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Narrowing women's time and income gaps: An assessment of the synergies between working time reduction and universal income schemes

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ABSTRACT

This paper departs from the hypothesis that policies targeting time poverty have the potential to reduce the gender income gap through the redistribution of time use between women and men. To this purpose, we compare two policy mixes and assess the synergies between working time reduction and two universal income schemes: a basic income and care income programme. While the former provides every individual with an equal monetary benefit, the latter ties monetary benefits to the amount of unpaid and care work performed by individuals. We assess the impact of these policy mixes by applying Eurogreen, a macrosimulation model tailored to Italy. Results suggest that while working time reduction directly drives a reduction of the aggregate amount of time spent by women in unpaid work, this does not imply a reduction in time poverty. The universal income schemes – and in particular the care income – promote a reduction of gender inequality in terms of income by sustaining women's total income, but leave the wage gap between women and men unchanged.

1. Introduction

Issues related to income inequality between men and women have been extensively considered in the economic literature. An overwhelming consensus recognizes disadvantages for women in terms of wages (Blau & Kahn, 2017; Weichselbaumer & Winter-Ebmer, 2005), labour force participation (Fortin, 2015), and overall income and wealth (Fortin, 2019; Grabka et al., 2015). Significantly less attention has been devoted to time use inequality between women and men, even if women's experience of time-poverty – the deprived access to time not spent on necessary paid and unpaid work (Hyde, Greene, & Darmstadt, 2020; Kalenkoski & Hamrick, 2013) – is well documented in the literature. Indeed, one of the crucial findings in the literature on time-poverty is related to the gendered nature of its manifestation. While gender inequality in terms of time varies across countries, regions and household types, its main driver is related to the fact that women spend significantly more time on unpaid work activities (e.g., cooking, cleaning and care) compared to men (Arora, 2015; Bardasi & Wodon, 2010; Chatzitheochari & Arber, 2012; Ghosh, 2001; Sweet & Kanaroglou, 2016; Turner & Grieco, 2000; Yerkes et al., 2020). This produces what we define as the time-poverty gap[1]: the difference in the percentage of women and the percentage of men likely to experience time-poverty.

The amount of time women spend on care and unpaid work not only results in time-poverty, especially for those balancing care activities with paid work, but also acts as a barrier for labour market participation. Accordingly, three interwoven dimensions appear of relevance for policies that aim to reduce gender inequality: time availability, access to employment and income distribution. In this paper we assess the capability of social policy mixes

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[1] This definition encloses the standard definition of time-poverty gaps based on arbitrarily defined time-poverty lines. The time-poverty gap for a single individual or group of individuals represents the (average) distance between the time-poverty line and the actual amount of time left after engaging in paid and unpaid activities (Arora, 2015; Bardasi & Wodon, 2010).

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to jointly address these three dimensions. In particular, we use a macrosimulation approach based on the Eurogreen model (Cieplinski et al., 2021; D'Alessandro et al., 2020). Eurogreen is calibrated for Italian trends and applies a system dynamics approach to provide a representation of the causal mechanisms, inclusive of feedback loops, that characterises an economy where the dynamics of production are driven by demand and there is no full capacity utilization of the factors of production (i.e. capital and labour). Individuals in households are assigned to categories based on gender, age, working status, skill level. Besides income from different sources, the model imputes a composition of time use to each of these categories, i.e. a distribution of five types of time use (physiological overhead, leisure and social, paid work, unpaid work and study). This imputation is the result of an econometric estimation based on Italian data from 2013 which allows us to measure the substitution between paid-work and unpaid-work time.

On this basis, we conduct a scenario analysis to compare the impacts of two types of policies that have the potential to reduce income gaps while redistributing time uses between genders. The first policy type is working time reduction (WTR), which aims to reduce the time spent on paid work and typically implies a decrease in the contractual hours worked on a weekly basis, e.g. from 40 to 35 h (Pullinger, 2014). The second policy type falls under universal income schemes (UIS) where universality indicates that the entire (adult) population, rather than a subset, is covered by an income transfer (De Wispelaere & Stirton, 2004). Two main motivations sustain our selection of these policy types. The first one is connected to their relevance in the context of both the scientific and political debate – with a peculiar salience in the case of the Italian social landscape. The second one targets a literature gap. Despite the fact that thorough analyses have been conducted for each of these types of policies, there is lack of consideration for their potential interactions and capability to reduce time poverty. More precisely, the current literature does not assess the possibility that WTR and UIS, when jointly implemented, can: a) mutually complement each other with respect to specific shortcomings when it comes to socio-economic impacts and b) produce synergies capable of fostering structural changes in the allocation of time use which in turn drive income redistribution.

