8	1.2	0.1	1.0	1.2	10.2	0.2	0.0	1.4	0.1
Bollène-Pierrelatte	0.7	1.5	0.1	1.1	0.9	16.3	0.1	0.5	0.7	0.6
Dole	0.7	1.2	0.5	1.4	2.4	10.2	0.2	0.3	1.4	0.0
Grenoble	1.0	0.8	0.2	0.8	0.4	0.9	0.5	1.4	1.0	8.8
Manosque	1.2	0.9	0.0	1.9	1.2	5.8	0.1	0.0	0.3	17.1

Reading note: In 2019, the Calvi employment zone had a hospitality sector specificity index of 4.9: this sector is 4.9 times larger in terms of the number of jobs in the Calvi employment zone than the rest of metropolitan France.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

APPENDIX 3

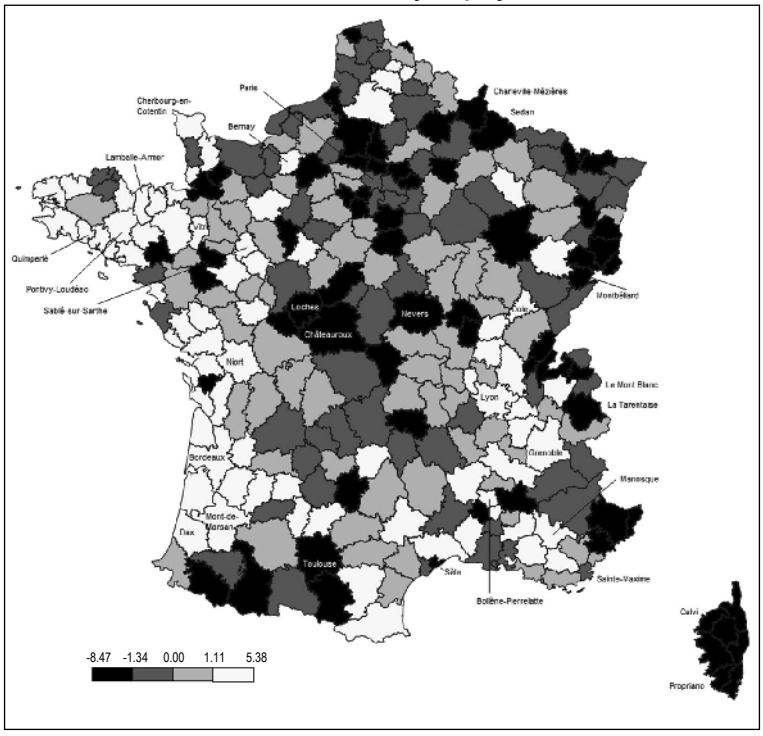
MAP OF RESULTS OF THE SHIFT-SHARE BREAKDOWN

Figure A3-I – **Structural effect, expressed as the deviation from the average national private-sector wage bill between 2019 and 2020, by employment zone**



Reading note: The Calvi employment zone shows a negative structural effect (−7.3%).
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

Figure A3-II – **Local effect, expressed as the deviation from the average national private-sector wage bill between 2019 and 2020, by employment zone**



Reading note: The Calvi employment zone shows a negative local effect (−8.5%).
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

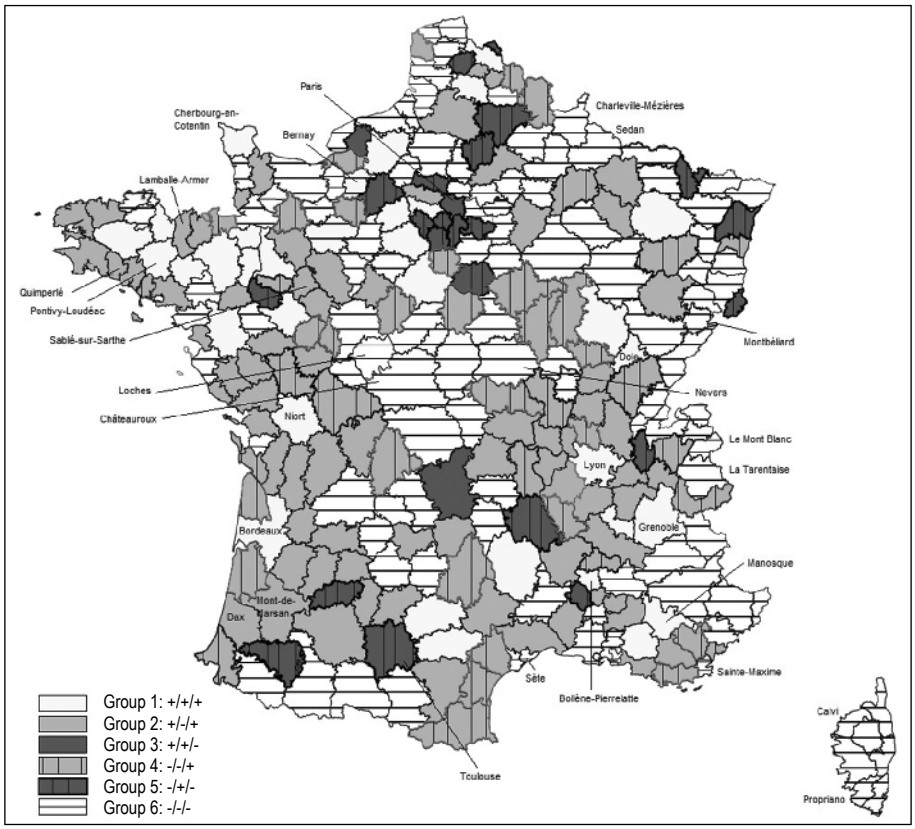
APPENDIX 4

REGION TYPOLOGY

The employment zones are categorised into six groups, based on the positive or negative nature of the variables of interest included in the shift-share analysis (Figure A4).

The first group is formed of 34 employment zones, representing 22.1% of salaried jobs in metropolitan France in 2020, which experienced a change in their private-sector wage bill above that observed in metropolitan France, associated with positive structural and local effects; these are the regions that best withstood the health crisis. The second group (71 employment zones, 17.4% of salaried jobs in 2020) includes the regions with resilience in the face of the crisis based on specific local characteristics. The third group (three employment zones, 17.9% of salaried jobs in 2020) is formed of employment zones with resilience in the face of the crisis based on the sectoral employment structure. The fourth group (45 employment zones, 9.7% of salaried jobs in 2020) is formed of the regions for which the negative impact of the health crisis is associated with the sectoral employment structure. The fifth group (23 employment zones, 9.8% of salaried jobs in 2020) is formed of the regions for which the impact of the health crisis is based on specific local characteristics. Lastly, the 111 employment zones that constitute the sixth group (23% of salaried jobs in 2020 in metropolitan France) are the regions in the most difficulty: they combine negative structural and local effects. These are the zones most negatively impacted by the health crisis.

Figure A4 – **Region typology**



Notes: Group 1: +/+/+; Group 2: +/−/+; Group 3: +/+/−; Group 4: −/−/+; Group 5: −/+/−; Group 6: −/−/−. The first sign corresponds to the change in the wage bill compared to the national average, the second sign to the structural effects and the third sign to the local effects, in line with the method suggested by Carré & Levratto (2013).
Reading note: The Calvi employment zone (group 6) shows a negative deviation from the national average wage bill variation (−15.7%), a negative sector-based effect (−7.3%), and a negative local effect (−8.5%). The Rennes employment zone (group 1) shows a positive deviation from the national average wage bill variation (+2.4%), a positive sector-based effect (+0.4%), and a positive local effect (+2%). The Paris employment zone (group 3) shows a positive deviation from the national average wage bill variation (+0.8%), a positive sector-based effect (+1%), and a negative local effect (−0.2%).
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

APPENDIX 5

ESTIMATION OF DIFFERENT SPATIAL MODELS

Table A5-1 – **Estimation results of the variation in the private-sector wage bill between 2018 and 2019**

	MCO	SEM	SAR	SLX	SDM
Constant	0.030*** (0.007)	0.028*** (0.007)	0.023*** (0.007)	0.041*** (0.012)	0.038*** (0.012)
Structural effect (variation 2018-2019)	1.806*** (0.312)	1.656*** (0.311)	1.616*** (0.305)	1.540*** (0.325)	1.517*** (0.318)
Proportion of executives (2018)	−0.029 (0.023)	−0.021 (0.023)	−0.023 (0.022)	−0.006 (0.026)	−0.005 (0.026)
Employment density (2018)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unemployment rate (2018)	0.079 (0.050)	0.080 (0.054)	0.057 (0.050)	0.050 (0.072)	0.049 (0.070)
Residential area (2020)	−0.004 (0.003)	−0.003 (0.003)	−0.003 (0.003)	0 (0.003)	0 (0.003)
% employment in temporary jobs (2018)	0.023 (0.022)	0.021 (0.023)	0.024 (0.022)	0.026 (0.024)	0.026 (0.023)
Concentration (Herfindahl index, 2018)	−0.479*** (0.165)	−0.457*** (0.161)	−0.478*** (0.160)	−0.520*** (0.164)	−0.513*** (0.159)
$\hat{\lambda}$		0.177* (0.086)			
$\hat{\rho}$			0.216*** (0.079)		0.074 (0.088)
$\hat{\theta}_{structural\ effect}$				1.804*** (0.665)	1.541** (0.681)
$\hat{\theta}_{proportion\ executives}$				−0.086 (0.054)	−0.082 (0.053)
$\hat{\theta}_{employment\ density}$				0 (0)	0 (0)
$\hat{\theta}_{unemployment\ rate}$				−0.050 (0.105)	−0.046 (0.102)
$\hat{\theta}_{residential\ area}$				−0.009 (0.006)	−0.008 (0.006)
$\hat{\theta}_{employment\ in\ temporary\ jobs}$				0.054 (0.044)	0.047 (0.043)
$\hat{\theta}_{HHI}$				−0.396 (0.333)	−0.343 (0.330)
AIC	−1503	−1504	−1508	−1506	−1505
Adjusted R^2	0.18	0.21	0.22	0.21	0.25

Notes: Contiguity matrix. Standard error in brackets. The values are different from zero at significance level: *** alpha=0.01; ** alpha=0.05; * alpha=0.1.
Sources and coverage: AGIRC-ARRCO salary database, authors' calculations. Employees contributing to AGIRC-ARRCO, excluding MSA employees, metropolitan France.

