The effects of remote working

Evidence from Covid-19

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Abstract

I estimate the effects of remote working during Covid-19 for Italian households on: labour market outcomes; financial aids received from the Government; sharing of family burden, like housekeeping. For remote working households the labour market outcomes were better than for non remote working households; as a consequence, their need of financial aids was lower; family burden instead became less balanced. I obtain the causal effect of remote working using a policy package which simplified the access to it for parents of children younger than 14 years as an instrument. I provide the description of households complier to this instrument. In a second step, I implement a hypothetical policy which extends the simplified access to remote working to parents of children younger than 18 years. I find that the hypothetical expansion would remain economically convenient. Finally, using bounds I conclude that remote working would have positive economic effects also for the entire population rather than for compliers only.

JEL classification: J21, J22, C26

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1 Introduction

During the Covid-19 pandemic several countries introduced lockdown policies to halt the diffusion of the virus (IMF, 2020). Other measures were implemented to avoid the complete stop of the economic activity. Among these measures, incentives to 'remote working', or 'working from home', were the most important. Italy, the first Western country where the virus was discovered, was among the first countries which implemented a lockdown between mid-March and mid-May and facilitated the access to remote working. The main scope of this paper is to estimate the effects of remote working on Italian households on various economic and non-economic dimensions.

Before the pandemic the interest on remote working surged because several firms, typically of medium-large size, introduced this form of working. When Covid-19 was discovered the research on remote working was however scant. In a seminal paper, Bloom et al. (2015) ran an *ad hoc* experiment in a Chinese call center and found that teleworking increased productivity by 13%. For Italy, Angelici and Profeta (2020) ran a similar experiment on a specific firm and found a larger productivity from 'smart working', the Italian version of remote working, by 10%. Yet, several open issues remain to be addressed. This paper tackles two of them. The first is specific to the Covid-19 pandemic: did remote working help sustain households that had the opportunity to work remotely during this period? If yes, on which dimensions? Although workers may self-select into remote working, to the best of my understanding the papers that tackled this issue during the health emergency treated the workplace as a random choice (e.g. Masayuki, 2020). This assumption is imposed because it is difficult to find an appropriate shifter of the choice of remote working without impact on the outcomes of interest (i.e. an instrument). It is exactly for this reason that the literature before the pandemic ran experiments. However, during the pandemic the Italian Government simplified the access to remote working for households with children younger than 14 years old (y.o.). The first contribution of this paper is to exploit this policy as an instrument to remove the assumption of random sorting into remote working. Thanks to this improvement I address the second issue, of more general interest: what is the benefit of remote working with observational data? As far as I know, this is the first paper that provides evidence on remote

working using observational data instead of experiments, while at the same time addressing the potential sorting into remote working, under mild assumptions. Thanks to this improvement, a second contribution of this paper is to bridge two closely related, but at the moment separate, literatures, regarding the characteristics of the remote workers and their benefits, in a unified framework. As there is large consensus that remote working will become increasingly important for the labour markets around the world (Ceurstemont, 2020; Barrero et al., 2021), this contribution may provide useful insights to design the most appropriate policies. A final distinctive feature of this paper with respect to the existing literature on remote working, whose focus is on *individual workers*, is that I introduce a new perspective by considering remote working *households* instead of *remote workers*. This new perspective suggests to look at outcomes never investigated before, and, at the same time, solves some potential econometric issues.

The observational data that I use for the analysis are from a special survey conducted by the Bank of Italy on the first Italian peak of the pandemic (March and April 2020). The survey is representative of the Italian households and covers a wide range of economic and non-economic information. I find that during the Italian peak of the Covid-19 remote working produced private and collective economic benefits: remote working households preserved their jobs more than non-remote working households, and -as a consequence- they needed less frequently financial aids from the Government, which implies a lower public expenditure. Accordingly, remote working households were more likely to maintain or even improve their expenditure power in the next 12 months. Among non-economic outcomes, the sharing of family burden, like housekeeping and cook, became less balanced. Overall, these results are coherent with and complement those on Covid-19 in Del Boca et al. (2020), who investigate how family roles -including burden sharing- changed in Italy, and in Adams-Prassl et al. (2020); Angelucci et al. (2020); Bonacini et al. (2020); Brynjolfsson et al. (2020), who study the labour market impacts for single workers. I consider some new and some different but related outcomes for households and, most important, I adopt a different approach, based on an Instrumental Variable (IV) estimator.

The IV allows me to take into account the possible sorting into remote working, using the simplified access for children below 14 years old as an instrument. However, it identifies a Local

Average Treatment Effect (LATE), instead of a Population Average Treatment Effect (ATE) (Imbens and Angrist, 1994). The effect is local because it refers to the subpopulation of compliers, i.e. households which exploit remote working because they have children younger than 14 y.o. but not otherwise (Angrist et al., 1996). It is thus interesting to know the characteristics of these households (or characterization; Angrist et al., 2010) and the consequences of an hypothetical policy which extends the simplification in the access to remote working to households with older children (Policy Treatment Effect; Heckman and Vytlacil, 2005). According to the analysis, with the current policy the compliers are households with observed characteristics that are typically associated to higher possibility to work remotely (Dingel and Neiman, 2020; Barbieri et al., 2020; Yasenov, 2020). This is not surprising given the small share of remote working in Italy before the pandemic (Istat, 2020). From this viewpoint Covid-19 was a major shifter of the Italian labour market culture. The 14 y.o. limit selected by the Italian Government provided the highest economic return, hence an extension of remote working to households with older children would still provide economic benefits, but of *decreasing* magnitude; the imbalance of the sharing of family burden would be less large. Given the decreasing magnitude of benefits, one may wonder whether the return to remote working eventually becomes *negative* for the entire population. To answer this question the ATE for the entire population is needed. In order to estimate the ATE while taking into account the possible selection into remote working I estimate bounds (Manski, 1990). Using bounds I find that on average remote working has positive economic effects on the entire population, but with negative consequences in terms of sharing of family burden. The policy implication is that extending remote working to the entire population would be beneficial for the entire Italian labour market. Inequality within households is an important issue to be monitored.

The paper is organized as follows. After a brief review of the literature in Section 2, in Section 3 I explain the Italian context. In Section 4 I present that data that are used in the analysis exploiting the methods of Section 5. The results and their discussion are in Section 6. Section 7 offers concluding remarks.

2 Literature review

In this section I briefly review the existing literature on remote working. Before the outbreak of the Covid-19 only few papers focused on remote working, and all of them on individuals rather than on households. Bloom et al. (2015); Angelici and Profeta (2020) run experiments to obtain consistent estimates of the remote working purged from potential bias from systematic sorting. They find an increase in productivity due to this work arrangement by 10–15%. All the other pre-pandemic papers based on observational data treated the choice of remote working as random. The consequences of this assumption are discussed in Section 5. A complete literature review until Covid-19 can be found in Angelici and Profeta (2020). Below I focus on new papers appeared during the pandemic.

The papers appeared during the pandemic differ in terms of countries and outcomes. As for countries, two possibilities are available: either a comparison across countries or a focus on single countries. The largest majority of the studies adopts the latter approach, because of the different legislations, cultures, and digital endowments. As for outcomes, most of the papers are based on surveys designed and conducted with a specific focus on the pandemic, therefore it is difficulty to find a (set of) harmonized questions. The main broad categories of outputs are: health related outcomes; economic outcomes, mainly related to the labour market; non-economic outcomes, mainly related to the inequality in the sharing of family burden within households.

Comparisons across countries are in Adams-Prassl et al. (2020); DeFilippis et al. (2020). Adams-Prassl et al. (2020) exploit a real time survey in UK, US and Germany, finding different results related to the different institutional settings: for example, the employment status of German employees was less affected by the crisis than in US or UK thanks to the short-time work scheme.[1] Overall, workers who had smaller possibility to work from home were more likely to reduce their working hours, to lose their jobs and to suffer from falls in earnings. DeFilippis et al. (2020) explore the impact of Covid-19 on employee's digital communication patterns. They consider the number and average length of meetings, the hours worked, and the email activities, in large cities of the

[1] The short-time work scheme allows firms to cut labor costs by providing wage subsidies to workers who reduce their working hours due to economic distress of their employer.

North America, Europe, and the Middle East. According to their findings, compared to pre-Covid-19 period the larger number of meetings was more than compensated by their smaller length, thus producing a decrease in the time spent in meetings per day, on average; instead, both the hours worked and the email activities increased substantially. Taken together the data document a change in the pattern of the employment activity.