WTR is currently argued to improve health and well-being through the alleviation of time-constraints (Ahn, 2016; Hamermesh et al., 2017; Sparks et al., 2001) and is proven to sustain employment through the redistribution of working hours across more people (Bosch & Lehndorff, 2001; De Spiegelaere & Piasna, 2017; Estevão & Sá, 2008; Messenger, 2018). In theory, this redistribution could present new employment opportunities for women. Moreover, working less could imply that employed men increase their uptake of unpaid work whilst reducing time constraints for employed women (Bianchi et al., 2000).

Notwithstanding, scholarly literature reveals that the reduction of income as the result of involuntary WTR at constant real wages will affect low-income workers to a larger extent (Antal, 2018; Coote et al., 2010). Given the wage gap, this bears negative implications especially for women and therefore undermines WTR's social acceptance and support. UIS can potentially compensate for this limit through the provision of monetary benefits to workers who are exposed to wage loss as a consequence of decreasing working time (Vobruba, 1990). Alternatively, UIS could incentivise voluntary working time reduction with a potential positive effect on (women) employment. This would be the case for an unconditional universal basic income (BI), where every individual receives a fixed annual payment, which is funded through a progressive tax on income and therefore results in a larger net-benefit for low-income workers (Martinelli, 2017; Widerquist, 2017).

Acknowledging the importance of unpaid work and care, feminist scholars point out that a BI can be seen as an instrument that rewards individuals, particularly women, for their non-market forms of productivity (Robeyns, 2001; Weeks, 2020; Zelleke, 2008). However, such an unconditional income transfer could be strengthened by making it conditional on the effective provision of care activities and unpaid work.[2] Such a conditional universal income – which we label as a care income (CI)– can be tailored to the exact amount of unpaid work performed by individuals thus rewarding unpaid work while simultaneously mitigating the reduction in income, especially of (women) low-wage workers, due to WTR. However, CI would also change the incentives for women to join the labour force by providing a selective reservation wage which may offset the positive impact of WTR on time-poverty and women's employment. To the best of our knowledge, discussions on the ability of a CI to effectively reduce gender gaps are very limited, and mainly advanced in political campaigns that are spearheaded by social movements (see Barca et al., 2020).

We contribute to this gap by including an hourly CI in our simulation – i.e., a UIS where individuals receive a variable annual payment based on the hours of unpaid work performed. This allows us to grasp its non-trivial impacts on the labour market and assess its potential in terms of a reduction in gender time use inequality. In this regard, it must be underlined that the economic incentive of a CI does not target any particular category of individuals in our population *ex ante* – e.g., neither women, nor men, neither employed, nor unemployed. Indeed, it may potentially trigger a substitution in the participation in care activities due to the incentive it provides to employed men to reduce working hours, thus complementing WTR.

Our simulation exercise aims at testing these potential effects of WTR in combination with BI and CI, respectively. To introduce it, we firstly provide a brief literature review which presents the relevance of these policy mixes in the context of the policy debate with specific reference to the Italian case (Section 2.1). In addition, we expand on time-poverty by discussing to what extent WTR and UIS can economically compensate for women's time-poverty and/or close the time-poverty gap between genders (Sections 2.2 To 2.4). Then, we estimate the effect of WTR on time-poverty using the 2013 Italian time use Survey microdata to obtain coefficients for the substitution between paid and unpaid work across age, gender, and occupational categories (Section 3). These coefficients are implemented in an adapted version of Eurogreen which includes a new time use module that is fully integrated with the rest of the macroeconomic module. To the best of our knowledge, this is the first macrosimulation model which allows a deeper understanding of WTR and UIS policy combinations and their impacts on time use and income gaps. The results of our simulations are presented in Section 4, while Section 5 discusses them and concludes.