Table A5-2 – **Estimation results of the variation in the private-sector wage bill between 2019 and 2020**

	MCO	SEM	SAR	SLX	SDM
Constant	−0.043*** (0.007)	−0.039*** (0.008)	−0.022*** (0.008)	−0.063*** (0.015)	−0.045*** (0.014)
Structural effect (variation 2019-2020)	1.523*** (0.091)	1.485*** (0.090)	1.397*** (0.088)	1.427*** (0.101)	1.429*** (0.094)
Proportion of executives (2019)	−0.097*** (0.026)	−0.091*** (0.025)	−0.086*** (0.024)	−0.072** (0.029)	−0.074*** (0.027)
Employment density (2019)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unemployment rate (2019)	−0.057 (0.054)	−0.081 (0.061)	−0.062 (0.050)	−0.082 (0.075)	−0.094 (0.069)
Residential area (2020)	−0.008*** (0.003)	−0.005* (0.003)	−0.007*** (0.003)	−0.004 (0.003)	−0.003 (0.003)
% employment in temporary jobs (2019)	0.110*** (0.022)	0.080*** (0.022)	0.078*** (0.022)	0.090*** (0.024)	0.079*** (0.022)
Concentration (Herfindahl index, 2019)	−1.337*** (0.300)	−1.224*** (0.281)	−1.304*** (0.280)	−1.417*** (0.302)	−1.330*** (0.281)
$\hat{\lambda}$		0.421*** (0.075)			
$\hat{\rho}$			0.299*** (0.055)		0.349*** (0.076)
$\hat{\theta}_{structural\ effect}$				0.075 (0.199)	−0.505** (0.224)
$\hat{\theta}_{proportion\ executives}$				0.031 (0.058)	0.046 (0.052)
$\hat{\theta}_{employment\ density}$				0 (0)	0 (0)
$\hat{\theta}_{unemployment\ rate}$				0.056 (0.109)	0.086 (0.101)
$\hat{\theta}_{residential\ area}$				−0.022*** (0.006)	−0.016*** (0.006)
$\hat{\theta}_{employment\ in\ temporary\ jobs}$				0.120*** (0.042)	0.073* (0.040)
$\hat{\theta}_{HHI}$				−0.341 (0.643)	0.272 (0.605)
AIC	−1505	−1528	−1530	−1514	−1531
Adjusted R^2	0.61	0.65	0.65	0.63	0.67

Notes, Sources, Coverage: Cf. Table A5-1.

Protein Deficit in France – A Prospective Analysis

Alexandre Gohin* and Alice Issanchou*

Abstract – France's deficit in protein-rich products dates back nearly 50 years. Many protein plans aimed at boosting the supply of legumes have succeeded one another without managing to solve the issue. Does it mean that French agriculture is economically tied to grain production using imports of synthetic fertilisers and to off-farm livestock production using soya imports? The novelty of our quantitative analysis is to take into account the role of French consumers' potential demand for products that are free from genetically modified organisms (GMOs). Our prospective simulations show that, while this demand is a far more powerful driver for reducing imports of GMO soya cake than traditional subsidies for legumes, it is unlikely to lead to a significant improvement in protein self-sufficiency, as net imports of other protein-rich products are increasing. In contrast, substantial progress could be made by improving the productivity of forage land.

JEL: Q11, Q16, Q18
Keywords: protein self-sufficiency, genetically modified organisms, markets, France

** UMR SMART (Joint Research Unit for Agricultural Structures and Markets, Resources and Land), Institut Agro – INRAE (French National Research Institute for Agriculture, Food and Environment), Rennes, France.* Correspondence: *alexandre.gohin@inrae.fr*

This research benefited from co-financing by two French regions (Brittany and Pays de la Loire) and the European Agricultural Fund for Rural Development 2014-2020 (PEI 16.1), under the project SOS-PROTEIN.

Received in August 2021, accepted in July 2022.
The opinions and analyses presented in this article are those of the author(s) and do not necessarily reflect their institutions' or INSEE's views.

Citation: Gohin, A. & Issanchou, A. (2022). Protein Deficit in France – A Prospective Analysis. *Economie et Statistique / Economics and Statistics*, 536-37, 115–131. doi: 10.24187/ecostat.2022.536.2083

Since the 1973 embargo on US soya exports following a major local drought, France has implemented various protein plans to promote its own production and limit the import of plant-based protein-rich products (PRPs), including soya beans and soya cake, high-protein peas, faba beans, rapeseed cake, lentils and chickpeas. Though initially motivated by purely economic considerations, recent protein plans increasingly emphasise the direct environmental benefits of these crops. Due to their ability to fix atmospheric nitrogen in the soil, legumes reduce the need for synthetic fertilisers on cultivated land, thereby reducing direct greenhouse gas (GHG) emissions.

Despite nearly 50 years of public support for this sector, France remains largely dependent on imports of PRPs, particularly soya cake for animal feed. The degree of public support and the raw material price ratios have so far had little impact on the decisions of French producers and users in terms of favouring domestic PRP production. The evolutions in recent years are due more to the growth of the first-generation biofuel sector, the consumption of which has been capped, than to French protein plans. Moreover, the expansion of legume crops does not always appear to be the best solution for mitigating GHG emissions from agriculture (Pellerin *et al.*, 2017). Strong public support for legumes as part of the fight against climate change is therefore unlikely to be achieved in the near future. Finally, while PRP trade policies are managed at the EU level, many Member States that are even more dependent on imports from third countries than France consider that specialisation and international trade based on comparative advantages could lead to potential improvements in standards of living (Mahé, 2005). As third countries have comparative advantages in terms of protein production (especially soya), they find imports preferable to local supply. This is reflected, for example, in attitudes towards free trade treaties with Canada and the Mercosur countries.

Is France set to remain heavily dependent on PRP imports for the foreseeable future? In other words, is French agriculture economically tied to grain production facilitated by imports of synthetic fertilisers and to off-farm livestock production facilitated by PRP imports, thereby generating excess nitrogen polluting our air, soil and water (Magrini *et al.*, 2015)? Will the new national plant-based protein plan announced in December 2020 deliver only modest results like its predecessors?

This article aims to make a quantitative contribution to the complex and perennial debate on plant-based protein by incorporating a new dimension, which is increasingly being discussed but has not been extensively measured to date: French consumer demand for local food products without genetically modified organisms (GMOs). Imported PRPs, especially soya, are largely derived from genetically modified crops. Consumer leverage could therefore be used to help reduce French protein dependence by reducing the amounts of these GMO-based products imported. Several surveys indicate a potential demand from French consumers for GMO-free food products and locally produced foods in general (FranceAgriMer, 2018). Agri-food industry stakeholders are increasingly moving to meet this potential demand, as detailed at the *États Généraux de l'Alimentation* (French National Food Conference) (Terres Univia, 2017).

This potential demand from French consumers concerns dried legumes and processed foods (meat and dairy products). A methodology that takes into account the different products and players in the food sector is essential to quantify this new driver of consumer demand and to compare it with the more conventional drivers of public support. We therefore develop an original computable general equilibrium (CGE) model that separates the non-GMO sectors from "conventional" sectors. CGE models are widely used for the *ex ante* assessment of the impact of public policies (such as free trade agreements and agricultural policies), whether in terms of production, trade, demand, price and market impacts in general. Our static model allows for the quantification of a wide range of consequences of different prospective scenarios, e.g. involving the acreage dedicated to legume crops or the dependence on GMO soya imports, including potential reductions in grain and/or animal product exports. It therefore allows us to determine whether gains in protein self-sufficiency might come at the expense of a loss of self-sufficiency in other sectors and, ultimately, the risk of a loss of agri-food trade surplus. It also measures the impact on revenue generated by agricultural and agri-food activities, enabling us to assess possible conflicts between protein self-sufficiency and the economic returns of the sectors. Our approach therefore provides a unified and coherent quantification of the various issues surrounding the broad topic of plant-based protein. However, our static model does not cover all the issues at stake, such as transient and long-term effects on biodiversity or

net GHG emissions, which is why no normative analysis of the objective of reducing France's protein deficit has been conducted.

Our prospective simulations show that, while this potential consumer demand is a far more powerful driver for the reduction of GM soya cake imports than traditional subsidies for legumes, it is unlikely to lead to a significant improvement in protein self-sufficiency, as net imports of other PRPs are increasing. In contrast, substantial progress could be made by improving the productivity of forage land. Changes in consumer demand have a greater positive impact on French agricultural and agri-food revenue than public subsidies.

The rest of the article is organised as follows: the first section provides a more detailed description of the issue under study; the second summarises the main findings of the available literature; the third is devoted to the model developed, with emphasis on the original elements introduced, and describes the scenarios tested; the fourth reviews the outcomes of these scenarios and includes a sensitivity analysis. The conclusion summarises the main findings and suggests possible extensions to this empirical study.

1. The Context: French and European Protein Self-Sufficiency

1.1. What Is It All About?

Both plant and animal proteins are made up of amino acids. The nutritional value of a protein is dependent on its ability to provide the amino acids essential for the growth of the organism concerned and to replenish the proteins in its body. Not all proteins contain the same amino acids. When it comes to human nutritional needs, sources of animal proteins are more balanced in terms of amino acids than plant proteins, something that can be corrected for by combining different sources of plant protein (e.g. grains and legumes).[1]

The rest of this article focuses on animal proteins and plant proteins used for animal feed. Due to the lack of macroeconomic data, sources of plant proteins used directly in human food have been omitted from the analysis. According to microeconomic data collected by Agrosynergie (2018), these mainly include dried legumes (lentils, chickpeas, beans, etc.) and soya beans. They represent a niche but growing market driven largely by the increasing popularity of vegetarian and vegan diets. These proteins enjoy a positive image in terms of health and environmental benefits, but a negative one in terms of digestibility and convenience (preparation time). The prospects of these markets depend largely on the public research strategy in this area and on the actions of the processing industry (Magrini *et al.*, 2018).

On average, it takes about 4.9 kg of plant protein to produce 1 kg of animal protein (weighted according to the weights of the different animal species) (Guéguen *et al.*, 2016). Indeed, livestock have specific protein requirements for growth and maintenance, which are covered by coarse fodder (grazed/harvested grass, maize/fodder beet, etc.) and single or mixed concentrate feed. The latter are made from different raw materials, and those containing more than 15% protein are considered PRPs. For example, grains are composed mainly of starch, a source of energy, and are therefore not classified as PRPs, even though they do contain protein. Oilseed (especially soya) cakes on the other hand are protein-rich products. Dry pulses (peas and faba beans) have a medium starch and protein content.

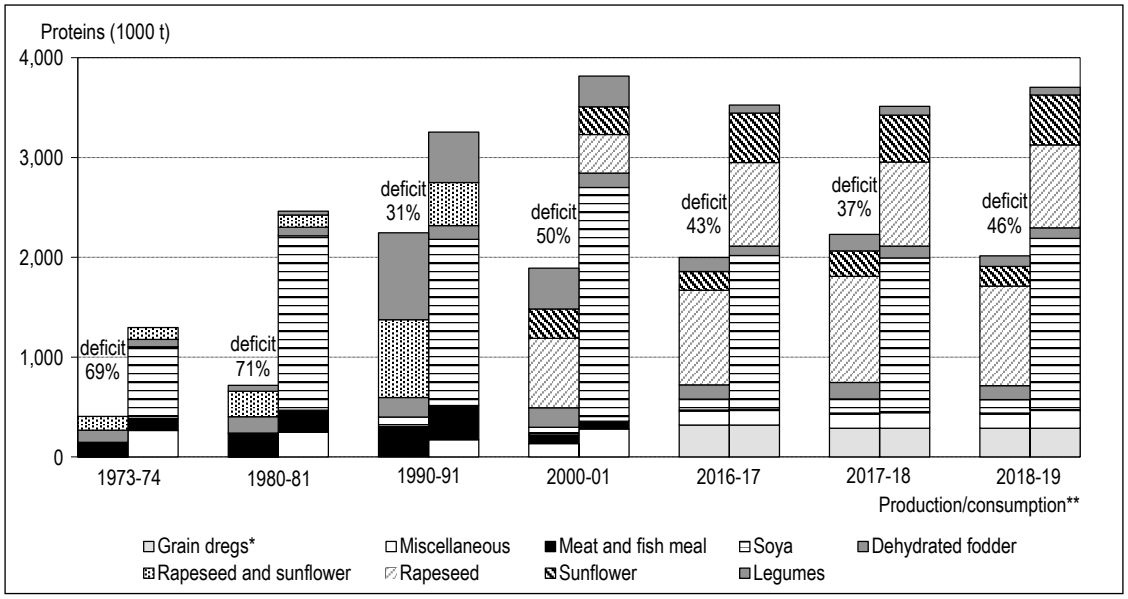
Figures I and II below show how the production and use of PRPs in animal feed in France and Europe have changed since 1973. While their use increased sharply at the beginning of the study period, since 2000, it has grown only marginally in Europe and even declined in France, due to a more modest increase in livestock production volumes and increased productivity in these sectors. Soya cake is the most widely consumed PRP, followed by other oilseed cakes (rapeseed and sunflower). PRP production also increased significantly at the beginning of the study period, with more modest increases since the early 2000s. Production of rapeseed and sunflower cake has increased considerably, partly due to the expansion of the biofuel industry. In contrast, production of legumes decreased substantially over the same period. The French PRP deficit has always been less pronounced than the European deficit, partly due to the available agricultural land, the scale of livestock production and national policies.