Among country-specific studies, for Italy Del Boca et al. (2020, 2021) analyze the effects of working arrangements on housework, childcare and home schooling among couples where both partners were employed. They use surveys collected in April and November 2020 from a representative sample of women. They find that inequality within households increased, with women bearing the burden of the additional housework, whilst childcare and home schooling was equally shared within the couple; the effects materialized at the beginning of the pandemic, in the first wave of the survey. Bonacini et al. (2020) use two surveys on the Italian labour market to explore the consequences in the labour income distribution due to remote working among Italian employees. They find unequal benefits, more favorable to male, older, high-educated, and high-paid employees. Therefore, remote working would likely exacerbate pre-existing inequalities in the labour market unless appropriate policies are implemented. For Germany, Alipour et al. (2021) study the relation between work and public health, combining administrative data on infections and on short-time work registrations with surveys conducted on employers and employees.[2] For employees, the recourse to remote working allowed to increase labor supply, measured in terms of fewer applications for the short-time work scheme. Moreover, remote working decreased mobility with a positive contribution in terms of reduction of the infection rate.

Studies on the effect of remote working were conducted even outside the European Union. For the US, Angelucci et al. (2020) use data from the Understanding America Study, a large nationally-representative, high-frequency panel dataset from March through July of 2020. They show that job losses were three times larger among non-remote workers than among remote workers, with large differences related to observable characteristics, like gender, ethnic groups, or educational attainments. Similar qualitative results are found in Brynjolfsson et al. (2020) who exploit two

[2] This is the only paper that considers remote working as endogenous, but only when the focus is on the employers.

waves (conducted in April and in May) of a nationally-representative sample of the US population, to study -among the other things- the impact of Covid-19 on the remote working and the related effect on unemployment. Although labour market outcomes deteriorated for all the workers, the possibility to work remotely made the effects of the pandemic substantially less severe. Moreover, most of the effects were realized as soon as Covid-19 arrived in the US (i.e. April wave). Finally, for Japan Masayuki (2020) uses a survey conducted to study the effects of the changing economic structure on the employees, finding a negative relationship between commuting times and wages and subjective well-being.

Like the most recent papers, the analysis presented here is based on an *ad hoc* survey (Section 4), with a focus on economic and non-economic outcomes. Although the period during Covid-19 is somewhat special, preliminary data suggest that remote working represents one of the major legacy of the pandemic for the labour market (Ceurstemont, 2020; Barrero et al., 2021). In this respect a better understanding of its consequences is essential. I try to make a step in this direction by adopting a different perspective from the existing literature. The main distinctive feature of this paper is the treatment of the endogenous sorting into remote working, which allows me to answer a wide range of questions (Section 5). I also focus on households instead of individuals (Chung and Meuleman, 2017; Del Boca et al., 2020). This is a slightly different perspective with respect to existing studies on remote working, but I show it is the most appropriate approach for this paper.

3 The Italian context

When Covid-19 was discovered in Italy, one of the main concerns of the Government was to save lives without destroying the economy. To this aim the circulation of individuals was greatly limited. The first measures introduced at the beginning of March 2020 were online schooling (law DL 4 March 2020) and several incentives to remote working (the first was in law DPCM 1 March 2020). Both measures are particularly relevant for this paper, because they jointly affect the probability of remote working, either directly or indirectly. In the Italian law children below 14 y.o. require the constant supervision of adults (art. 591 C.P.), therefore online schooling required an adult at home

in presence of these pupils. In this case, parents were allowed to benefit of additional holidays or of a voucher for baby sitting (DPCM 17 March 2020), unless remote working was possible.

In the Italian law remote working is defined as a flexible organization of the work formally agreed between employers and employees to work without hours or geographical constraints, for a given period of time (Law 81/2017). During Covid-19 the Government introduced strong incentives towards remote working. The main innovation was the removal of the agreement between the employee and the employer (since 1 March 2020). Although the intervention was directed to all workers the Italian Government made explicit the need of remote working for parents of young children. The access to remote working was granted to private sector workers with at least one child below 14 y.o. (law DL 19 May 2020). During the pandemic the Italian Government 'strongly recommend[ed]' the use of remote working several times (law DPCM 24 October 2020). Moreover, there is a widely shared opinion that work from home will stick: for example, Barrero et al. (2021) estimate that 1 worker each 5 will work remotely after the pandemic ends. Given the recommendation of the Italian Government and the expected evolution of the labour supply, it is important to know whether remote working had positive effects for households who used it and whether it is worth extending its access. These are the main goals of the paper.

The Government introduced also other measures during the pandemic.[3] The most important for this paper is the ban of firing, which excludes a trade off between job and children. Measures with a negative impact on the economy were instead avoided as long as possible, therefore they were introduced several weeks later than those exploited here. For instance, the suspension of non-essential activities was introduced at the end of March they lasted for a very short time. Given the data at hand (Section 4) and the econometric drawbacks that these policies would introduce (discussed in Section 6.1), these measures are not considered as possible instruments.

4 The data

In 2020 Bank of Italy ran a Special Survey of Italian Households (SSIH) to gather timely information on the Italian economic situation during the Covid-19 pandemic, focusing on households living in

[3] According to the official website of the Italian Government 78 measures were introduced in 2020 for Covid-19.

Italy (i.e. the reference population). For each household the respondent is always the head of the family. A set of weights makes the sample (2,346 obs.) representative of the Italian households (25.3 million).[4]

The survey was mainly centered on the economic situation (expenditure power and income) of the households and their working life during the peak of the pandemic (March and April 2020). Most of these questions are qualitative, which is a remarkable advantage given the uncertainty during the health emergency. For example, for the expected expenditure power of the households over the next 12 months I know only the direction of the evolution, i.e. whether it will increase, remain unchanged, or decrease; similarly, for the relation between expenditures and income I only know whether the former will be more than, equal to, or less than the latter. As for the working life, the most important aspect for this paper is related to remote working. The data identify the presence of remote workers in the household during the entire lockdown between the beginning of March and the beginning of May,[5] but not which individual was a remote worker. Therefore, differently from the existing literature on remote working I focus on households rather than on individuals. This represents the best approach to address the research questions of this paper (further discussion on the theoretical and empirical motivations is postponed to Section 6). Continuing with the available information on the labour market outcomes, I know the number of employed individuals before and during the pandemic, and the presence of financial aids from the Government. The financial aids from the Government refers to both employees and self-employed. For the former I have information about the presence of a wage integration (or 'Cassa Integrazione Gaudadagni' in Italian) and about a more general support to employees, like the unemployment benefits. For self-employed, I have information on the presence of an income integration introduced during the pandemic, equal to 600 euros in March and April (Banca d'Italia, 2021, Ch.5). For all the households I also observe if they enjoy a family income integration, like the basic income, introduced in 2019, or the emergency income, introduced during the pandemic, which aims at meeting the basic needs of the households. which is generally reserved to employees, and family income integration. Finally, a rich set of socio-

[4] The sample to population ratio is comparable to other surveys conducted during the pandemic, namely those of the papers reviewed in Section 2.

[5] This time definition is much larger than that regarding the distinction between essential and non essential activities, which started only at the end of March and became less restrictive only two weeks later (mid-April).

demographic and labour market characteristics of the household are available, namely: the gender distribution and the age distribution, with a split between children below 14 y.o. and between 14 and 17 y.o.; the evolution of the distribution of family tasks among components (whether more balanced, equal to, or less balanced than before the lockdown); the number of employed components. Further details on the survey are in Rondinelli and Zanichelli (2020).

From the reference population of 25.3 million households I focus on the respondents' age range 25–64 (to 15.6 million) to avoid confounding effects related to educational or retirement choice, in the private sector (to 13.4 million), which was subject to different rules than the public sector. Qualitative results are insensitive to the sample definition. After this selection, on average the Italian households are composed of about 2.5 components, equally split between men and women, of which 2 adults and less than a child per household. During lockdown "remote working households" represented 38% of the *households* (coherent with other surveys on lockdown, e.g. Politecnico Milano estimates 34%=6.6/19.3mio of *workers*). According to unconditional statistics the economic outcomes of these households were better than for non remote working households and they needed less frequently financial aids from the Government (Table 1). Coherent with this evidence, the expenditure power of remote working households was more preserved than for non remote working households. However, in remote working households the sharing of family burden became less balanced. In the rest of the paper I estimate the causal effect of remote working taking into account the characteristics determining both the outcomes and the remote working mechanism.