2. Literature review

Working time reduction and universal income schemes are subject to a wide scientific and political debate worldwide. This section provides a literature review which briefly introduces WTR, BI, and CI policies in a global context, while highlighting their specific relevance for the Italian case. In addition, we introduce the notion of time-poverty and justify why we focus on it as a key aspect for assessing the impacts of the simulated policy mixes. Finally, by referring to the scientific literature, we discuss whether the WTR, BI and CI are respectively able, on the one hand, to economically compensate for women's time-poverty and/or, on the other hand, reduce time use inequality between genders. This latter discussion allows us to introduce the main hypotheses that are

[2] It must also be noted that a BI programme can be implemented alongside specific subsidies for caring and parenting. See more on this discussion in Section 2.1.

tested in the simulation of the policy mixes in which WTR and UIS policies interact.

2.1. Working time reduction and universal income schemes programmes

When it comes to WTR, the world average working time reduced from 64.3 to 45.4 h per week in the period from 1870 to 1950s (Huberman and Minns, 2007). This was due to a variety of factors such as the rise in real wages, value of leisure time, technological advances and labour-saving capital (Greenwood & Vandenbroucke, 2005). From the mid-nineteenth century onwards, ensuing working time reductions (WTR) were introduced with the objective to improve health, well-being, and the distribution of employment in a number of Western European countries such as Finland, Belgium, Denmark, Germany, France, Sweden and the Netherlands (Anttila et al, 2005; Askenazy, 2013; De Spiegelaere & Piasna, 2017; Bosch & Lehndorff, 2001). Apart from France, the aforementioned countries were subject to union-led and collectively agreed WTR that were limited to specific municipalities, sectors or companies. France forms the exception due to their introduction of two separate laws, Aubry I in 1998 and Aubry II in 2000 which has reduced the legal working week from 39 h to 35 for both small and large firms (Askenazy, 2013). In sum, recent experiences of WTR in European countries have been either bargain-based or state-led (Keune, 2006).

In Italy, company-level bargaining, the increased prevalence of shift work[3] and the unfavourable economic situation in 2001 are argued to be the main drivers of WTR (D'Aloia et al., 2006; Karamessini, 2008). From 1995 to 2003, the average annual hours worked in manufacturing industries decreased from 1688 to 1648 h per year (D'Aloia et al., 2006). In an attempt to follow France's footsteps, the 1997 Centre-Left Prodi government set up a draft legislation to reduce statutory working times to 35 h in 2001 which was subsequently refuted by both employers' organisations and trade unions (D'Aloia et al., 2006; Went, 2000). As such, the average weekly working hours in Italy have experienced a limited decrease from 41 to 38 h over from 2004 to 2020 (ISTAT, 2022a). Notwithstanding, working time reduction has gained momentum in the political debate in the aftermath of the Covid-19 crisis, and has been sustained by centre-left parties in the 2022 political election as well as major trade unions (e.g., CGIL, 2022; UIL, 2022).

The academic literature on basic income (BI) programmes is extensive and addresses its i) advantages in light of automation and stagnant wages (Cabrales et al., 2020; Martinelli, 2019; Pulkka, 2017), ii) differences compared to other redistributive policies such as negative income taxes and guaranteed minimum income schemes in terms of outcome and funding mechanisms (Gentilini et al., 2019; Harvey, 2006; Reed and Lansley, 2016; Van Parijs, 2004), iii) the impact on climate change (Alexander, 2012; Andersson, 2010; Howard et al., 2019; Van Parijs, 2010) and iv) how the introduction of a BI can reinforce economic growth through its stimulation of open innovation (Yun et al., 2019).

Pilot BI programmes have been implemented and proposed in both developed and developing countries and vary in size, duration, funding mechanisms and conditionality (Banerjee et al., 2019; Standing, 2021).[4] Finland is known for its government-run BI experiment that ran from January 2017 to December 2018 in the town of Kela where unemployed people between 28 and 58 years old were given a monthly BI of €560 (De Wispelaere et al., 2019; Halmetoja et al., 2019; Kangas et al., 2019). In Kenya, a non-governmental organisation has initiated BI experiment in 2017 which is meant to last 12 years and involves the provision of a long-term BI (approximately $23 per month) to randomly assigned households in 44 villages (IPA, 2018). Italy has implemented a guaranteed minimum income programme, called "Reddito di cittadinanza", since 2019. It can be considered as a conditional universal income scheme since income transfers – up to a maximum of 9.360 euro yearly per household for a period no longer than 18 months – are guaranteed only to low income and low wealth households.[5] In the Italian political debate it is criticised mainly because of its inefficiency as an active labour policy, but its impact on employment appears neutral (Maitino et al., 2022). On the contrary, evidence shows that it protected the part of the population, most vulnerable to the economic consequences of the pandemic crisis, from poverty. This saved 1 million people (approximately 500 thousand households) from indigence (ISTAT, 2022b).