1.2. Impact of Public Policies

The French and European deficits in PRP for animal feed are partly explained by a an agreement adopted in the 1960s between Europe and the US, which allowed the European Union (EU) to implement a price support policy for its cereals in exchange for duty-free access to the EU for

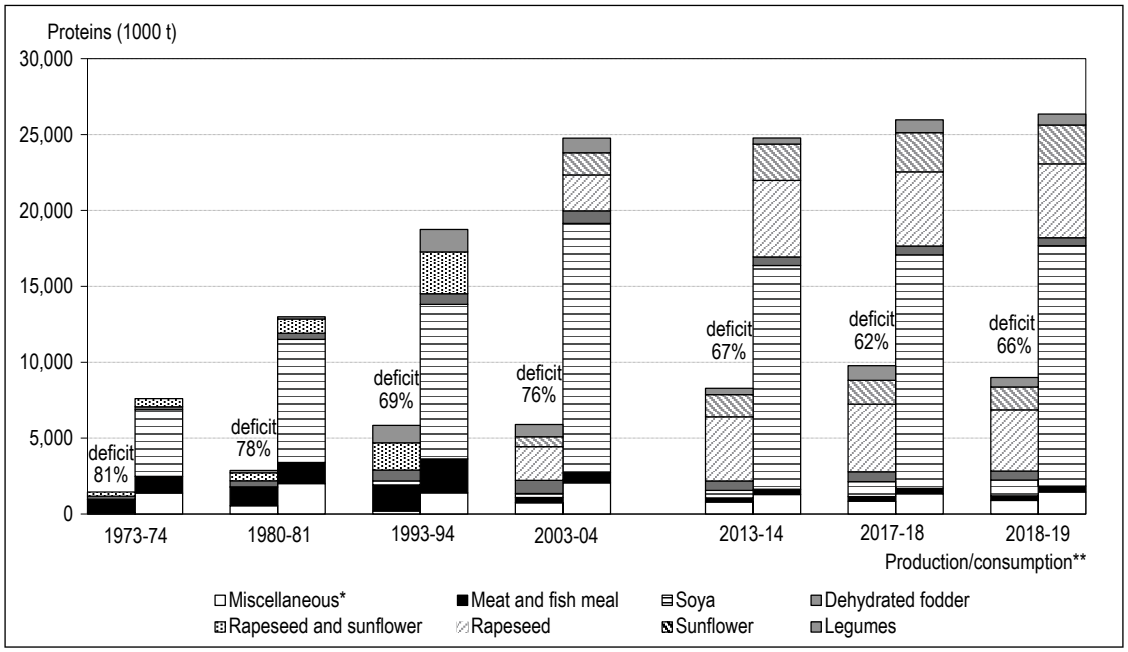
1. See also in Agrosynergie (2018) a more comprehensive overview of the topic.

Figure I – **Changes in the French balance of protein-rich products (PRPs) for animal feed**



*Estimated data not available before 2009-10.
**For each period, the first bar corresponds to production, the second to consumption.
Sources: Terres Univia (estimate).

Figure II – **Changes in the European PRP balance for animal feed**



*Excluding grain dregs (data not available).
**For each period, the first bar corresponds to production, the second to consumption.
Sources: Terres Univia (estimate).

US oilseed imports (Hache, 2015). Therefore, the EU and France came to depend on soya bean and soya cake imports from the US, Argentina and Brazil. In a highly concentrated global soya market, such a dependence was a weakness for the European animal production sector (in 1973, the United States reduced its soya exports due to a severe drought). As a result, Europe implemented various protein plans to boost European legume production, the first of which dates back to 1975 and the latest to 2020.

Support for legume and soya bean acreage and production has been a recurrent feature of these protein plans.[2] Since 1992 and the MacSharry reform of the Common Agricultural

2. For details, see: https://draaf.nouvelle-aquitaine.agriculture.gouv.fr/IMG/pdf/AgresteNA_AR_67_proteagineux-lien_cle8119fc.pdf

Policy (CAP), support for the cultivation of legumes and soya beans (on a per-hectare basis) has decreased overall, but less so than for other crops competing for agricultural land. However, combined changes in support, crop prices, yields and variable production costs led to a decline in margins per hectare of land dedicated to legume crops between 1992 and 2008 relative to the margins per hectare of competing crops (Ramanantsoa & Villien, 2012). This contributed to a sharp decline in French land allocated to legume crops.[3] The CAP Health Check in 2008 brought an increase in relative support for legume acreage, leading to an increase in the amount of land dedicated to growing these crops.

The latest plan (period 2014-2020) falls within the framework of the post-2013 CAP, with combined support for land dedicated to legume crops, including fodder crops, in amounts ranging from €100 to €200/ha. These crops are now also indirectly supported by the eligibility criteria for direct payments under the first pillar of the CAP, which encompass the bulk of agricultural budget support. These criteria, known as "greening", require the maintenance of minimum areas of ecological interest, which include protein acreage. The agri-environmental and climate measures under the second pillar of the CAP are another public instrument promoting legume crops and recognising their positive environmental impacts (input reduction through longer rotations). However, restrictions/bans on plant protection products (e.g. against faba bean seed beetle) have made these crops less attractive to farmers. During that period, the acreage devoted to legumes in France increased only marginally. In contrast, the acreage devoted to soya increased significantly, partly due to new seed varieties that were better suited to different geographical areas and to the implementation of a French soya charter involving the various stakeholders in the industry in order to meet the French demand for non-GMO soya. Despite this increase, legumes still accounted for only a modest share (4%) of French arable land surface area, which was largely dominated by grains.

The health crisis that emerged at the beginning of 2020 brought the issue of French sovereignty to the fore, not only in terms of medical equipment (masks) but also in relation to food supply. Jaravel & Méjean (2021) begin by demonstrating that, in terms of vulnerability, the French agri-food supply is just behind the chemical sector. They then propose three measures aimed at building a realistic and effective resilience strategy without resorting to excessive protectionism: greater diversification of supplies, expansion of storage capacity for low value-added products and, finally, increased innovation for vulnerable inputs at the technological frontier. However, the government-led France Relance recovery plan includes further measures intended to boost French production, including the supply of plant proteins. This new plan aims to double the acreage devoted to legumes by 2030, to 8% of the available agricultural land. In concrete terms, this plan, initially endowed with 100 million euros, provides public funds to help structure supply chains (inspired in part by the example of the soya sector) and encourage investment in agricultural holdings (the initial budget of 20 million euros was used up in the first year and a new budget for the same amount was approved in 2021). These amounts remain well below the combined subsidies for acreage dedicated to legume crops (under the national low-carbon strategy, the budget announced for 2027 alone amounts to 236 million euros). Like previous plans, it includes actions to promote human consumption of legumes (not explicitly covered in this article) and support varietal research.

In this respect, GMO seed crops have been banned in France since 2008 (only one crop – maize – is allowed in Europe, which is mainly grown in Spain); however, about a hundred GMO crops and their by-products are authorised for import and use in food and feed. This includes soya beans and by-products such as soya oil and soya cake. These authorised GMO products are subject to traceability and labelling obligations, with an exemption threshold to account for possible cases of accidental presence (e.g. in the management of raw material transport). These obligations do not apply to products (dairy, meat) from animals that may be fed GMO raw materials. Operators in these sectors can choose to declare that their livestock have been fed "GMO-free", at extra cost to themselves and/or to consumers.

GMO farming began in the mid-1990s and has grown steadily since then, recently approaching 190 million hectares, i.e. more than 10% of the world's arable land, concentrated in three countries: the United States, Brazil and Argentina (75, 50 and 24 million hectares, respectively).

3. Other factors contributed to this decline, including greater volatility in the yields of these crops and blocking of supply chains (Zander et al.*, 2016; Magrini* et al.*, 2016). To our knowledge, there is no econometric quantification of the relative contributions of these different factors to changes in PRP acreage/production/balance sheets.*

They mainly consist of soya, maize, cotton and rapeseed, with almost 96, 60, 25 and 10 million hectares, respectively. As a result, almost 80% of the soya grown worldwide is GMO, making it increasingly difficult to supply certified non-GMO soya in France and Europe.

This expansion of GMO crops is partly due to the ever-increasing numbers of new GMO seeds being authorised (Nes *et al.*, 2021). Resistance to herbicides (especially the controversial glyphosate) and insects are still the dominant traits of GMO crops. New GMO seeds target other characteristics, such as increased resistance to climatic hazards or changes in the nutritional composition of products. Moreover, while GMOs are organisms whose genetic material has been detectably altered, this is not the case for seeds produced through new technologies, generally grouped together under the term "genome editing", which were introduced in laboratories in the mid-2000s. These technologies, also used in gene therapy (Parisi & Rodriguez-Cerezo, 2021), do not insert one or more genes from another organism into the genome of an organism: rather, they selectively modify a genetic sequence within an organism by means of different processes, such as gene mutation, activation or silencing. The products created using these new technologies can also be obtained by conventional (natural) plant breeding techniques. A major advantage of these new technologies is their lower procurement cost in research and development (only 5% of the cost of conventional technology – Bullock *et al.*, 2021). The cultivation of these new seeds has recently begun in the United States (Gotch *et al.*, 2021).

European countries have debated at length the legal status of the products created using these new technologies. In July 2018, the EU Court of Justice temporarily settled the debate on the grounds that they should be governed by the rules applied to GMO products. However, in the spring of 2021, following a request from the European Council, the European Commission published a report that was more favourable to these new technologies and derivatives, stressing on the one hand that they can contribute to more sustainable food systems and therefore to the objectives of the Green Deal, and on the other hand that the current EU legislation on GMOs, adopted in 2001, is no longer appropriate. The debate on these technologies and the resulting products, as well as their possible contributions to protein self-sufficiency, are therefore being reopened in Europe and France (see for example Le Déaut, 2021).

2. Literature Review

French and European protein independence is a long-standing issue that has given rise to numerous research projects. This article is limited to a summary of recent studies that include economic computations.