5 Methods

This paper estimates the effect of remote working on various outcomes of interest (Y). The direct comparison of the outputs for remote working households (D=1) vs non-remote working households hardly addresses the questions of interest, because, differently from experiments (Bloom et al., 2015; Angelici and Profeta, 2020), with observational data workers may self-select into remote working. If the self-selection is based on characteristics unobservable to the researcher the direct comparison of the outcome between the two groups of households is a biased estimator, even after controlling for

covariates (which are kept implicit in the notation of this section, unless necessary). This is relevant because the choice of remote working might be the result of a complicated utility maximization process not directly observable to the researcher, which for example includes the interactions of workers with children. For this reason I employ an Instrumental Variable (IV) approach. For concreteness, as instrument I define $Z = 1$ if in the household there are children below the age 14 (for short, simply 'children'). Under the following assumptions (Imbens and Angrist, 1994; Angrist et al., 1996): *1)* the potential outcomes for each worker are unrelated to the treatment (i.e. remote working) status $d \in D$, with $D \in \{0, 1\}$, of other workers (Stable Unit Treatment Value Assumption; SUTVA); *2)* the instrument is randomly assigned; *3)* exclusion restriction (i.e. $Y_d \equiv Y(Z = 0, d) = Y(Z = 1, d)$); *4)* nonzero average causal effect of Z on D (i.e. $E[D_1 - D_0] \neq 0$, with $D_z \equiv (D|Z = z)$); *5)* monotonicity (i.e. $D_1 \geq D_0$ *for <u>all</u> households*, such that an increase in the level of the instrument does not decrease the level of the treatment; or vice-versa); then I identify a Local Average Treatment Effect (LATE):

$$\beta_Z = \frac{E[Y|Z = 1] - E[Y|Z = 0]}{E[D|Z = 1] - E[D|Z = 0]} = E[Y_1 - Y_0|D_1 > D_0]. \tag{1}$$

This parameter identifies the effect of remote working on Y for households who worked remotely *because* they had children below 14 y.o., but not otherwise (i.e. compliers; Angrist et al., 1996). In general, the parameter estimated by different instruments in eq. 1 is different (i.e. $\beta_Z \neq \beta_{Z'}; \forall Z \neq Z'$), because Z and Z' affect different subpopulations of compliers (hence 'local'). As a consequence, beyond β_Z three questions are relevant for the policy maker: 1) what are the characteristics of the compliers, the households induced into remote working by the policy? 2) does the policy Z={children younger than 14 y.o.} maximize the return to remote working? 3) what is the effect of remote working for the entire population rather than for compliers only? To the best of my knowledge all these three questions are new to the literature on remote working.

To explain who are the compliers from the instrument Z, I count them and describe their characteristics (i.e. characterization of compliers; Angrist et al., 2010). The size of compliers is equal to the denominator of equation 1 (i.e. the first stage: $E[D|Z = 1] - E[D|Z = 0]$). For a binary

characteristic X, as in the empirical application, the composition of compliers in the population is equal to the ratio $\frac{E[X=1|D_1>D_0]}{E[X=1]} = \frac{E[D|Z=1,X=1]-E[D|Z=0,X=1]}{E[D|Z=1]-E[D|Z=0]}$. A ratio larger (smaller) than 1 implies that compliers induced into remote working by the policy are more (less) likely to have the characteristic X than the rest of the population.

To understand whether the measure introduced by the Italian Government maximized the return to remote working I take advantage of the information contained in the dataset and use the presence of children between 14 and 17 y.o. as a different instrument (Z'). These households could not access remote working thanks to the actual policy,[6] but they would under an hypothetical policy which extends the same possibility to households with children younger than 18 y.o. (Appendix A). The parameter identified with the instrument Z' is the effect of the remote working thanks to this hypothetical policy. The instrument Z' targets a different subpopulation of compliers. Given the local identification power of the IV-LATE the parameters identified by two different instruments are different, i.e. $\beta_Z \neq \beta_{Z'}$. The parameter $\beta_{Z'}$ corresponds to the effect on Y of the hypothetical policy which extends the possibility of remote working beyond the current rules (a marginal treatment effect). See Heckman and Vytlacil (2005) for formal results. Central to the interpretation of $\beta_{Z'}$ is the policy invariance assumption, that an external manipulation of the policy, like the proposed extension, does not affect anything else in the model apart from the selection into treatment.[7] The result of this exercise is relevant to understand whether the return from extending the possibility of remote working is increasing (i.e. it is worth extending remote working because the maximum has not yet been reached), decreasing but positive (i.e. extending remote working is still convenient but the maximum benefit has already been reached), decreasing and negative (i.e. extending remote working is not convenient). Beside theis marginal treatment effect, in a second step I exploit both the the instruments Z and Z' to estimate the Policy Total Effect (PTE), i.e. $\beta_{Z\cup Z'}$. The PTE is the *total* benefit from enlarging the access to remote working beyond the current rules. This is the parameter the policy maker needs to conclude whether the extension of remote working would still produce benefits or not.

[6] Of course they may access remote working thanks to other reasons.

[7] The policy invariance assumption is untestable. However, in Section 6.4 I follow Heckman and Vytlacil (2005) to show that in this application it is credible.

Should the return to remote working be decreasing in the population targeted from the policy, a natural question would be whether remote working is beneficial for the entire population or not, on average. As the identification power of the IV is local I need to recover the treatment effect for the entire population, or ATE instead of LATE. The ATE is a weighted average of different LATEs, namely for the always-takers (AT), the never-takers (NT), and the compliers (C):

$$ATE = \pi_{AT}\, LATE_{AT} + \pi_{NT}\, LATE_{NT} + \pi_{C}\, LATE_{C},$$

where π_i is the proportion of the subpopulation i. Unless the effect of remote working is homogeneous (i.e. $LATE_{AT} = LATE_{NT} = LATE_C$), I can point-identify only $LATE_C$ using the IV-LATE approach of Imbens and Angrist (1994), but not the $LATE_{AT}$ or $LATE_{NT}$. To identify $LATE_{AT}$ and $LATE_{NT}$ I need different assumptions that typically deliver bounds rather than a single point (Manski, 1990).[8] Different assumptions identify different bounds. Among the bounds that I estimate, I present only those narrowest that are comparable to LATE and for which the underlying hypotheses can be justified.[9] Bhattacharya et al. (2012) consider the case where: 1) the outcome is bounded ($Y \in [k_0, k_1]$), like in a dichotomous indicator; 2) the instrument is valid (Y_0, Y_1 are independent of Z); 3) the system may be represented as a threshold crossing model (Vytlacil, 2002);[10] 4) the monotonicity of the outcome in the treatment holds (on *average* the remote working is not harmful within groups, i.e. $E[Y_1|k] \geq E[Y_0|k]$, with k={always takers, compliers, never takers}; Chen et al., 2018). Bhattacharya et al. (2012) show that under the above assumptions the bounds are identified as:

If	$E[Y\|Z=1] - E[Y\|Z=0] > 0$
lower	$E[Y\|Z=1] - E[Y\|Z=0]$

[8] Partial identification estimates a set of admissible parameters for the treatment effect (or bounds) while imposing a set of assumptions that may be increasingly restrictive.

[9] In particular, I refrain from imposing assumptions that may have strong power to narrow the distance between the upper and the lower bounds, but that may turn out to be false. This approach is consistent with the 'law of decreasing credibility' that the credibility of inference decreases with the strength of the assumptions maintained (Manski, 2011).