As mentioned in the introduction, remunerations based on the actual amount of unpaid work activities performed, or an hourly CI, are rarely discussed in the literature. Even more and to the best of our knowledge, the implementation of an hourly CI has not taken place anywhere. Instead, scholarly contributions focus on fixed household care allowances or grants (Himmelweit et al., 2004; Letablier, 2003; Strong-Boag, 1979). Robeyns (2001) discusses housewives' wages which are conditional upon taking care of small children and withdrawal from the labour market and argues that a BI bears more benefits due to its unconditional character. A notable exception to the general lack of discussions on an unconditional CI is given by the 2020 Care Income Now campaign launched by the Global Women's Strike network. The campaign demands a planetary CI for every individual that takes care of people and the environment (Barca et al., 2020, p.18). While the authors of the Care Income Now manifesto argue that a CI would render care work more attractive for all genders (Barca et al., 2020, p. 27), reflections on whether women empowerment and gender equality can actually be driven by income or work remain absent.[6]

The hourly CI we propose can also be seen as a type of participation BI programme (Atkinson, 1996, 2017) where conditionality is based on participation in unpaid work activities. It must also be noted that a BI programme can be implemented alongside specific subsidies for caring and parenting. Even more, the International Labour Organisation strongly suggests BI proposals to retain social benefits and services to prevent the exacerbation of social inequalities (Ortiz et al., 2018). However, our analysis separates the two types of UIS to single out the specific impacts of a CI which, due to its systematicity and magnitude, is expected to stimulate structural changes at the macro level, for example in the labour market.

In Italy, gender disparities with regard to care and household work and time use in general (Anxo et al., 2011) are still present even if women have experienced increased access to paid work since the 2000s (Toffanin, 2011). When it comes to the extension of social benefits for childcare, Italian households have access to maternity and paternity leave which is conditional on social security membership for women and employment for men (Addabbo et al., 2022). Compulsory maternity leave lasts six months with full retribution, but can be voluntarily prolonged with a curtailment of the monthly check for an additional six months (it is paid 30 % of average daily wage); compulsory paternity leave lasts ten days

[3] Shift work encompasses the performance of work outside of the conventional day time and typically covers evening and night work or roster work (Bøggild & Knutsson, 1999). Examples are typically found in the health care sector, public services (e.g. waste collection), inventory management and private security sector.

[4] More specifically, BI programmes and proposals vary in i) the frequency of the payment (e.g. weekly or monthly), ii) the periodic amount of the transfer (e.g. at a subsistence or a democratically decided level), iii) the funding mechanism (e.g. earmarked funding or returns on investment) and iv) whether the BI substitutes other welfare benefits and transfers (Alexander, 2014; Fouksman & Klein, 2019; Torry, 2019; Van Parijs, 2004).

[5] See https://www.redditodicittadinanza.gov.it/ for access criteria.

[6] In addition, Barca et al. (2020) do not specify whether the CI they demand is hourly, monthly or yearly.

with full retribution, but a further leave can be enjoyed with a curtailment of the monthly check for an additional six months (it is paid 30 % of average daily wage) (Ibid, 2021). In March 2020, Law Decree 30 introduced a kindergarten bonus to cover the costs of kindergarten or home care, in case a child is seriously ill, for children up to 3 years old (Ibid, 2021). Since January 2022, households receive a monthly check for childrend (till they reach 21 years old) called "Assegno unico e universale per i figli a carico" which sums up all the deductions and benefits previously that were distributed in several forms, which is universal because accessible from every household, but paid proportionally based on income level.

Approximately 3 million people in Italy regularly take care of people with disabilities, the elderly and sick people – where 63 % to 75 % of caregivers are women (Petrini et al., 2019). The main cash benefit for caregivers was established by national law in 1980 and in 2015, 363,868 individuals were granted €508 per month. According to a study by Courbage et al. (2020), the extension of this benefit has increasingly led to substitution of informal care for formal and paid care, or private home help. Indeed, the study by Toffanin (2011) highlights that the decrease in women's commitment to care and household work is not attributable to a decrease in the asymmetry between men and women in the same household, but to the assignment of care work to people outside of the household. Where private caregivers are over-represented by migrant women coming from Eastern Europe (Boccagni, 2018; Lyon, 2006; Marchetti & Venturini, 2014). Studies have also shown that the status of paid care work in Italy is highly precarious and informal (Shutes & Chiatti, 2012; van Hooren, 2014).