In terms of supply, many studies consider the size of the agricultural holding, the field crop farm and/or the mixed crop-livestock farm. These studies mainly analyse the potential trade-offs between economic and environmental objectives where levels of legume/PRP production/use vary. They include prospective and *ex post* comparative analyses, but make no attempt to statistically explain farmers' choices in terms of levels of production of PRPs. Summarising the findings of the various French studies conducted to date, Magrini *et al*. (2015; 2016) conclude that there is no trade-off for French farms: the expansion of legume crops is beneficial in the long term, within the framework of appropriate rotations, from both an environmental and economic point of view. These results are not consistently observed in other production regions. As an example, Reckling *et al.* (2016) evaluate the same trade-offs between the economic and environmental effects of the integration of legumes in five European regions. These authors find that, while the introduction of legumes led to significant reductions in nitrous oxide emissions and nitrogen fertiliser use, it also led to a decrease in gross margins in three out of five regions. More recently, Cortignani & Dono (2020) show that the expansion of legume crops promoted by the greening measures of the CAP improved the environmental balance of Italian farms as expected, but to the detriment of economic (income) and social (salaried and non-salaried work) impacts. Lastly, using a micro-econometric model that takes into account the heterogeneity of French agricultural holdings, Koutchadé *et al.* (2021) quantify the impact of coupled subsidies on extensive margins, i.e. on decisions to include legumes in crop rotation. They also show that these subsidies have much more limited impacts on intensive margins, i.e. the number of hectares cultivated once the crop is integrated into the crop rotation.

Some macroeconomic analyses have examined the supply of legumes at national level in France. The latest to our knowledge was provided by Ramanantsoa & Villien (2012), who simulated the impacts of different public support schemes for legume and soya bean production at national level using the MAGALI supply model.

They showed that the price changes considered would have a greater impact on PRP land use and production than direct subsidies. They also pointed out that the cost of reducing GHG emissions is high in relation to the carbon price.

Other studies have focused specifically on the French demand for PRPs, in particular by French animal feed companies. Le Cadre *et al.* (2015) therefore investigated the possible use of locally produced, certified non-GMO soya cake, showing major raw material substitutions and once again the importance of relative prices.

Europe-wide studies covering all aspects of legume/PRP markets are more numerous (recent examples include Henseler *et al.*, 2013; Kalaitzandonakes *et al.*, 2014; Kuhlman *et al.*, 2017; Deppermann *et al.*, 2018; Jensen *et al.*, 2021; Gotch *et al.*, 2021). Using the CAPRI model, Kuhlman *et al.* (2017) test six scenarios, finding that those in which foreign GMO products were rejected (captured by a reduction in imports) in Europe and the introduction of a carbon tax were the most effective for promoting legume production. The scenario combining a tax on meat consumption and a subsidy for the consumption of vegetables has a neutral effect on the acreage devoted to legume crops, due to the decrease in the land used for soya as a result of the decrease in meat production. Deppermann *et al.* (2018) use the Globiom model to simulate the impacts of restricting animal feed to using only local raw materials until 2050; it resulted in a decrease in milk and meat production, as well as in the acreage used for grain production (replaced by legumes). The authors found that the gain in protein independence came at the expense of self-sufficiency for animal products and grains. Jensen *et al.* (2021) use the Aglink-Cosimo model developed by OECD and FAO to quantify the impact of three scenarios on European protein autonomy: a subsidy coupled to land used for legume production, an increase in pea and soya yields and finally a halt in palm oil imports for biodiesel production. *A priori*, the latter scenario should stimulate European rapeseed oil production (to replace palm oil) and simultaneously European rapeseed cake production, thereby reducing the need to import soya cake. The authors find that only the second scenario (increased yields) leads to a significant improvement in European protein self-sufficiency. Lastly, Gotch *et al.* (2021) examine the economic issues related to the legal status of crops derived from new genome editing technologies. For these authors, the economic and environmental impacts are negative, considerable and quite similar to those calculated by Deppermann *et al.* (2018) if the EU keeps these products in the GMO category.

In all the above-mentioned studies, the methods applied do not explicitly differentiate between the GMO and non-GMO sectors, mainly because of the lack of data to measure them, but more theoretical studies have investigated the impacts of the introduction of GMO technologies and their regulation. For example, Moschini *et al.* (2005) concluded that the introduction of GMO food products would have a negative impact on the European economy due to the high costs of traceability and segregation. This is also due to the resistance of European consumers to taking up these products/technologies, as recently measured by Marette *et al.* (2021).

3. Modelling and Definition of Scenarios

Compared to the various macroeconomic models mentioned above, our CGE model makes it possible to simultaneously consider consumers, producers and the entire sector, with two major original elements: the database constructed and the specification of the behaviour of economic agents. Indeed, this model describes the French agricultural and agri-food sectors in great detail, distinguishing between sectors described as certified non-GMO and other sectors ("conventional"). Clearly, this separation in two of the diversity of French agricultural sectors is reductive, as it, for instance, places the organic sector and others that use plant protection products in the former group, but it is still an improvement on existing models, which generally consider a single market/technology for each product. Moreover, the specification of producer/consumer behaviour is more complex than conventional CES production/utility functions, in order to better capture the economic trade-offs of these agents between the two sectors.

Our CGE model is otherwise traditional in its general principles: it is a static model, allowing the analysis of steady states and not the dynamics between these states; it presupposes pure and perfect competition in all product markets, with the price balancing supply and demand. It is a single-country model centred on France; trade with other countries is specified with the traditional Armington specification. The economic behaviours of agents in the "Rest of the World" are specified through export and import demand functions.

For the macroeconomic closure, we assumed that investment is determined by savings, which is itself determined by an exogenous savings

rate for French households. Public consumption of goods and subsidy/tax rates on the various cash flows are also fixed. The balance of the State budget is ensured by a variation in net levies on households. Finally, the trade balance is fixed and the real exchange rate endogenous. Kilkenny & Robinson (1990) showed that none of these macroeconomic assumptions had any substantial bearing on the market impacts that we measure and constitute the aim of this article. In the same vein, Gohin & Moschini (2006) showed that for agricultural policy reform scenarios, the impacts on markets measured by a CGE model were very similar to a partial equilibrium (PE) model defined on the same sectors of interest. In this article, we opted for the use of the full CGE model, which poses no additional difficulties in terms of data resolution and acquisition; CGE modelling, which satisfies Walras' law, ensures the economic consistency of the findings.

The database of our CGE model is a Social Accounting Matrix (SAM) representing the macroeconomic accounts of the French socio-economic system; its structure is detailed in the Box below. The remainder of this section sets out the main specifications of economic behaviour and the three scenarios tested.

Box – **The Social Accounting Matrix**

The basic SAM at the French level was constructed based on the tables of the National Accounts (INSEE): Input-Output Table (IOT) and Table of Integrated Economic Accounts (TIEA), in the version that includes 17 activities. At this stage, there is only one aggregate sector for agriculture, forestry and fisheries. Agricultural production was then differentiated from forestry and fishing, and the products of the French agricultural sector were differentiated using different data sources from INSEE and Agreste: Resource-Use Balances (RUB), supply balances, agricultural accounts and price or quote data. A distinction was also made between the various agri-food sectors and their energy consumption based on ESANE, a system used for the compilation of INSEE's annual company statistics, FranceAgriMer's statistical data, Agreste's *Enquêtes triennales sur l'alimentation animale* (three-yearly surveys on animal feed) and INSEE's *Enquête annuelle sur les consommations d'énergie dans l'industrie* (annual survey on industrial energy consumption – EACEI).

Next, a distinction was made between farms in Brittany and the Loire region, which are particularly active in livestock production, and the rest of France using data derived mainly from regional agricultural accounts, the *Tables de l'Agriculture Bretonne* (TAB) and the memento of agricultural statistics of Pays de la Loire.

The main originality of our SAM lies in the distinction between conventional and certified non-GMO goods for a number of products from agriculture and the agri-food industries, whether produced, traded or consumed on the French market. Only limited data are available on animal products fed with or without GMOs. We used the study by Tillie & Rodríguez-Cerezo (2015) whose data date back to 2012 and concern the European markets for certified non-GMO soya and its by-products (see table below). Market data were collected for 14 EU countries, including France, for three types of soya-derived products: soya beans, soya cake and soya-containing compound feed for livestock. We used these data to make assumptions about the quantities and prices of various certified GMO-free products (including concentrate feed, milk, meat).

Table – **Characteristics of non-GMO markets**

Data	% non-GMO (quantity)	Premium/additional cost (%)
Soya bean imports	10	+15.65
Soya cake imports	10	+20.10
Production of concentrate feed for poultry	10	
Production of concentrate feed for cattle	19	
Production of concentrate feed for swine	7	
Concentrate feed		+18.85
Cost of broiler chicken production		+19.50
Cost of milk production		+7.50
Cost of pork production		+14.50
Consumer price of poultry meat		+16.20
Consumer price of eggs		+16.40
Consumer price of milk		+12.70
Consumer price of pork		+14.00

Sources: Tillie & Rodriguez-Cerezo (2015)

We had access to the quantities of non-GMO certified and conventional soya and soya cake imports and the quantities of non-GMO certified compound feed produced in France for poultry, cattle and swine. Based on operator surveys, Tillie & Rodrìguez-Cerezo (2015) also provided the additional costs of non-GMO certified soya, soya cake or concentrate feed according to regulatory tolerance thresholds. The authors also estimated the increase in production costs for one kilogram of chicken, milk and pork from certified non-GMO fed animals and the difference in retail prices for animal products labelled as being derived from non-GMO fed animals. ➔

Box – *(contd.)*

We assumed that certified non-GMO or standard concentrate feeds have the same nutritional value and the same yield. Next, we estimated the number of animals fed with certified non-GMO feed in relation to certified non-GMO concentrate feed produced in France. In order to determine the value of the certified non-GMO production of the various animal products, we applied marked-up producer prices, assuming that these producer prices reflected the increase in production costs estimated in Tillie & Rodrìguez-Cerezo (2015). For the agri-food sector, we assumed that the production of products from non-GMO fed animals is proportional to the domestic production of non-GMO fed animals and that the increase in production costs at the farmer level is passed on along the chain.

For household consumption, we assumed that the proportion of certified non-GMO goods is the same as that of certified non-GMO goods produced in France. We applied the premium paid by consumers for certified non-GMO products as estimated in the report by Tillie & Rodriguez-Cerez (2015) and reported in the table to the values obtained.

Overall, our analysis distinguished between 26 agricultural products[(i)] and 19 products from the agri-food industry.[(ii)]

(i) For crop production, we distinguished between soft wheat, barley, maize, rapeseed, non-GMO soya, conventional soya, sunflower, peas, faba beans and other oilseeds, fodder, fruit and vegetables and beet. For animal production, we distinguished between cattle, calves, swine, milk, poultry and eggs, and for each of these products, we determined the proportion of non-GMO products. The remainder of these values is classified as "other agricultural products".

(ii) For agri-food products, we distinguished between beef (conventional and non-GMO), pork (conventional and non-GMO), poultry meat (conventional and non-GMO), other meats, dairy products (conventional and non-GMO), soya oil, other oils, soya cake (conventional and non-GMO), other oil cakes, compound feed (conventional and non-GMO), sugar, beverages and tobacco, and finally a residual "other agri-food products".