[10] Vytlacil (2002) shows the equivalence between the threshold crossing model, which defines the selection mechanism, and the independence and monotonicity assumptions of the LATE approach.

$$\begin{aligned} \text{upper} \quad & E[Y|D=1,Z=1]\,P(D=1|Z=1) + k_1\,P(D=0|Z=1) \\ & -E[Y|D=0,Z=0]\,P(D=0|Z=0) - k_0\,P(D=1|Z=0) \end{aligned} \tag{2}$$

$$\begin{aligned} \text{If} \quad & E[Y|Z=1] - E[Y|Z=0] < 0 \\ \text{lower} \quad & E[Y|D=1,Z=1]\,P(D=1|Z=1) + k_0\,P(D=0|Z=1) \\ & -E[Y|D=0,Z=0]\,P(D=0|Z=0) - k_1\,P(D=1|Z=0) \\ \text{upper} \quad & E[Y|Z=1] - E[Y|Z=0] \end{aligned} \tag{3}$$

which can be estimated using their sample analog. Three properties of these bounds are most important. Firstly, they are sign defined, because if the lower bound is positive (negative) the upper bound is "more" positive (negative). Secondly, the sign of the population average treatment effect is derived from the data rather than imposed a priori. Thirdly, they allow the effect of the treatment to be positive for some households and negative for others, because only the averages of eqs. 2–3 are involved, rather than being verified for all individuals (Manski and Pepper, 2000). See Bhattacharya et al. (2012) for further properties of these bounds.

6 Empirical Application

I use SSIH data to estimate the effects of remote working on the Italian households, using the presence of children in the household as instrument against the possible self-selection into treatment. The focus on the households instead of the single workers is the most appropriate for this paper, for an economic and an econometric reason. On the economic side, remote working may depend on the interaction between partners, therefore considering households is important to consider the joint utility function of the family. For example, suppose an household with a child lives in a flat with two desks, so that, if schools go online and the child needs one desk, only one individual can work from home. The partners might agree that partner A goes to work whilst partner B stays at home. In this case A goes to work because there is a child; viceversa, B stays at home because there is a child. Thus, on the econometric side, if I focus on the single individual the instrument

would violate the SUTVA and the monotonicity assumptions (Imbens and Angrist, 1994), and the empirical content of the identified parameter becomes unclear. If I focus on the household this critique is irrelevant.

Throughout the paper I consider four economic and non-economic dimensions: occupational situation; financial aids received from the Government; economic situation; sharing of family burden. The occupational situation that I consider is the number of jobs preserved during the pandemic, defined as the ratio between the number of jobs after the 'first-wave' of the pandemic (i.e. before summer 2020) and the number of jobs before it, the latter providing a normalization. Because preserving the occupational status might exert positive effects also on the public finance, I consider the presence of financial aids received from the Government, namely wage integration (i.e. 'Cassa Integrazione Guadagni' in Italian) and the overall benefits towards employees, including the unemployment benefits; the presence of income integration to self-employed; the presence of the family income integration schemes, namely basic income and emergency income. The economic situation is summarized by the evolution (i.e. increase, equal, decrease) of expenditure and the relation between income and expenditure (i.e. whether expenditure will be equal to, higher or lower than income), expected for the next 12 months. On the non-economic side, I focus on the *evolution* of the sharing of family burden like housekeeping and cook (i.e. more or less balanced or equal to the period preceding the pandemic).

Apart from the number of jobs preserved during th pandemic, all the outcome variables are discrete indicators taking two or three values. Binary indicators take value 1 if the condition is verified. For the outcomes taking three values I use a multinomial definition, without loss of generality. For example, the expected evolution of expenditure may increase, remain constant, or decrease. I therefore build three indicators: 1) increase vs {equal, decrease}; 2) equal vs {increase, decrease}; 3) decrease vs {increase, equal}. I treat similar cases with the same approach.[11]

All the models are linear models (e.g. linear probability models). All the estimates are con-

[11] Binary indicators are the presence of: wage integration; benefits to employees; benefits to self-employed; basic income; emergency income. Three values indicators are: expected expenditure (increase, equal, decrease); the expected relation of expenditure and income (the former less than the latter; the two will be equal; the former more than the latter); the evolution of the sharing of family burden (more balanced, equal, less balanced than before the pandemic).

ditional on household characteristics, namely: region of residence; number of components, distinguishing between men and women; number of adults; income brackets. The conclusions are robust to controls for the characteristics of the respondents, namely: gender, age, education, and sector of activity. These controls (results available upon request) are used as robustness checks only, because the unit of interest and the reference population are the households. The estimates are weighted so as to be representative of the Italian households (although point estimates are fairly stable between weighted and unweighted regressions). Robust standard errors are clustered according to geographical area (Abadie et al., 2017).

6.1 Valid instrument

I take advantage of the policies introduced by the Italian Government during the pandemic (Section 3), to use the presence of children below 14 y.o. in the household as an instrument. Two conditions must be met for the validity of the instrument: exogeneity and relevance. As for exogeneity, it is worth emphasizing that: 1) Italy is the first Western country where Covid-19 was discovered and thus where it represented a completely unexpected shock against which households could do nothing (e.g. in terms of fertility or occupational choice);[12] 2) thanks to the overall policy package introduced by the Government, there is no trade-off between children and job and more generally children do not have any direct or indirect impact on the *evolution* of the outcomes, as analyzed here. Exceptions are the Universal Basic Income and the Emergency Income, where the law set less stringent eligibility conditions in the presence of children. Beside these 'narrative' arguments I exploit two statistical arguments: 1) as in Bhattacharya et al. (2012) I examine the possibility of systematic differences between households with and without children by regressing the instrument on observable characteristics (first including the adjusting covariates and then also exploiting additional information from the questionnaire, e.g. the ownership of the house), and I fail to reject the null hypothesis that the coefficients on all the variables are equal to zero (F-stat.=2.0; P-value=0.33), thus there is no systematic difference between household with and without children - or the difference in the instrument assignment is random between the two type of the households; 2)

[12] In this respect the instrument is 'as good as randomly assigned'.

apart from income integration, i.e. the outcomes where children play a role by law, on a more formal ground I fail to reject the joint null hypotheses of exogeneity and monotonicity of the instrument (at standard confidence level; Mourifié and Wan, 2017).[13] Overall, the 'narrative' arguments presented above are not falsified. I decide to present the analysis also for Universal Basic Income and the Emergency Income, where children play a role on the dependent variables (instrument is invalid), because these outcomes are of huge policy relevance.

According to the first stage of the IV regression, thanks to the overall policy package the presence of children in the household increases the probability of remote working by 13.5%; the instrument is highly relevant as the F-statistic is about 30 (Bound et al., 1995; Stock and Yogo, 2002).[14]

Before proceeding, it is worth emphasizing that other instruments could be used. Other instruments would however identify the effect of remote working for a different subpopulation of compliers, i.e. would deliver a different result (Section 5). I explicitly address this issue by estimating bounds for the entire population rather than for compliers only (ATE in Section 6.5). An important advantage of the instrument based on the presence of children below 14 y.o. in the household is that it captures the *first* policy introduced by the Italian Government (Section 3), thus the identification is transparent. Later policies would instead identify their own effect *mixed* with the effects of previous policies, thus making the identification less clear. In addition, if later policies could be anticipated their exogeneity would be violated and the identification strategy would be violated. [15] Overall, once the exogeneity and relevance conditions are properly considered, the instrument based on the presence of children is the most appropriate for this paper.

[13]The test of Mourifié and Wan (2017) takes the form of two inequalities that are necessary to identify the LATE: $P[y, D = 1|Z = 0] \leq P[y, D = 1|Z = 1]$ and $P[y, D = 0|Z = 1] \leq P[y, D = 0|Z = 0]$. If any of the two inequalities is violated, the validity of the instrument is falsified. For computational reasons I do not weight the observations in this case. This is a minor issue because weighted and unweighted results are remarkably similar. Mourifié and Wan (2017) encounter similar difficulties in their illustrative empirical application.

[14] The survey asks about remote working 'during' the lockdown, not 'since' the lockdown. In the latter case the relevance of the instrument would have been higher, because in May the Government explicitly granted remote working for parents of children below 14 y.o. (Section 4). The overall policy package that I exploit in the paper delivers a 'minimum share of compliers' therefore from this viewpoint the conclusions are conservative. Apart from the conservative conclusions, no other consequence arises, especially on econometric side.

[15] The most important of the later policies was the suspension of non-necessary activities since the end of March. In this case the anticipation and the reaction to the policy played an important role. Several firms changed strategically their NACE classification after the issue of the policy (Mistretta, 2020), or obtained by local authorities a special exemption from the rule, thus jeopardizing the exogeneity condition.

6.2 The effect of remote working

The causal effects of remote working on the outcomes of interest are in Table 2.[16] Before discussing the results it is worth emphasizing that the parameters presented in this section refer to compliers only. I defer the characterization of compliers to Section 6.3; in Section 6.4 I show that these compliers enjoy the highest effects. The causal effect of remote working in the overall population, or ATE, is in Section 6.5. Moreover, although the treatment effect is heterogeneous and therefore the empirical content of the Hausman (1978) test is less clear than under homogeneous effect, the OLS is significantly smaller than the IV (for significant parameters).