In sum, the Italian landscape for care and household work is currently characterized by benefits that are conditional on having children in a specific age-bracket. Instead, when it comes to long-term care provided by caregivers, significant benefits are extended by the state but are often used to purchase private home help. This thus captures a potential risk of implementing a CI – the substitution of in-house care work for informal and precarious mostly performed by migrant women.

Overall, Italy represents a relevant case to ground our simulation exercises due to the characteristics of Italy's socio-cultural landscape and the salience of WTR and UIS policies in the current political debate. However, it must be underlined that the Eurogreen simulation model only offers a stylized representation of a macroeconomy. In other words, the model overlooks specific features of the Italian context and aims at grasping the main causal factors and effects. Accordingly, the calibration exercise based on the Italian data is only meant to depict the main trends and to set a baseline scenario which acts as a benchmark for assessing the relative impacts of the considered policies. Consequently, the results of our simulations are only generalizable to an extent that they are based on an internally valid and theory-based representation of socio-economic phenomena. This is to say that when it comes to external validity, our simulation and its results are only sparsely representative for other socio-economic and cultural systems, particularly in the Global South.

2.2. The time-poverty gap as a policy target

Two motivations lead us to focus our simulation exercise on time-poverty and time use as the target for social policies. The first motivation is conceptual in essence. We believe that addressing time use distributions with dedicated policies has multifaceted socio-economic implications whose analysis opens the possibility to cast a new light on the relationship between income generation and well-being generation. More specifically, we hypothesize that policies targeting specific time uses (such as care and unpaid work) have the potential to reduce income inequality because of the compensation they embody as well as the promoted changes in time use distributions, both in the allocation between genders and within each category. All in all, our study opens up a discussion on dimensions of inter-related inequalities (time use and income) that are often disregarded in economic studies. The second motivation stems from a literature gap. Despite the existence of a stream of literature where macrosimulations are applied to investigate the potential impacts of WTR and UIS in terms of the redistribution of economic resources,[7] the interaction between the two policy types as well as time uses and time-poverty as a policy target is yet to be investigated.[8]

Time-poverty is a concept which departs from the idea that economic deprivation is not only related to an individual's income but also their availability of time (Antonopoulos et al., 2012). Whether an individual is time-poor can be measured using different methodologies (see Harvey & Mukhopadhyay, 2007; Hyde et al., 2020; Kalenkoski & Hamrick, 2013; Williams, Masuda, Tallis, 2016; Zacharias, 2011), but it is typically a function of i) the total amount of hours in a given time-frame, ii) time spent on income generation and iii) time spent on personal care and other unpaid activities such as productive, reproductive (care and domestic) and voluntary work (Kes & Swaminathan, 2006). An individual is said to be time-poor if the amount of time left after subtracting each time-consuming activity from the total amount of hours in a time frame falls below a certain threshold.

Ever since the introduction of time-poverty by Vickery (1977), an increasing amount of research has been directed at understanding the relation between time-constraints and physical and mental well-being and the interdependence between income and time-poverty (Krueger et al., 2009; Gershuny, 2011; Kalenkoski, Hamrick, & Andrews, 2011; Giurge, Whillans, & Yemiscigil, 2021; Giurge, Whillans, & West, 2020). When it comes to the latter, Williams et al. (2016) argue that compared to wealthier individuals, poorer individuals may lack time saving devices (e.g., household appliances) and services (e.g., childcare) which subsequently influences the time which is necessary to escape income-poverty (e.g., not able to work enough hours or dedicate time to formative and social activities). Unpaid work or care activities expose women to be more vulnerable to time-poverty through a direct and uncompensated impact on residual time, thus generating a gap compared to men (Arora, 2015; Bardasi & Wodon, 2010; Chatzitheochari & Arber, 2012; Ghosh, 2001; Sweet & Kanaroglou, 2016; Turner & Grieco, 2000; Yerkes et al., 2020). In this regard, it is relevant to highlight that unpaid caregivers – of which women and girls represent four-fifths – are estimated to constitute approximately-one to two-fifths of the labour force in 2030 (King et al., 2021).