3.1. Main Characteristics of the Computable General Equilibrium Model

SAM data are fed into a CGE model that simulates the behaviour of firms in terms of product supply, input demand and use of factors (capital, labour or land for the agricultural sector) and the behaviour of households in terms of final consumption of products and savings. These behaviours depend not only on prices, technical and budgetary constraints, but also on regulatory constraints and taxes or subsidies that can be modelled. We assume here that producers maximise their profits under the constraint of a production function and consumers maximise their utility under a budget constraint.

3.1.1. The Behaviour of Agricultural Producers

This section focuses on representative regional multi-output farms. Three farms are included in our model: one representative of the agricultural sector in Pays de la Loire, one representative of Brittany and one representative of the rest of France. We only distinguish between the two main French regions for livestock production in terms of agricultural production due to availability of the data. Each farm maximises its profits under technical constraints. The decision variables are the inputs specific to each output, acreage allocated to the different crops, numbers of animals, non-attributable intermediate consumption (such as insurance services) and salaried jobs. The maximisation programme depends on input and output prices, fixed factors (material and building capital, total agricultural surface area and self-employed labour) and technological possibilities. For the latter, we follow Koutchadé *et al.* (2021) and model crop yields using a quadratic function specific to each crop, dependent on the quantities of inputs used (fertilisers and plant protection products). However, these yields do not depend on the number of hectares cultivated. Gross margins are derived per hectare for each crop, assuming that producers determine the optimal crop rotations that maximise the sum of these margins multiplied by the acreage allocated to these crops, minus a concave cost function dependent on acreage. We proceed in the same way for each animal activity: the yields per animal are then quadratic functions of feed intake (concentrates and fodder for herbivores), and the optimal numbers of animals maximise the sum of margins minus a concave cost function which depends on the number of animals.

Technologies in multi-product sectors are traditionally specified with CES functions. The results are then used to model land use trade-offs and came under significant criticism due to the non-additivity of quantities. Gohin (2020) solved the problem by developing a quadratic approach. However, it is parameter-intensive. To reduce the number of parameters, the logistic functions are specified as in Koutchadé *et al.* (2021).

3.1.2. French Consumer Behaviour

We assume that consumers make a series of choices: firstly, they choose between the consumption of food and non-food goods according to a linear expenditure system (LES)

function. It is therefore assumed that a minimum necessary amount is allocated to food and non-food goods. This expenditure system makes it possible to capture non-homothetic income effects, which are regularly estimated in econometric studies conducted on both microeconomic and macroeconomic data. The choice between food and non-food goods is made according to a Cobb-Douglas function, which is not critically important in our analysis, as prices of other goods vary little in the simulated scenarios.

Within food goods, consumers then make a choice between meat, dairy products, eggs, cooking oils and other food goods, again using a LES function. The choice between other food goods (fruit, beverages, etc.) is made according to a Cobb-Douglas function, again without prejudice, as the prices of these goods vary little in our scenarios. A choice is also made between different meats (beef, pork, poultry and other meats) according to a new LES function. The final level of decision-making is between certified non-GMO and conventional products and concerns eggs, dairy products and different meats. This last level of trade-off is specified by a CES-LES function. This function, which is used in the MIRAGE model, is parsimonious, regular and more flexible than the LES function in taking into account price effects, the latter restricting goods to the status of gross complements. This allows for greater relevance in the analysis of a change in French consumer demand for GMO-free food products.

3.1.3. Calibration

The parameters of the production and utility functions are calibrated using SAM data and price or expenditure elasticity. For agricultural supply, the parameters are determined on the basis of the econometric findings of Koutchadé *et al.* (2021). For example, the price elasticity of wheat production is 0.55, broken down into a surface area effect (0.50) and yield effect (0.05). For (non-GMO) soya produced in France, these elasticities are respectively 0.80, 0.54 and 0.26. For final household demand, we rely mainly on the econometric findings of Caillavet *et al.* (2016), and for the distinction between non-GMO and conventional food goods on the recent econometric estimates on organic dairy products by Lindström (2021). For trade, we assume that France is a small country on the world markets for agricultural and agri-food products. The same values were therefore adopted for the price elasticities of export demand (to the nearest whole number), import supply and Armington substitution elasticities. Fontagné *et al.* (2022), who have estimated these elasticities econometrically, find values close to 10 for animal products. This value is therefore used for conventional food products. However, to reflect the preferences of French households for local and certified non-GMO products, we retain a value of 0.1 for the own-price elasticity of import supply in order to take account of the fact that foreign producers may also want to offer certified non-GMO food products, competing with those produced in France, especially for French households located near land borders (with Germany for example). Similarly, the own price elasticity of export demand is set at −0.1. This means that foreign consumers also tend to favour domestic non-GMO production. These two elasticities are not supported at all by the econometric estimation, so we conduct a sensitivity analysis of the results obtained with these elasticities.

3.2. Definition of Scenarios

A number of proposals have been made to improve protein self-sufficiency, at the national and/or European level (see literature review). Here, we consider three contrasting scenarios in terms of protein independence strategies, all tested on our model calibrated for the year 2011, for two reasons: on the one hand, this avoids the need to establish a reference scenario (e.g. for 2030), which is a tricky exercise: for example, there is a lack of information to quantify the trend in certified non-GMO sectors in France over the last ten years. On the other hand, the main economic variables have shown little change over the last ten years, the main exceptions being the steady decline in the number of farms, the rise of soya and the decline in the price of sugar (which was high in 2011 compared to the average of the last ten years). Conversely, the levels of production and prices of the main agricultural commodities observed in 2011 are in line with the average of the last ten years. The results presented here should therefore be understood as the effects that would have occurred in 2011 had these scenarios been implemented, economic stakeholders had adapted to them (according to the elasticities mentioned above) and markets had reached a new steady state.

The *first scenario* ("*Coupled subsidies*") is a conventional one that appears in all protein plans and is regularly tested in analyses. It concerns the increase in coupled aid for the cultivation of soya and legumes authorised by the new CAP and already planned in France as part of its national low carbon strategy. It simulates

an amount of coupled aid of €200/ha for soya, pea and faba bean crops (compared to €0/ha for soya in 2011 and €155/ha for peas and faba beans), which is close to the maximum amount of coupled aid paid for the last 10 years for a legume crop.

The *second scenario* ("*Technical progress*") simulates a varietal improvement that would compensate for the productivity gap between legumes and wheat (Magrini *et al.* 2016) through investment in research, at least initially driven by public authorities. As pointed out by Alston & Pardey (2021), it is not easy to determine the research and development expenditure needed to obtain a given varietal improvement; therefore, the costs associated with this scenario are omitted from our computations and, as mentioned in the introduction, no normative analysis is conducted. We assume that this varietal improvement would lead, all else being equal, to an increase in yield per hectare of 25% for peas/faba beans/soya and 12.5% for fodder. Note that Jensen *et al.* (2021) made more conservative assumptions (8% for the former, 0% for the latter), consistent for these latter crops with almost zero efforts in recent years in terms of varietal selection for grassland forage species (ACTA, 2021). These conservative assumptions are also consistent with the vision of lock-in described in Magrini *et al.* (2016), where research efforts focused primarily on "main" plants. As a counterpoint, new genome editing technologies no longer focus exclusively on these plants; some are applied to protein and fodder crops (alfalfa, ryegrass) (Parisi & Rodriguez-Cerezo, 2021). It is impossible to predict whether these new technologies will be authorised in France and in Europe in the short-to-medium or long term. Our aim here is just to test a breaking scenario.

The *third scenario* ("*Demand*") simulates an increase in consumer demand for French and certified non-GMO products. We then assume a doubling of the demand for eggs, poultry and pork, all else being equal. Initially these demands represent 10%, 10% and 7% of total demand for these products by French households in terms of volume. For certified non-GMO beef and dairy products, the initial levels of demand are higher (20%) and a 50% increase is assumed. Correspondingly, demand for conventional products decline such that initial budgets are unchanged. As the prices of certified non-GMO products are higher than those of conventional products, these assumptions imply a decrease in the overall quantities consumed. These assumed trends (all else being equal) are based on increases in the consumption of organic products in recent years and on the health, environmental and societal concerns of households. Therefore, according to CRÉDOC surveys summarised in FranceAgriMer (2018), the "Made in France" criterion has become the main criterion for choice, ahead of price and food safety. This third scenario is in line with a trend identified in Soler & Thomas (2020) of French households preferring to consume smaller quantities of better quality food. It is also consistent with recent analyses quantifying the effects of a reduction in red meat consumption motivated by health and environmental considerations (Cavaillet *et al.*, 2016; Bonnet *et al.*, 2018). Finally, the scale of our shocks (leading to market shares for non-GMO products ranging from 20% to 30%) is consistent with the objective set out in the European Green Pact to reach 25% organic products by 2030.

4. Results

In this section, we describe and comment on the findings obtained for the three scenarios. Table 1 provides a summary of those findings.

4.1. Coupled Subsidies Scenario

Unsurprisingly, the first scenario involving increased coupled subsidies to soya, pea and faba bean acreage leads to an increase in planted acreage (e.g. 8.6% for soya). The percentage increase is higher for soya than for the other two crops as the increase in the coupled subsidy is also higher. However, these increases remain modest and far from the stated objectives of doubling production. Consider the example of soya. In this scenario, the coupled subsidy is increased from €0/ha to €200/ha, which represents an equivalent price increase of 17.1% based on the initial soya yield. All else being equal, and in particular before modification of the equilibrium prices, this stimulates an increase in soya acreage of 9.2% (given the elasticity of 0.54 reported previously) and therefore in production of the same level. Smaller increases are obtained of 8.6% for acreage and 8.1% for production (Table 1-A). Indeed, the additional production leads to a fall in the price of certified non-GMO soya beans (Table 1-B) of around 1.8%, which reduces the initial effect of the subsidy on both planted acreage and yields (a decrease of 0.5%, consistent with the own price elasticity of the soya yield). Another, more limited effect, leading to a modest increase in French soya bean production, stems from the increase in the acreage planted with high-protein peas and faba beans.