The main finding is that remote working produced economic benefits both private, thanks to a higher probability of maintaining the job and preserving the expenditure power, and collective, in terms of reducing the impact on the public finance. A critical aspect is related to the increase in inequality of family burden within households.

The labour market outcomes of "remote working households" are better than for "non-remote working households". Other things equal, the former households have, on average, 55 percentage points higher ratio than the latter of maintaining at least the same employment level during the pandemic with respect to the previous period. As a consequence, remote working reduced the impact of the pandemic on the public finance. The probability of receiving a wage integration is lower for remote working households than for non-remote working households by 10% for wage integration (although point estimate is not very precise); the probability of receiving unemployment benefits is lower for remote working households than for non-remote working households by 15%. For the presence of family income integrations, namely basic income and emergency income, the LATE coefficients are never statistically significant, because the employment status does not directly affect these benefits.[17]

Thanks to these better outcomes, remote working preserved expenditure (Panel "Expenditure"). The effect of remote working for the indicator of (expected) higher expenditure for primary needs is significantly positive (by 38 percentage points), whereas for the indicator of lower

[16] The full set of coefficients is available upon request.

[17] Moreover, Universal Basic Income and Emergency Income are the only outcomes where eligibility becomes less stringent with the presence of children, therefore the instrument is invalid (Section 6.1).

expenditure is negative. Correspondingly, the probability that remote working households will manage to spend less than their income is higher than for non-remote working households (indeed, $\beta_{Less} \equiv \beta_{Expenditure<Income} > 0$).

When I consider non-economic outcomes, namely the sharing of family burden (bottom panel), in remote working households the imbalances in the burden sharing *increased* with respect to non remote working households: the relevant parameter is indeed negative by 20% for the indicators of *more* or equal balanced sharing of duties with respect to the period before the pandemic and positive for a *less* balanced sharing of duties. A potential threat to identification with this indicator is that childcare may affect the sharing of family burden. Had I considered the *actual* distribution of family burden this critique would have been of great concern, given the major changes produced to the households by the birth of children. Del Boca et al. (2020) show that child caring did not have impact on the *evolution* of the distribution of family burden during the same period of the pandemic as considered here; in their analysis the imbalance increased with respect to housework. In principle it is however possible that household members agree that one of them spends more time with children, whereas the other(s) not. In this case the instrument would be invalid. To check this channel I dropped the households where someone left or reduced the job because of the children (5% of the observations). Even with this selection, I find that the sharing of family burden became less balanced by 23% (standrd error=6.8%, significant at 99% level), thus confirming the conclusions discussed above. [18] Based on these overall results, the evolution of the sharing of family burden is a critical aspect that the policy maker should closely monitor to contrast the gender inequality, one of the goals of the 2030 Agenda for Sustainable Development of the United Nations. Del Boca et al. (2020) warn that this larger imbalance may further jeopardize the female participation to the labour market.

[18] One way to bring together the main analysis in Table 2 and the robusteness check which drops the households where someone left the job because of children is to explicitly allow for the possiblity that the instrument is invalid. To this aim I use the approach in Conley et al. (2012). The approach consists in purging the dependent variable y from the size of invalidity of the instrument (i.e. $\tilde{y} = y - \gamma Z$, $\gamma \in G$, with $G \in [-\gamma, \gamma]$ from the reduced form regression), and then running the regression of $\tilde{y}$ on X using Z as instrument. In a regression estimate that $y = \gamma Z + X\beta$ I estimate a value of γ equal to 0.01. Therefore I set $G \in [-\gamma, \gamma] \equiv [-0.05, +0.05]$, or 5 times larger than the possible violation of the instrument validity. Over the entire grid, the estimated coefficients confirm the conclusions reached in the etxt (results available upon request).

6.3 The compliers

The results discussed in Section 6.2 refer to compliers. Although the compliers cannot be flagged it is possible to evaluate their size and describe their average characteristics, or characterization. The size of compliers (i.e. the first stage, given monotonicity; or $E[D_1 > D_0]$) is 13.5% (Angrist et al., 2010). This proportion is comparable to, and in fact slightly higher than, those surveyed in Angrist and Pischke (2008, Table 4.4.2). This is one more argument in favour of this policy over the other late policies as an instrument.

As for the characterization of compliers (Table 3), complier households are more likely to be a family with at least 2 adults (i.e. a couple rather than a single parent), with a net income higher than 2000 euros (which broadly corresponds to the upper 30% of the income distribution), living in Northern or Center Italy. This description is not surprising given the small frequency of remote working in Italy before the pandemic (Istat, 2020), approximately 2 percentage points below the European Union average, according to Eurostat. By adding individual level characteristics, households where the respondents hold at least a BA, are younger, or work in sector related to services (Dingel and Neiman, 2020; Barbieri et al., 2020; Yasenov, 2020), are more likely to be remote working households.[19] To the best of my knowledge, this is the first paper which formalizes the connection between sorting into work-from-home during the pandemic and the effects of remote working on key outcomes in a unified framework. This is an important piece of information if the policy maker wishes to induce into remote working households with some characteristics rather than others.

6.4 The effects of an hypothetical policy to increase remote working

As the access to remote working was considerably simplified for households with children younger than 14 y.o., one may wonder whether the *extension* of remote working to other households would have been convenient. Considering the Italian law the most natural extension would be to households with non-adults teenagers (between 14 and 17 y.o.; for short, simply 'teenagers'). This

[19] The result for the sector 'Construction' deserves further investigation, impossible with the data at hand. One explanation is that the workers of this sector do not use remote working, therefore in presence of children the other adult must stay at home, as required by law.

hypothetical policy would have practical relevance because legal experts agree that currently it is still unclear who is responsible for students, without age distinction until 18 y.o., during online lessons (mainly with respect to legal responsibility and injuries). The policy proposed here, possibly accompanied by other measures, would help to find a solution.

The hypothetical extension of this section is important in two aspects: as an ex-post evaluation of the age limit selected by the Italian Government during the 'first wave' of the pandemic; as an ex-ante expectation about possible extensions of the access to remote working to specific groups of workers, especially if 20% of the labour supply will be from home in the future (Barrero et al., 2021), or if the next pandemic will come within the next decade as G20 High Level Independent Panel (2021) predict.

Following Heckman and Vytlacil (2005), I evaluate the hypothetical policy using the proposed extension, i.e. to households with children between 14 and 17 y.o., as an additional value of the instrument (i.e. $Z' \neq Z$). This gives rise to LATE identification with multivalued instrument (Angrist and Imbens, 1995), which rests on assumptions similar to the standard LATE of Imbens and Angrist (1994).[20] Although a more technical discussion is in Appendix A, it is worth emphasizing that an important assumption for the evaluation of the hypothetical policy is the policy invariance. Policy invariance states that the proposed measure does not change anything else in the model, apart from selection into treatment. This (untestable) assumption may not be innocuous. However, I believe it is credible in this setting, because the additional age range from below 14 y.o. to 14-17 y.o. is relatively small (see Heckman and Vytlacil, 2005 for similar arguments) and because part of the children between 13 and 14 y.o. already attend the same school grades of those considered in the main analysis of Section 6.2, under the Italian schooling enrollment rules.

I run two exercises. First, by comparison of households with children vs households with teenagers I evaluate how the return to remote working with the age bracket of the children 0-13 y.o. compares to the age bracket of the children 14-17 y.o. (or marginal return). The effects of remote working (Table 4) are qualitatively identical to those described in Section 6.2, but the *economic* benefits are smaller (Table 4 vs Table 2). Thus, among policies based on the age of

[20] Intuitively, the identification with multivalued instrument follows immediately from the discussion of eq. 1.

children, the limit of 14 y.o. selected by the Italian Government maximized the *economic* return. The imbalance in the sharing of family burden would instead be less large (regardless of which households are considered).

Second, by considering the eligibility to remote working for households with children younger than 18 y.o. I evaluate the overall effects of the hypothetical policy (Policy Total Effect; Table 5). Increasing the eligibility to remote working from 0-13 y.o. to below 18 y.o. children (as going from Table 2 to Table 5), the estimated parameters maintain the sign but become smaller –apart from the benefits towards employees– and in several cases no longer significant. If the access to remote working were extended to a larger age bracket it would remain effective, while in general producing smaller effects. Beside confirming the 'maximization result' of the first exercise, two further conclusions can be drawn: 1) return to remote working is heterogeneous, namely decreasing in the age bracket of the children; 2) increasing the size of remote working to households with older children would remain economically convenient, with less large inequality within households (under policy invariance).