Table 1 – **Simulation findings by scenario: variation in level and % from baseline**

	Baseline value	Scenario 1 "Coupled subsidies"		Scenario 2 "Technical progress"		Scenario 3 "Demand"	
		Level	(%)	Level	(%)	Level	(%)
A – **Impacts on French crop production (acreage in thousands of hectares, production in thousands of tonnes)**							
Wheat acreage	4,990	−1.70	−0.03	−4.95	−0.10	9.55	0.19
Wheat production	36,236	−12.15	−0.03	−37.97	−0.10	69.86	0.19
Rapeseed acreage	1,560	−0.55	−0.04	−1.38	−0.09	2.49	0.16
Rapeseed production	4,812	−1.60	−0.03	−5.85	−0.12	8.23	0.17
Soya acreage	40	3.45	8.62	3.22	8.05	2.80	7.00
Soya production	137	11.06	8.07	44.12	32.20	13.63	9.95
Pea acreage	180	3.02	1.68	11.89	6.60	0.31	0.17
Pea production	1,070	15.69	1.47	318.54	29.77	2.00	0.19
B – **Impacts on prices (€/tonne)**							
Conventional soya	354	−0.13	−0.04	−1.03	−0.29	−1.00	−0.28
Non-GMO soya	403	−7.34	−1.82	−34.62	−8.59	48.92	12.14
Conv. soya cake	300	0.16	0.05	−1.50	−0.50	−1.92	−0.64
Non-GMO soya cake	340	−5.29	−1.55	−28.88	−8.49	55.41	16.30
Conv. poultry	1,880	0.02	0.00	4.17	0.22	−5.36	−0.28
Non-GMO poultry	2,120	−2.12	−0.10	−12.13	−0.57	214.93	10.14
Soft wheat	183	0.02	0.01	−0.26	−0.14	0.14	0.08
C – **Impacts on demand for raw materials for animal feed (thousands of tonnes)**							
Wheat	11,328	1.05	0.01	−146.56	−1.29	67.70	0.60
Conv. soya cake	3,416	−1.30	−0.04	−151.92	−4.45	−149.94	−4.39
Other oil cakes	4,134	−3.73	−0.09	−145.33	−3.52	74.09	1.79
Non-GMO soya cake	452	8.34	1.84	31.57	6.99	17.26	3.82
D – **Impacts on livestock production (thousands of tonnes)**							
Conv. pork	1,895	0.00	0.00	−1.65	−0.09	−94.29	−4.98
Non-GMO pork	148	0.01	0.01	0.09	0.06	110.12	74.41
Conv. poultry meat	1,678	−0.03	0.00	−2.70	−0.16	−111.68	−6.66
Non-GMO poultry meat	186	0.09	0.05	0.67	0.36	117.96	63.42
Conv. cow's milk.	19,226	−0.55	0.00	416.40	2.17	−1,414.47	−7.36
Non-GMO cow's milk	5,880	0.07	0.00	−1.07	−0.02	2,136.26	36.33
E – **Impacts on trade**							
Wheat (000t)	18,267	−11.00	−0.06	124.58	0.68	−85.16	−0.47
Conv. soya cake (000t)	3,061	0.11	0.00	−141.03	−4.61	−142.48	−4.65
Conv. pork meat (€M)	−13	0.05	−0.36	−11.81	90.87	183.52	−1,411.72
Conv. poultry meat (€M)	396	0.01	0.00	−9.95	−2.51	124.75	31.50
Conv. dairy products (€M)	2,344	−0.53	−0.02	388.70	16.58	988.64	42.18
PRP (€M)	−897	6.21	−0.69	174.37	−19.44	10.46	−1.17
Agri/agro balance (€M)	10,843	−12.90	−0.12	873.58	8.06	1,570.69	14.49
F – **Impacts on business income and employment**							
Farm income (€M)	38,114	10.93	0.03	643.16	1.69	336.34	0.88
AFI income (€M)	29,814	0.04	0.00	74.10	0.25	590.48	1.98
Agricultural salaried employment	230,674	−8.03	0.00	4,449.33	1.93	2,743.49	1.19
Agri-food salaried employment	534,661	6.37	0.00	1,142.40	0.21	9,197.38	1.72

For meat, the unit of measurement is the tonne of carcass equivalent (see https://www.franceagrimer.fr/FAQ/VIANDES/Viandes-Que-signifie-T.E.C).
Sources: Authors' calculations.

This supplement of non-GMO French soya beans goes mainly to the French vegetable fat industry, with little change in trade (imports and exports). The 8.4% increase in French production of certified non-GMO soya cake is therefore entirely absorbed by animal feed. However, this represents an increase of only 1.8% of this tonnage as a large proportion (almost 80%) is originally imported (Table 1-C). The consequences are somewhat different for peas and faba beans, as a high percentage (around 30%) is exported. Production supplements are therefore also partly exported, which contributes to a smaller fall in prices (0.4% compared to 1.8% for soya beans).

These PRP supplements used in animal feed modestly displace the use of conventional soya cake and other oil cakes (especially rapeseed cake), by less than 0.1%. The use of soft wheat in animal feed even increases slightly, complementing the rations fed to poultry. The increases in certified non-GMO granivore and herbivore production (Table 1-D) are actually very limited, the most significant in percentage being poultry production, which is more reliant on soya cake than other animal production.

In terms of trade in products (Table 1-E), net exports of soft wheat fall slightly, mainly due to a slight decrease in allocated production and acreage. More surprising is the near stagnation of imports of conventional soya cake, while their use in animal feed falls slightly. This is due to the fact that the French fat sector uses its crushing plants more frequently for the crushing of certified non-GMO soya beans than for that of conventional soya beans, resulting in a decrease in French production of conventional soya cake. However, imports of conventional soya beans decrease, causing the French PRP balance to improve by 6.4 million euro. Protein self-sufficiency improves, but only marginally. In contrast, the French agricultural and agri-food trade balance deteriorates by around 12.8 million euro, mainly due to the decline in grain exports.

While this scenario improves farm incomes by almost 11 million euro for an additional budgetary expenditure of 21 million euro, i.e. a transfer efficiency of 0.5 (Table 1-F), this does not lead to an increase in paid labour in agriculture, but rather to an increase in the rental value of agricultural land. This scenario benefits vegetable production, which is relatively less labour-intensive and more land-intensive. The impacts on the agri-food industries are negligible.

In general, for this scenario, the main results of our simulation are consistent with those obtained in the literature (e.g. Jensen *et al*., 2021), which emphasise the modest impacts of acreage-based subsidies on the markets. Our main contribution is to show the differentiated impacts between the conventional and certified non-GMO sectors. This first scenario also gives credibility to our modelling choices.

4.2. Technological Progress Scenario

Some of the mechanisms identified above are also at work in our second scenario. Indeed, all else being equal, an increase in yields leads to an increase in margins per hectare, which encourages a change in crop rotation in favour of seed and forage legumes. This results in an increase of 8% in the French acreage of non-GMO soya beans (Table 1-A). In contrast to the previous scenario, the increases are higher in terms of percentage of production (close to 32% for soya beans) due to the exogenous increase in yields. In fact, the increase in production once again leads to price reductions (exceeding 8% for non-GMO soya beans, Table 1-B), which limit the increase in yields and ultimately production. The increase in legume acreage is at the expense of all other arable crops; forage acreages are also down slightly because yield growth is assumed to be lower.

In terms of animal feed (Table 1-C), we again see an increase in the use of certified non-GMO soya cake, which is more competitive in price. By contrast, reductions in the use of other PRPs are significant, especially conventional soya cake (of the order of −150,000 tonnes) and even grains (by a similar tonnage for wheat). This is explained by the increase in the production of fodder for own consumption. In fact, production of herbivores increases (Table 1-D), with total milk production increasing by 1.6%, i.e. by over 400 million litres.

This scenario leads to an increase in certified non-GMO granivore production, to the detriment of conventional granivore production, as the cost of certified non-GMO feed is reduced. Conversely, conventional milk production increases and milk production from non-GMO fed cows stagnates. This is due to the greater weight of fodder in the production costs of conventional milk than in those of certified non-GMO milk. Indeed, all fodder produced in France is non-GMO and can therefore be used in both sectors. However, the non-GMO sectors are subject to additional traceability and labelling costs (cf. section 3.1 for sizing).

In terms of trade (Table 1-E), this scenario leads to a significant decrease in imports of conventional soya cake (nearly 150,000 tonnes) and, at the same time, an almost equivalent increase in net exports of wheat, mainly due to the above-mentioned effects on animal feed. Although net exports of white meats decline, net exports of dairy products increase very strongly, also contributing to the improvement of the French agricultural and agri-food trade balance: this gain approaches one billion euro.

This scenario is also positive in terms of agricultural and agri-food income as well as salaried employment in both sectors (Table 1-F). In particular, the increase in salaried agricultural employment is significant because livestock

activities (especially dairy) are labour intensive. Employment increases comparatively more slowly in the agri-food industries, as the positive effects obtained in the meat and dairy industries are partially mitigated by a decline in employment in the compound feed industry.

Once again, the main results for this scenario are qualitatively in line with those obtained in the literature (e.g. Jensen *et al*., 2021), which emphasise the importance of technological progress. Our results appear stronger, mainly because we assumed an increase in forage yields of 12.5%. In fact they are critically dependent on this assumption. If, conversely, we assume no increase in forage yields, the impacts are once again modest, as in the first scenario. Fodder is rarely studied in global macroeconomic approaches (Gohin, 2020), usually due to the lack of available data, but our analysis illustrates the importance of taking it into account in agri-environmental issues.

4.3. Consumer Demand Scenario

The logic of the counterpart of this third scenario is different. The shift in demand towards French certified non-GMO products leads to an increase in the prices of the relevant products (Table 1-B). Conversely, it leads to price decreases for conventional products. For example, the increase is 10.1% for certified non-GMO poultry meat with a decrease of 0.3% for the conventional counterpart. These price changes are necessary to stimulate a shift in supply from French farmers and agri-food companies. Demand for certified non-GMO raw materials for animal feed is increasing, justifying a price increase of more than 16% for certified non-GMO soya cake. The increase in the price of certified non-GMO soya beans, however, is slightly less (12%) because, in our scenario, the soya oil extracted from them is not more valuable to French consumers.

Unsurprisingly, this scenario also leads to an increase in legume and soya bean acreage (Table 1-A) and, on the other hand, to an increase in grain and oilseed acreage. At the end of the simulation, only fodder acreage decreased. The main explanation is that the increase in demand for certified non-GMO white meat is higher than that for livestock products (red meat and dairy products). However, white meat production does not require fodder, only simple and compound concentrated feed.

This scenario too leads to a significant decline in the use of conventional soya cake in animal feed (150,000 tonnes, Table 1-C). This decline is partly offset by certified non-GMO soya cake and partly by the consumption of other oilseeds, particularly rapeseed produced in France, i.e. non-GMO. There is also an increase in the use of soft wheat for animal feed for the same reasons.

Total animal production (certified non-GMO and conventional) increases (Table 1-D) even though total French demand for these products decreases. For example, French pork production increases by 16,000 tonnes. This is due to terms of trade effects: conventional French production becomes more competitive in price. Indeed, agri-food companies make better margins on certified non-GMO products sold on the domestic market, which allows them to reduce their margins on conventional production.

This scenario leads to a considerable increase, of more than 1.5 billion euro, in the French trade surplus in agricultural and agri-food products (Table 1-E), mainly due to animal products. In contrast, the PRP deficit is barely reduced (by only 10 million euro). In fact, the decline in imports of conventional soya cake is offset primarily by an increase in imports of other oilseed cakes and to a lesser extent by a decline in exports of peas and faba beans.

This scenario is favourable to agricultural and agri-food incomes, as well as to salaried employment in these sectors (Table 1-F). The percentage effects are strong for agri-food industries, especially the dairy and meat industries, which are the target of new French consumer demands. Unlike the previous two, this scenario does not lead to an increase in the rental value of agricultural land, so the increase in agricultural incomes primarily benefits active farmers.

4.4. Robustness

The findings presented above obviously depend on many modelling assumptions and choices with regard to the calibration of behavioural parameters. As noted in section 3.1, the choice of many parameters was based on econometric studies. The notable exception concerns the parameters governing trade in non-GMO products. So far, we have assumed low own-price elasticities of export demand and import supply for these products (−0.1 and 0.1) compared to conventional products (−10 and 10). In this sensitivity analysis, the latter values are assumed for both product types (i.e. −10 and 10). This is an extreme calibration as it implies that French households no longer favour local products, and similarly foreign consumers no longer favour their local production.

This alternative calibration only marginally affects the results of the first coupled subsidy scenario, as the price impacts are small with the standard version. For example, the price of non-GMO soya beans falls by 1.2%, compared to 1.8% with the central calibration.

The results of the second crop improvement scenario change more significantly. For example, the fall in the prices of non-GMO soya beans and soya cake amounts to 5%, compared with 8.5% with the central calibration. This is because it becomes easier for French producers to export their additional production of non-GMO soya beans and soya cake on the world market, which limits the price drop. However, this does not lead to a significant change in the French protein deficit, which is reduced by 181 million euro, compared to 174 million euro with the central calibration. That is because at the same time, net trade in conventional oil cakes improves less, as these are still used in animal feed due to price effects. The effects on agricultural and agri-food incomes are unchanged.

The results of the demand change scenario also change perceptibly. The price increase for non-GMO poultry is only 6.6%, compared to 10.1% with the central calibration. Again, this does not lead to a significant change in the French protein deficit: the balance improves by 24 million euro, compared to 10 million euro with the central calibration. Again, this results from a substitution between GMO soya cake and other oil cakes. Finally, it is worth noting that, in this scenario, farm incomes do not improve with the alternative calibration, whereas they increase by 336 million euro with the central calibration. This is due to lower animal production (especially milk), which generates more value added than crop production.

* *
*

French protein independence is a nearly 50-year-old antiphon, which endures to this day, in the face of economic pressures. Will the new context – characterised by the health crisis that emerged in 2020, the increasingly perceptible changes in societal demands in favour of the environment and localism, and the emergence of new plant breeding technologies – allow these economic pressures to be overcome? This article provides some answers to this question through the development of an original economic model and the quantification of three contrasting scenarios.

The results of our simulations show that changes in French consumer demand for products derived from non-GMO fed animals is a much more powerful driver for reducing soya cake imports than traditional coupled subsidies for legume crops. However, this demand scenario does not lead to a significant improvement in protein self-sufficiency, as imports of other oil cakes increase. The trade balance of agricultural and agri-food products improves significantly, mainly due to the increase in net exports of dairy products. Moreover, this demand scenario increases the income of agri-food activities, slightly less so those of agricultural activities, stimulating their net job creation.

The scenario of coupled support for legume acreage, which is the preferred scenario in all the protein plans that have succeeded one another over the past 30 years, has little effect on the markets for plant-based products and no effect on the markets for animal products. French legume production grows less than the dedicated acreage, as coupled subsidies do not provide an incentive to increase yields. As a result, the effects on agricultural and agri-food incomes are barely noticeable.

In contrast, the scenario of crop improvement for fodder and seed legumes logically leads, by extending the scope of possibilities, to an improvement in protein self-sufficiency, in the agricultural and agri-food trade balance, as well as in agricultural and agri-food revenues. French households enjoy an additional supply of white meat from non-GMO-fed animals. However, the growth of fodder has a negative impact on the compound feed sector.

In short, this quantitative study shows that several drivers are necessary to reduce the French protein deficit and that this reduction cannot depend solely on public action but also on citizens in their consumer behaviour and acceptance or not of new technologies.

As in any empirical study, many hypotheses were put forward to obtain the above findings, which require further exploration. In particular, a more detailed representation of the agricultural sectors beyond that used in this article with the original separation of the certified non-GMO sectors in France (distinction of the organic sectors or pulses used directly in human food) would help to improve robustness. □

BIBLIOGRAPHY

ACTA (2021). Risques climatiques dans la perspective de la mise en place d'un système assurantiel de gestion du risque. Note dans le *Rapport sur la gestion des risques présenté par F. Descrozaille*, Assemblée nationale. http://descrozaille.fr/gestion-risques-agricoles/Rapport-M.Le%20Ministre-F.DESCROZAILLE-avec-annexes-.pdf

Agrosynergie (2018). *Market developments and policy evaluation aspects of the plant protein sector in the EU. Final Report*, Directorate General for Agriculture and Rural Development. https://op.europa.eu/fr/publication-detail/-/publication/271a5587-4f86-11e9-a8ed-01aa75ed71a1

Alston, J. M. & Pardey, P. G. (2021). The economics of agricultural innovation. In: Barrett & Just (Eds.), *Handbook of Agricultural Economics*, Ch. 5, pp. 3895–3980. Amsterdam: Elsevier. https://doi.org/10.1016/bs.hesagr.2021.10.001

Bonnet, C., Bouamra-Mechemache, Z. & Corre, T. (2018). An Environmental Tax Towards More Sustainable Food: Empirical Evidence of the Consumption of Animal Products in France. *Ecological Economics*, 147, 48–61. https://doi.org/10.1016/j.ecolecon.2017.12.032

Bullock, D. W., Wilson, W. W. & Neadeau, J. (2021). Gene Editing versus Genetic Modification in the Research and Development of New Crop Traits: An Economic Comparison. *American Journal of Agricultural Economics*, 103(5), 1700–1719. https://doi.org/10.1111/ajae.12201

Caillavet, F., Fadhuile, A. & Nichele, V. (2016). Taxing animal-based foods for sustainability: environmental, nutritional and social perspectives in France. *European Review of Agricultural Economics*, 43(4), 537–560. https://doi.org/10.1093/erae/jbv041

Cortignani, R. & Dono, G. (2020). Greening and legume-supported crop rotations: An impacts assessment on Italian arable farms. *Science of the Total Environment*, 734. https://doi.org/10.1016/j.scitotenv.2020.139464

Deppermann, A., Havlik, P., Valin, H., Boere, E., Herrero, M., Vervoort, J. & Mathijs, E. (2018).

The market impacts of shortening feed supply chains in Europe. *Food Security*, 10, 1401–1410. https://doi.org/10.1007/s12571-018-0868-2

Fontagné, L., Guimbard, H. & Orefice, G. (2022). Tariff-based product-level trade elasticities. *Journal of International Economics*, 137. https://doi.org/10.1016/j.jinteco.2022.103593

FranceAgriMer (2018). Enquête Comportements et Consommations alimentaire en France en 2016. Synthèse du Credoc pour FranceAgriMer, *FranceAgriMer,* 2018, 7.1. https://www.franceagrimer.fr/fam/content/download/60065/document/7-1_Synth%C3%A8se%20de%20l%E2%80%99enqu%C3%AAte%20Comportements%20Alimentaires%20en%20France%20en%202016.pdf?version=3

Gohin, A. & Moschini, G. (2006). Evaluating the Market and Welfare Impacts of Agricultural Policies in Developed Countries: Comparison of Partial and General Equilibrium Measures. *Applied Economic Perspectives and Policy*, 28(2), 195–211. https://doi.org/10.1111/j.1467-9353.2006.00281.x

Gohin, A. (2020). The Land Use Impacts of the EU Biodiesel Policy: Assessing the Direct, Indirect and Induced Effects. *Journal of Agricultural Economics*, 71(2), 305–329. https://doi.org/10.1111/1477-9552.12365

Gotch, A., Consmüller, N., Ferike, T. & Grethe, H. (2021). Economic and Environmental Consequences of the ECJ Genome Editing Judgement in Agriculture. *Agronomy*, 11(6). https://doi.org/10.3390/agronomy11061212

Guéguen, J., Walrand, S. & Bourgeois, O. (2016). Les protéines végétales : contexte et potentiels en alimentation humaine. *Cahiers de nutrition et de diététique*, 51(4), 177–185. https://doi.org/10.1016/j.cnd.2016.02.001

Hache, E. (2015). Géopolitique des protéines. *Revue internationale et stratégique,* 97(1), 36–46. https://doi.org/10.3917/ris.097.0036

Henseler, M., Piot-Lepetit, I., Ferrari, E., Gonzalez Mellado, A., ... & Hélaine, S. (2013). On the asynchronous approvals of GM crops: Potential market impacts of a trade disruption of EU soy imports. *Food Policy,* 4, 166–176. https://doi.org/10.1016/j.foodpol.2013.05.005

Jaravel, X. & Méjean, I. (2021). Quelle stratégie de résilience dans la mondialisation ? *Les Notes du Conseil d'analyse économique*, 64(10), 1–12. https://www.cae-eco.fr/staticfiles/pdf/cae-note064.pdf

Jensen, H. G., Elleby, C. & Domínguez, I. P. (2021). Reducing the European Union's plant protein deficit: Options and impacts. *Agricultural Economics*, 67(10), 391–398. https://doi.org/10.17221/94/2021-AGRICECON

Kalaitzandonakes, N., Kaufman, J. & Miller, D. (2014). Potential economic impacts of zero thresholds for unapproved GMOs: The EU case. *Food Policy,* 45, 146–157. https://doi.org/10.1016/j.foodpol.2013.06.013

Kilkenny, M. & Robinson, S. (1990). Computable general equilibrium analysis of agricultural liberalization: Factor mobility and macro closure. *Journal of Policy Modeling*, 12(3), 527–556. https://doi.org/10.1016/0161-8938(90)90012-4

Koutchadé, O., Carpentier, A. & Femenia, F. (2021). Modeling Corners, Kinks, and Jumps in Crop Acreage Choices: Impacts of the EU support to Protein Crops. *American Journal of Agricultural Economics*, 103(4), 1502–1524. https://doi.org/10.1111/ajae.12152

Kuhlman, T., Helming, J. & Linderhof, V. (2017). Optimizing Legume Cropping: the Policy Questions. In: Murphy-Bokern, D., Stoddard F. L., Watson C. A. (Eds), *Legumes in Cropping Systems*, Ch. 14, pp. 226–242.

Le Cadre, P., Pressenda, F., Labalette, F. & Peyronnet, C. (2015). Valorisation de tourteaux de soja issus d'une production locale non OGM chez les fabricants d'aliments. *OCL*, 22(5), 1–7. https://doi.org/10.1051/ocl/2015034.

Le Déaut, J.-Y. (2021). Innovation et agriculture : les techniques d'hier ne résoudront pas les problèmes de demain. *Paysans et Société*, 388(4), 6–13. https://doi.org/10.3917/pes.388.0006

Lindström, H. (2021). The Swedish consumer market for organic and conventional milk: A demand system analysis. Umeå University, Department of Economics, *Umeå Economic Studies* N° 998. http://www.usbe.umu.se/ues/ues998.pdf.

Magrini, M.-B., Anton, M., Cholez, C., Corre-Hellou, G., Duc, G., Jeuffroy, M.-H., ... & Walrand, S. (2016). Why are grain-legumes rarely present in cropping systems despite their environmental and nutritional benefits? Analyzing lock-in in the French agrifood system. *Ecological Economics,* 126, 152–162. https://doi.org/10.1016/j.ecolecon.2016.03.024

Magrini, M.-B., Thomas, A. & Schneider, A. (2015). Analyses multi-enjeux et dynamiques socioéconomiques des systèmes de production avec légumineuses. In: *Les légumineuses pour des systèmes agricoles et alimentaires durables*. Éditions Quae.