Notwithstanding the decreasing return to remote working in the age of the children, these findings provide support for the recommendation of the Government during the pandemic to extend the access to remote working, at least according to this hypothetical policy. More generally, if the share of remote workers will increase in the future, its access will be established by law, given the Italian rules (e.g. with respect to insurance against work elated accidents). This exercise provides support for a policy which grants access to households with children below 18 y.o., in an attempt to also provide incentives to labour force participation of the women, without jeopardizing the economic and non-economic outcomes.

6.5 The effect of remote working for the entire population

The decreasing pattern of return to remote working in the age of children rises the doubt that remote working eventually becomes inconvenient. To solve this doubt I estimate the return to remote working for the *entire population*. This exercise is of crucial interest in the current debate, where remote working is deemed to becoming the new normal in several countries regardless of the

presence of the children in the household (Ceurstemont, 2020; Barrero et al., 2021). The LATE of Sections 6.2-6.4 does not provide "the" benefit of remote working for all of the Italian households if the return is heterogeneous. For this reason I exploit partial identification and estimate the ATE of remote working for the entire population using an IV (eqs. 2–3). A huge advantage of the identification for the entire population rather than for compliers only is that the description of the characteristics of compliers is no longer needed. As a consequence, the IV-ATE for the entire population makes the discussion about a policy or another as an instrument irrelevant for the consistency of this estimator.[21] On the other hand, IV-LATE allows to describe more directly who was affected by the actual policy (Section 6.3) and what would happen with an hypothetical policy (Section 6.4).

The bounds in Table 6 confirm all the results discussed so far. Considering the financial aids received from the Government, the upper bounds are remarkably small for employees and larger for self-employed. Thus, whilst for the former workers even other tools proved to be successful (e.g. compulsory holidays), for the latter remote working really made a difference. Gallo and Raitano (2020) reach a similar result using a microsimulation model, which simulates the benefits introduced by the Government during the pandemic. As for the sharing of family burden, the estimated parameters are rather large, reflecting the small attention received from this critical aspect (Del Boca et al., 2020).

Two technical features are also worth emphasizing. First, the large width of the bounds confirms the relevance of the heterogeneity in the return to remote working in the entire population. Second, although the LATE parameters are within the bounds almost always (the only exception being the benefits for self-employees), there are several cases where the effect for compliers is close to one extreme of the admissible set, coherent with the idea that the policy designed by the Italian Government maximized the return to remote working.

Using the treatment effect for the entire population one can conclude that the extension of remote working to the entire population would have been beneficial for the Italian labour market,

[21] Different *valid* instruments may however affect the width of the bounds, i.e. the distance between the upper and the lower bounds. As I discuss in Section 6.1 it is doubtful that with the data at hand such alternative valid instruments exist (Mistretta, 2020).

on average.

7 Conclusions

I estimate the benefits of remote working for Italian households during Covid-19. Overall, remote working produced both private benefits, thanks to the possibility of preserving the job and the expenditure power, and collective benefits, thanks to the lower impact on the public finance. A critical aspect was related to the inequality within households.

This paper differs in various respects from the existing literature. Beside the focus on households instead of individuals, it is the first paper which uses observational data while taking into account the possible selection into remote working. As instrument I use the policy package introduced by the Government to simplify the access to remote working for households with children below 14 y.o. This allows me to describe the characteristics of the households that exploit remote working thanks to the policy package and to evaluate whether a different design would still produce benefits. The population affected by the policy is made of households with income in the 30% upper part of the distribution, living in the North or Center, with at least 2 adults (Yasenov, 2020). Although these households enjoy the highest economic return to remote working, extending the access to remote working to households with teenagers would remain convenient, but with smaller benefits. Actually, remote working could be extended to the entire population, because its return in the entire population is, on average, positive. The inequality in the sharing of family burden within households is an issue that must be tackled (Del Boca et al., 2020).

Apart from the specific results of this paper, which are clearly related to the specificity of the Covid-19 pandemic, the approach that I introduced in this literature may enrich our understanding of who actually opts for remote working, what are the related effects, and for whom. All these aspects are extremely informative for the policy makers to design appropriate policies for the future working environment, especially if labour supply from home will increase much in the future (Barrero et al., 2021; Ceurstemont, 2020), or if the next pandemic will come within couple of years G20 High Level Independent Panel (2021).

References

Abadie, A., S. Athey, G. W. Imbens, and J. M. Wooldridge (2017). When Should You Adjust Standard Errors for Clustering? Working Paper 24003, National Bureau of Economic Research, Cambridge, MA.

Adams-Prassl, A., T. Boneva, M. Golin, and C. Rauh (2020). Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys. *Journal of Public Economics 189*(13183), 104245.

Alipour, J.-V., H. Fadinger, and J. Schymik (2021, apr). My home is my castle The benefits of working from home during a pandemic crisis. *Journal of Public Economics 196*(178), 104373.

Angelici, M. and P. Profeta (2020). Smart-working: Work Flexibility Without Constraints.

Angelucci, M., M. Angrisani, D. Bennett, A. Kapteyn, and S. Schaner (2020, aug). Remote Work and the Heterogeneous Impact of COVID-19 on Employment and Health. Technical report, National Bureau of Economic Research, Cambridge, MA.

Angrist, J., V. Lavy, and A. Schlosser (2010). Multiple Experiments for the Causal Link between the Quantity and Quality of Children. *Journal of Labor Economics 28*(4), 773–824.

Angrist, J. D. and G. W. Imbens (1995). Two-Stage Least Squares Estimation of Average Causal Effects in Models with Variable Treatment Intensity. *Journal of the American Statistical Association 90*(430), 431–442.

Angrist, J. D., G. W. Imbens, and D. B. Rubin (1996). Identification of causal effects using instrumental variables. *Journal of the American Statistical Association 91*(434), 444–455.

Angrist, J. D. and S. Pischke (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Banca d'Italia (2021). *2020 Annual Report*. Banca d'Italia.

Barbieri, T., G. Basso, and S. Scicchitano (2020). Italian workers at risk during the COVID-19 epidemic. Questioni di Economia e Finanza (Occasional Papers) 569, Bank of Italy, Economic Research and International Relations Area.

Barrero, J. M., N. Bloom, and S. Davis (2021, apr). Why Working from Home Will Stick. Working paper, National Bureau of Economic Research, Cambridge, MA.

Bhattacharya, J., A. M. Shaikh, and E. Vytlacil (2012). Treatment effect bounds: An application to Swan Ganz catheterization. *Journal of Econometrics 168*(2), 223–243.

Bloom, N., J. Liang, J. Roberts, and Z. J. Ying (2015). Does working from home work? Evidence from a chinese experiment. *Quarterly Journal of Economics 130*(1), 165–218.

Bonacini, L., G. Gallo, and S. Scicchitano (2020, sep). Working from home and income inequality: risks of a new normal' with COVID-19. *Journal of Population Economics*.

Bound, J., D. Jaeger, and R. Baker (1995). Problems with instrumental variable estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American Statistical Association 90*, 443–450.

Brynjolfsson, E., J. Horton, A. Ozimek, D. Rock, G. Sharma, and H.-Y. TuYe (2020, jun). COVID-19 and Remote Work: An Early Look at US Data. Technical report, National Bureau of Economic Research, Cambridge, MA.

Ceurstemont, S. (2020). Teleworking is here to stay here's what it means for the future of work. *Horizon - The EU Research and Innovation Magazine*.

Chen, X., C. A. Flores, and A. Flores-Lagunes (2018). Going beyond LATE. *Journal of Human Resources 53*(4), 1050–1099.

Chung, H. and B. Meuleman (2017). European parents' attitudes towards public childcare provision: the role of current provisions, interests and ideologies. *European Societies 19*(1), 49–68.

Conley, T. G., C. Hansen, and P. E. Rossi (2012). Plausibly Exogenous. *The Review of Economics and Statistics 94*(1), 260–272.

DeFilippis, E., S. M. Impink, M. Singell, J. T. Polzer, and R. Sadun (2020, July). Collaborating during coronavirus: The impact of covid-19 on the nature of work. Working Paper 27612, National Bureau of Economic Research.

Del Boca, D., N. Oggero, P. Profeta, and M. Rossi (2020). Womens and mens work, housework and childcare, before and during COVID-19. *Review of Economics of the Household 18*(4), 1001–1017.

Del Boca, D., N. Oggero, P. Profeta, and M. C. Rossi (2021). Did COVID-19 Affect the Division of Labor within the Household ? Evidence from Two Waves of the Pandemic in Italy. (14453).

Dingel, J. I. and B. Neiman (2020). How many jobs can be done at home? *Journal of Public Economics 189*, 104235.

G20 High Level Independent Panel (2021). *A GLOBAL DEAL FOR OUR PANDEMIC AGE*. G20.

Gallo, G. and M. Raitano (2020). Sos incomes: Simulated effects of covid-19 and emergency benefits on individual and household income distribution in italy. Working Papers 566, ECINEQ, Society for the Study of Economic Inequality.

Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica 46*(6), 1251–1271.

Heckman, J. J. and E. Vytlacil (2005). Structural Equations, Treatment Effects, and Econometric Policy Evaluation. *Econometrica 73*(3), 669–738.

Imbens, G. W. and J. D. Angrist (1994). Identification and Estimation of Local Average Treatment Effects. *Econometrica 62*(2), 467–475.

Imbens, G. W. and C. F. Manski (2004). Confidence Intervals for Partially Identified Parameters. *Econometrica 72*(6), 1845–1857.

IMF (2020). Policy responses to covid-19. `https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#I`.

Istat (2020). *Rapporto Annuale 2020*. Istat.

Manski, C. F. (1990). Nonparametric Bounds on Treatment Effects. *American Economic Review 80*(2), 319–323.

Manski, C. F. (2011). Policy Analysis with Incredible Certitude. *Economic Journal 121*(554), F261–F289.

Manski, C. F. and J. V. Pepper (2000). Monotone Instrumental Variables : With an Application to the Returns to Schooling. *Econometrica 68*(4), 997–1010.

Masayuki, M. (2020). Productivity of Working from Home during the COVID-19 Pandemic: Evidence from an Employee Survey. Discussion papers 20073, RIETI.

McCarthy, I., D. L. Millimet, and M. Roy (2015). Bounding treatment effects: A command for the partial identification of the average treatment effect with endogenous and misreported treatment assignment. *Stata Journal 15*(2), 411–436.

Mistretta, A. (2020). La demografia d'impresa ai tempi del covid-19: Un approfondimento sui cambi di codice dell'attivita'. Report, Banca d'Italia. In Italian.

Mourifié, I. and Y. Wan (2017). Testing Local Average Treatment Effect Assumptions. *The Review of Economics and Statistics 99*(2), 305–313.

Rondinelli, C. and F. Zanichelli (2020). Principali risultati dell'indagine straordinaria sulle famiglie italiane nel 2020. Covid-19 note, Bank of Italy. In Italian.

Stock, J. and M. Yogo (2002). Testing for weak instruments in linear iv regression. In D. Andrews and J. Stock (Eds.), *Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg*. Cambridge University Press.

Vytlacil, E. J. (2002). Independence, Monotonicity, and Latent Index Models: An Equivalence Result. *Econometrica 70*(1), pp. 331–341.

Yasenov, V. (2020). Who Can Work from Home? IZA Discussion Papers 13197, Institute of Labor Economics (IZA).

Table 1: Descriptive statistics for selected variables.

Variables		Full sample (100%)		Smart working No (62%)		Smart working Yes (38%)	
		Mean	SE	Mean	SE	Mean	SE
Labour charct.	Employed	0.753	0.028	0.735	0.035	0.783	0.021
	Employed after Covid	1.396	0.045	1.321	0.046	1.518	0.066
Financial aids	Salary Integration	0.224	0.026	0.241	0.036	0.196	0.025
	Employees	0.287	0.027	0.323	0.041	0.229	0.022
	Basic Income	0.059	0.021	0.071	0.025	0.040	0.020
	Emergency Income	0.055	0.019	0.055	0.021	0.055	0.018
Evolution of Expenditure (exp.)	Increase	0.057	0.004	0.061	0.008	0.050	0.011
	Unchanged	0.597	0.008	0.558	0.015	0.660	0.031
	Decrease	0.346	0.006	0.381	0.014	0.290	0.024
Expenditure vs Income (exp.)	Less	0.434	0.020	0.391	0.015	0.504	0.037
	Like	0.455	0.019	0.489	0.018	0.399	0.034
	More	0.111	0.005	0.120	0.008	0.096	0.010
Evolution of family burden	More Equal	0.206	0.012	0.216	0.013	0.191	0.016
	Unchanged	0.694	0.019	0.689	0.026	0.701	0.011
	Less Equal	0.100	0.017	0.095	0.025	0.108	0.010

Notes: 'exp.' means 'expected for the next 12 months'.

Table 2: The effect (and standard errors) of remote working on Italian households during Covid-19 pandemic. Actual policy: presence of children below 14 y.o. in the household.

Labour market outcomes & financial aids received from the Government

	Preserving job	Wage integration	Employee (unemp.ben.)	Self-Empl.	Basic Income	Emergency Income
LATE	0.584 ***	-0.100	-0.167 *	-0.509 *	0.141	-0.053
	(0.222)	(0.079)	(0.088)	(0.283)	(0.130)	(0.146)

Expenditure

	Expected expenditure			Expected expenditure vs income		
	Increase	Equal	Decrease	Less	Equal	More
LATE	0.381 *	-0.033	-0.348 *	0.259 **	0.001	-0.260
	(0.214)	(0.176)	(0.204)	(0.113)	(0.096)	(0.206)

Evolution of sharing of family burden within the household

	More balanced	Equal	Less balanced
LATE	-0.222	-0.196 *	0.418 ***
	(0.138)	(0.114)	(0.068)

Notes: Variables denoted with * (**) [***] indicate statistical significance at the 10 (5) [1] percent level. 'Preserving jobs' is ratio between the number of jobs during and before the Covid-19. All the other outcomes are binary variables taking value 1 if the condition in the column header is satisfied. For the categories 'Expected expenditure', 'Expected expenditure vs income', and 'Evolution of sharing of family burden' which take three values, I build a multinomial variable, e.g. for the columns 'Increase' of 'Expected expenditure' Increase=1 and {equal,decrease}=0. I condition on region of residence; number of components, distinguishing between men and women; number of adults; income brackets. All models are linear. Robust standard errors are cluster according to geographical area.

Table 3: Description of the characteristics of the compliers. Actual policy: presence of children below 14 y.o. in the household.

Characteristic		Odds
Adults	1	0.1201
	At least 2	1.0694
Income	$\leq$ 2,000 euros	0.6817
	$>$ 2,000 euros	1.9457
Area	North	1.4183
	Center	1.2349
	South	0.8410
Education	No BA	0.6804
	At least BA	2.3250
Age	$\leq$ 40	3.1784
	$>$ 40	0.9453
Sector	Services	1.8690
	Industry	0.5457
	Construction	1.2999
	Others	1.0228

Table 4: The effect of remote working on Italian households during Covid-19 pandemic. Marginal effect (and standard errors) of children below 14 y.o. vs 14-17 y.o.

Labour market outcomes & financial aids received from the Government

	Preserving job	Wage integration	Employee (unemp.ben.)	Self-Empl.	Basic Income	Emergency Income
LATE	0.563 ***	-0.054	-0.199 **	-0.389	0.127 ***	0.067
	(0.166)	(0.122)	(0.098)	(0.254)	(0.037)	(0.171)

Expenditure

	Expected expenditure			Expected expenditure vs income		
	Increase	Equal	Decrease	Less	Equal	More
LATE	0.239	-0.148	-0.091	0.140	0.226 **	-0.365 *
	(0.177)	(0.243)	(0.137)	(0.175)	(0.094)	(0.215)

Evolution of sharing of family burden within the household

	More balanced	Equal	Less balanced
LATE	-0.093	-0.233	0.326 ***
	(0.142)	(0.186)	(0.045)

Notes: Variables denoted with * (**) [***] indicate statistical significance at the 10 (5) [1] percent level. See Table 2 for further information.

Table 5: The effect (and standard errors) of remote working on Italian households during Covid-19 pandemic. Hypothetical policy: presence of children below 18 y.o. in the household.