Magrini, M.-B., Anton, M., Chardigny, J.-M., Duc, G., Duru, M., Jeuffroy, M.-H., ... & Walrand, S. (2018). Pulses for Sustainability: Breaking Agriculture and Food Sectors Out of Lock-In. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2018.00064

Mahé, L.-P. (2005). La question de l'autosuffisance protéique est-elle définitivement obsolète pour l'Union européenne ? *OCL*, 12(3), 196–202. https://doi.org/10.1051/ocl.2005.0196

Marette, S., Disdier, A. C. & Beghin, J. (2021). A Comparison of EU and US consumers' willingness to pay for gene-edited food: Evidence from apples. *Appetite*, 159, 10506. https://doi.org/10.1016/j.appet.2020.105064

Moschini, G., Bulut, H. & Cembalo, L. (2005). On the Segregation of Genetically Modified, Conventional and Organic Products in European Agriculture: A Multi-market Equilibrium Analysis. *Journal of Agricultural Economics*, 56(3), 347–372. https://doi.org/10.1111/j.1477-9552.2005.00022.x

Nes, K., Schaeffer, K. A. & Scheitrum, D. P. (2021). Global Food Trade and the Costs of Non Adoption of Genetic Engineering. *American Journal of Agricultural Economics*, 104(1), 70–91. https://doi.org/10.1111/ajae.12213

Parisi, C. & Rodríguez-Cerezo, E. (2021). *Current and future market applications of new genomic techniques*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2760/02472

Pellerin, S., Bamière, L., Angers D., Béline, F., Benoit, M., Butault, J.-P., … & Chemineau, P. (2017). Identifying cost-competitive greenhouse gas mitigation potential of French agriculture. *Environmental Science and Policy*, 77, 130–139. https://doi.org/10.1016/j.envsci.2017.08.003

Ramanantsoa, J. & Villien, C. (2012). Soutien public à la production de protéagineux et de soja : rétrospective et projections à partir du modèle MAGALI. Ministère de l'agriculture, Centre d'études et de prospective, *Analyse* N° 43. https://agriculture.gouv.fr/soutien-public-la-production-de-proteagineux-et-de-soja-retrospective-et-projections-partir-du

Reckling, M., Bergkvist, G., Watson, C. A., Stoddard, F. L., Zander, ... & Bachinger, J. (2016). Trade-Offs between Economic and Environmental Impacts of Introducing Legumes into Cropping Systems. *Frontiers in Plant Science*, 7, 669. https://doi.org/10.3389/fpls.2016.00669

Soler, L. G. & Thomas, A. (2020). Is there a win-win scenario with increased beef quality and reduced consumption? *Review of Agricultural, Food and Environmental Studies*, 101, 91–116. https://doi.org/10.1007/s41130-020-00116-w

Terres Univia (2017). Plan de filière 2018-2022. En route pour le « made in France » des huiles et des protéines végétales. https://www.terresunivia.fr/sites/default/files/articles/publications/brochures/TU-Plan%20Filiere-64Pages.pdf

Tillie, P. & Rodríguez-Cerezo, E. (2015). Markets for non-Genetically Modified, Identity-Preserved soybean in the EU. *JRC Science and Policy Reports* 1–72. https://doi.org/10.2791/949110

Zander, P., Amjath-Babu, T. S., Preissel, S., Reckling, M., Bues, A., Schläfke, N., … & Watson, C. (2016). Grain legume decline and potential recovery in European agricultural: a review. *Agronomy for Sustainable Development*, 36(2), 1–20. https://doi.org/10.1007/s13593-016-0365-y

N° 528-529 (2021)

DOSSIER THEMATIQUE / THEMATIC SECTION

• Inégalités scolaires et politiques éducatives : une introduction / *School Inequalities and Educational Policies: An Introduction* – Georges Felouzis

• Mixité sociale : retour sur douze ans de ciblage des politiques d'éducation prioritaire / *Social Diversity: A Review of Twelve Years of Targeting Priority Education Policies* – Pierre Courtioux & Tristan-Pierre Maury

• Qu'est-ce qu'un bon lycée ? Mesurer les effets établissements, au-delà de la moyenne / *What Makes a Good High School? Measuring School Effects beyond the Average* – Pauline Givord & Milena Suarez Castillo

• Les inégalités de compétences à la fin des études / *Inequalities in Skills at the End of Education* – Fabrice Murat

• L'université française, lieu de brassage ou de ségrégation sociale ? Mesure de la polarisation du système universitaire français (2007-2015) / *French Universities – A Melting Pot or a Hotbed of Social Segregation? A Measure of Polarisation within the French University System (2007-2015)* – Romain Avouac & Hugo Harari-Kermadec

ARTICLES

• La participation des salariés à la gouvernance d'entreprise : quel impact sur la performance et la politique de distribution des liquidités dans le SBF 120 (2000-2014) ? / *Employee Participation in Corporate Governance: What Impact on the Performance and Cash Distribution Policy in the SBF 120 (2000-2014)?* – Cécile Cézanne & Xavier Hollandts

• Caractériser le paysage dans l'analyse des facteurs de l'urbanisation : méthodologie et illustration pour l'aire urbaine d'Angers / *Characterising the Landscape in the Analysis of Urbanisation Factors: Methodology and Illustration for the Urban Area of Angers* – Julie Bourbeillon, Thomas Coisnon, Damien Rousselière & Julien Salanié

N° 526-527 (2021)

DOSSIER THEMATIQUE / THEMATIC SECTION

• Imposition des couples et statut marital – Simulation de trois réformes du quotient conjugal en France / *Taxation of Couples and Marital Status – Simulation of Three Reforms of the Marital Quotient in France* – Guillaume Allègre, Hélène Périvier & Muriel Pucci

• Effets redistributifs de l'imposition des couples et des familles : une étude par microsimulation de l'impôt sur le revenu / *Redistributive Effects of the Taxation of Couples and Families: A Microsimulation Study of Income Tax* – Mathias André & Antoine Sireyjol

• Commentaire – La familialisation des taxes et transferts, un enjeu pour l'impôt sur le revenu et les autres politiques publiques / *Comment: Family-Based Tax and Transfer System – Issues for Income Tax and Other Public Policies* – Clément Carbonnier

ARTICLES

• Les inégalités de revenu entre les départements français depuis cent ans / *Income Inequality across French Departments over the Last 100 Years* – Florian Bonnet, Hippolyte d'Albis & Aurélie Sotura

• Le travail dissimulé en France / *Undeclared Work – Evidence from France* – Laila AitBihiOuali & Olivier Bargain

• Le durcissement des conditions d'accès et d'emploi dans les professions artistiques en France – Les cas de la danse et du cirque (2006-2016) / *The Tightening of Employment Conditions and Access to Jobs in Artistic Occupations in France – The case of Dance and Circus Arts (2006-2016)* – Samuel Julhe & Émilie Salaméro

• Évaluation du crédit d'impôt innovation / *An Evaluation of the Innovation Tax Credit* – Simon Bunel & Benjamin Hadjibeyli

Economie et Statistique / Economics and Statistics

Objectifs généraux de la revue

Economie et Statistique / Economics and Statistics publie des articles traitant de tous les phénomènes économiques et sociaux, au niveau micro ou macro, s'appuyant sur les données de la statistique publique ou d'autres sources. Une attention particulière est portée à la qualité de la démarche statistique et à la rigueur des concepts mobilisés dans l'analyse. Pour répondre aux objectifs de la revue, les principaux messages des articles et leurs limites éventuelles doivent être formulés dans des termes accessibles à un public qui n'est pas nécessairement spécialiste du sujet de l'article.

Soumissions

Les propositions d'articles, en français ou en anglais, doivent être adressées à la rédaction de la revue (redaction-ecostat@insee.fr), de préférence en format MS-Word. Il doit s'agir de travaux originaux, qui ne sont pas soumis en parallèle à une autre revue. Un article standard fait environ 11 000 mots en français (y compris encadrés, tableaux, figures, annexes et bibliographie, non compris éventuelles annexes en ligne). Aucune proposition initiale de plus de 12 500 mots (11 500 pour les soumissions en anglais) ne sera examinée.

La soumission doit comporter deux fichiers distincts :

- Un fichier d'une page indiquant : le titre de l'article ; le prénom et nom, les affiliations (maximum deux), l'adresse e-mail et postale de chaque auteur ; un résumé de 160 mots maximum (soit environ 1 050 signes espaces compris) qui doit présenter très brièvement la problématique, indiquer la source et donner les principaux axes et conclusions de la recherche ; les codes JEL et quelques mots-clés ; d'éventuels remerciements.
- Un fichier anonymisé du manuscrit complet (texte, illustrations, bibliographie, éventuelles annexes) indiquant en première page uniquement le titre, le résumé, les codes JEL et les mots-clés.

Les propositions retenues sont évaluées par deux à trois rapporteurs (procédure en « double-aveugle »). Les articles acceptés pour publication devront être mis en forme suivant les consignes aux auteurs (accessibles sur https://www.insee.fr/fr/information/2410168). Ils pourront faire l'objet d'un travail éditorial visant à améliorer leur lisibilité et leur présentation formelle.

Publication

Les articles sont publiés en français dans l'édition papier et simultanément en français et en anglais dans l'édition électronique. Celle-ci est disponible, en accès libre, sur le site de l'Insee, le jour même de la publication ; cette mise en ligne immédiate et gratuite donne aux articles une grande visibilité. La revue est par ailleurs accessible sur le portail francophone Persée, et référencée sur le site international Repec et dans la base EconLit.

Main objectives of the journal

Economie et Statistique / Economics and Statistics publishes articles covering any micro- or macro- economic or sociological topic, either using data from public statistics or other sources. Particular attention is paid to rigor in the statistical approach and clarity in the concepts and analyses. In order to meet the journal aims, the main conclusions of the articles, as well as possible limitations, should be written to be accessible to an audience not necessarily specialist of the topic.

Submissions

Manuscripts can be submitted either in French or in English; they should be sent to the editorial team (redaction-ecostat@insee.fr), preferably in MS-Word format. The manuscript must be original work and not submitted at the same time to any other journal. The standard length of an article is of about 10,000 words (including boxes if needed, tables and figures, appendices, bibliography, but not counting online appendices if any). Manuscripts of more than 11,500 words will not be considered. Submissions must include two separate files:

- A one-page file providing: the title of the article; the first name, name, affiliation-s (at most two), e-mail et postal addresses of each author; an abstract of maximum 160 words (about 1050 characters including spaces), briefly presenting the question(s), data and methodology, and the main conclusions; JEL codes and a few keywords; acknowledgements.
- An anonymised manuscript (including the main text, illustrations, bibliography and appendices if any), mentioning only the title, abstract, JEL codes and keywords on the front page.

Proposals that meet the journal objectives are reviewed by two to three referees ("double-blind" review). The articles accepted for publication will have to be presented according to the guidelines for authors (available at https://www.insee.fr/en/information/2591257). They may be subject to editorial work aimed at improving their readability and formal presentation.

Publication

The articles are published in French in the printed edition, and simultaneously in French and in English in the online edition. The online issue is available, in open access, on the Insee website the day of its publication; this immediate and free online availability gives the articles a high visibility. The journal is also available online on the French portal Persée, and indexed in Repec and EconLit.

N° 536-37 - 2022

Economie ET Statistique

Economics AND Statistics

ISBN 978-2-11-162370-5 - ISSN 0336-1454 - ECO 536-37
Parution décembre 2022 - PRIX : 17,20 €