Labour market outcomes & financial aids received from the Government

	Preserving job	Wage integration	Employee (unemp.ben.)	Self-Empl.	Basic Income	Emergency Income
PTE	0.022	-0.168 *	-0.323 ***	-0.088	0.133 ***	0.218
	(0.156)	(0.095)	(0.085)	(0.166)	(0.039)	(0.157)

Expenditure

	Expected expenditure			Expected expenditure vs income		
	Increase	Equal	Decrease	Less	Equal	More
PTE	0.095	-0.049	-0.046	0.148	0.114	-0.262
	(0.104)	(0.340)	(0.249)	(0.128)	(0.112)	(0.222)

Evolution of sharing of family burden within the household

	More balanced	Equal	Less balanced
PTE	0.014	-0.124	0.109
	(0.125)	(0.290)	(0.194)

Notes: Variables denoted with * (**) [***] indicate statistical significance at the 10 (5) [1] percent level. See Table 2 for further information. PTE: Policy Total Effect.

Table 6: The effect (and 95% confidence intervals) of remote working on Italian households during Covid-19 pandemic. Actual policy: presence of children below 14 y.o. in the household. Bounds of Bhattacharya et al. (2012)

Labour market outcomes & financial aids received from the Government

	Preserving job		Wage integration		Employee (unemp.ben.)		Self-Empl.		Basic Income		Emergency Income	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
ATE	0.078	0.897	-0.324	-0.013	-0.355	-0.022	-0.325	-0.068	0.019	0.728	-0.290	-0.007
C.I.	0.075	0.902	-0.325	-0.013	-0.356	-0.022	-0.326	-0.067	0.018	0.731	-0.290	-0.007

Expenditure

	Expected expenditure						Expected expenditure vs income					
	Increase		Equal		Decrease		Less		Equal		More	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
ATE	0.051	0.690	-0.442	-0.004	-0.524	-0.046	0.035	0.589	0.000	0.491	-0.363	-0.035
C.I.	0.049	0.694	-0.443	-0.004	-0.525	-0.044	0.032	0.591	-0.236	0.716	-0.364	-0.033

Evolution of sharing of family burden within the household

	More balanced		Equal		Less balanced	
	Lower	Upper	Lower	Upper	Lower	Upper
ATE	-0.439	-0.030	-0.577	-0.026	0.056	0.739
C.I.	-0.440	-0.027	-0.578	-0.025	0.054	0.742

Notes: C.I.: 95% 'Confidence Intervals'. For inference see Imbens and Manski (2004); McCarthy et al. (2015). See Table 2 for further information.

A More on the hypothetical policy

The hypothetical policy introduced in the paper extends the access to remote working to households with children younger than 18 y.o. It is intended to affect anything else in the model apart from the selection into treatment, such that the policy invariance condition is satisfied. A similar approach can be found in Heckman and Vytlacil (2005) and the following literature. Heckman and Vytlacil (2005) discuss at length the assumption.

A technical complication with the proposed extension is that the additional hypothetical policy may target some households already eligible for remote working under the current policy design. I explicitly handle this case (about 5% of the households), therefore this complication is not an issue. Consider the three following examples of households with children, such that:

1. all the children are younger than 14 y.o.;
2. all the children are younger than 18 y.o., but older than 14 y.o;
3. some children are younger than 14 y.o., whereas some are younger than 18 y.o., but older than 14 y.o.

The treatment of examples 1 & 2 is straightforward, whereas the treatment of example 3 is not obvious: the household of example 1 is already eligible under the actual policy design; the household of example 2 is eligible only under the hypothetical policy but not under the actual; the household of example 3 is eligible under the actual policy design, but it would remain eligible even in the absence of children younger than 14 y.o. under the hypothetical policy, thanks to children younger than 18 y.o.

For a multivalued instrument taking k values, Angrist and Imbens (1995) show that the estimator obtained using mutually exclusive instruments is equivalent to a (weighted) average of estimates like eq. 1 (adapting the notation):

$$\beta_{k,k-1} = \frac{E[Y|Z=k] - E[Y|Z=k-1]}{E[D|Z=k] - E[D|Z=k-1]} = E[Y_k - Y_{k-1}|D_k > D_{k-1}].$$

This result suggests a simple solution to address this potential issue. The solution consists in

the construction of three different instruments that cover all the three possible examples, and which therefore are mutually exclusive. Thanks to the mutually exclusive instruments all the three examples are well defined and -as a consequence of theoretical arguments in Angrist and Imbens (1995)- their contribution to identification is transparent.

In practice, when I estimate the marginal treatment effect of remote working, I compare households with children vs households with teenagers: I use only instruments for examples 2 & 3. When I estimate the overall treatment effect of remote working consistent with the hypothetical policy, I compare households with children younger than 18 y.o. to the other households: I use all the three instruments for examples 1 & 2 & 3; in this way I derive the Policy Total Effect (PTE), which is the total benefit from treatment obtained from enlarging the share of treated households.

B Questionnaire

In this appendix I present the questions of the survey that I use in the paper. Further details can be found in Rondinelli and Zanichelli (2020).

1. Gender of the respondent: Man [1];Woman [2]
2. Age of the respondent
3. Number of members of the household
4. Number of men in the household
5. Number of women in the household
6. Number of members aged 13 or younger
7. Number of make nti aged between 14 and 17 years
8. Highest completed educational level of the respondent: No title[1]; Elementary school[2]; Lower secondary school license [3]; High school [4]; Lower-level college degree [5]; Upper-level college degree / Previous system [6]; Postgraduate [7]

9. Family monthly net income: Up to 150 euros[1]; From 151 to 300 euros[2]; From 301 to 450 euros[3]; From 451 to 600 euros[4]; From 601 to 750 euros[5]; From 751 to 900 euros[6]; From 901 to 1 050 euros[7]; From 1,051 to 1,200 euros[8]; From 1.201 to 1.350 euros[9]; From 1,351 to 1,500 euros[10]; From 1,501 to 1,650 euros[11]; From 1,651 to 1,800 euros[12]; From 1,801 to 1,950 euros[13]; From 1,951 to 2,100 euros[14]; From 2,101 to 2,250 euros[15]; From 2,251 to 2,400 euros[16]; From 2,401 to 2,550 euros[17]; From 2,551 to 3,050 euros[18]; From 3,051 to 3,550 euros[19]; From 3,551 to 4,000 euros[20]; From 4.001 to 5.000 euros[21]; From 5,001 to 7,000 euros[22]; Over 7,000 euros[23]; No personal income[97]; I don't know / don't want to answer[98].

10. Geographical area : North West[1]; North East[2]; Center[3]; South[4]; Islands[5]

11. How many members were employed, including yourself, when lockdown started?

12. How many members were smart worker, including yourself, during the lockdown?

13. Excluding yourself, how many members are currently employed, i.e. have a paid activity ?

14. What is your current employment condition (Employed if in a paid activity)? Employee[1]; Self-Employed [2]; Unemployed [3]; Retired - Invalid [4]; Student [5]; Other (e.g. housewife) [6]

15. (If 'Self-Employed/Employee') In which sector of economic activity? Agriculture [1]; Industry [2];Construction [3]; Trade, repairs, hotels and restaurants [4]; Transport and communications [5]; Monetary, financial and insurance brokerage [6]; Real estate activities, business services, other att. professional [7]; Domestic and other private services [8]; PA, defense, education, health and other public services [9]; Other [98].

16. Did your family have access to the following forms of income support during the following periods ? CIG, ordinary check from the wage integration fund (FIS) or solidarity fund [Yes/No]; Unemployment benefit (NASPI, agricultural unemployment) [Yes/No]; Basic income [Yes/No]; Emergency income [Yes/No]; Support measures for the self-employed and professionals [Yes/No]; Baby-sitter bonus [Yes/No].

17. During the lockdown, the distribution of the family burden: became more equal [1]; remained unchanged [2]; became less equal [3].

18. Do you expect that in the next 12 months: Expenditure will be less than annual income, managing to set aside some savings [1]; Expenditure will be equal to the annual income, without being able to save anything [2]; Expenditure will be more than annual income, having to liquidate savings or get into debt [3].

19. Considering expenditures for food, clothing and footwear, and household goods and services. How does your family plan to change their overall spending on these goods in 3 months? It will increase [1]; It will remain unchanged [2]; it will decrease [3]