Compensating for women's time-poverty by means of policies sustaining income *indirectly* – i.e., via employment and wages – or *directly* – with direct income transfers, may disclose some opportunities. For instance, increased income could finance the purchase of time saving devices or practices. But it may also result in shortcomings and increased gender inequality, if we consider,

[7] Existing macroeconomic simulations that estimate the single impact of BI programmes focus on on i) the advantage of progressive taxation as a funding mechanism when fiscal neutrality acts as a constraint (Colombino et al., 2010); ii) substantial effects on poverty and inequality reduction (Somers et al., 2021); iii) negative labour supply effects as the result of increased disposable income (Schubert, 2018) and iv) diminished welfare gains/welfare losses for younger people of current and future generations (Daruich & Fernández, 2021; Luduvice, 2021). When it comes to WTR policies, macroeconomic simulations have focused on effects related to employment, inequality, deficit-GDP ratios and carbon emissions (Cieplinski et al., 2021).

[8] To the best of our knowledge, only one recent paper integrates a time use module in macrosimulation model (Ilkkaracan et al., 2021), but this is done to estimate the impact of increased public expenditures on early childhood education and elderly care on unpaid work; thus, with no reference to policies directly targeting time use distributions.

for example, that to save time women could delegate care activities to professional caregivers, who are predominantly women and low-paid. Moreover, if economic compensation for time-poverty was acquired through employment, it could also exacerbate women's vulnerability to time-poverty. This would be the case if the time spent on paid work would not be balanced by a decrease in unpaid work.

Notwithstanding, the reduction of women's vulnerability to time-poverty cannot be obtained via income compensation alone, but also requires the closure of the time-poverty gap via a) the decrease in women's participation in unpaid and care activities and/or b) the increase in men's participation. However, it must be noticed that the substitution of women's unpaid work for men's unpaid work, i.e., the combination of a) and b), can only be obtained through a change in the persistent culture and norms that attribute the identity of caregivers to women (Piasna & Spiegelaere, 2021). In what follows, we rely on the existing literature to discuss whether WTR or UIS can produce either compensation or closure of the time-poverty gap.

2.3. Compensation

As mentioned in the introduction, WTR policies have the potential to economically compensate for time-poverty by providing new opportunities of employment. If these opportunities were met, persons solely or mainly engaged in domestic care and unpaid work could in principle increase their income by increasing their share of paid work. This would not per se alleviate time-poverty – since it does not imply a decrease in unpaid work – but it could reduce income deprivation and consequently a crucial aspect of inequality suffered by time-poor, especially women. However, such an effect is subject to two limitations highlighted in the literature.

First, in absence of a wage-rate increase, a reduction in the amount of paid working hours due to WTR will result in a decrease of income figures where low-income workers and underemployed will be hit hardest (Antal, 2018, p. 233; Coote et al., 2010, p. 26). Hence, the potential compensation effect driven by new hirings could be offset by a loss in income for low-income workers and underemployed workers that are typically the categories that suffer from time-poverty (Giurge et al., 2021). This negative impact of WTR on income distribution can be dampened if the WTR scheme is voluntary since it is likely that participation rates will be higher for people who can afford salary cuts. This may ensure a redistribution of working-time hours from high-income earners to low-income earners and underemployed and reduce income inequality between the former and the latter. But this reduction in income equality risks causing an increase in leisure time inequality, with an alleviation of time-poverty only for high-income workers (Antal, 2018, p. 233; Persson et al., 2022, p. 84; Pullinger, 2014, p. 17).

Second, the income compensation from WTR could be conditioned by a regressive redistribution from labour to capital, in case WTR incentivizes capitalists to substitute labour for capital, potentially leading to an overall decrease of labour demand which limits the effect of WTR on unemployment reduction (Kallis & Kalush, 2013, p. 1561; Estevão and Sá, 2008, p. 424). Another driver of limited unemployment reduction is the manifestation of bottlenecks as the result of a mismatch between unemployed and employed people in terms of labour skills (Bosch & Lehndorff, 2001, p. 231). These limits to income compensation by WTR policies disclose the necessity to consider additional policies that address income inequality by means of direct transfers.

A BI – a universal and periodic cash payment which is unconditionally delivered to every individual (BIEN, 2020) – *per se* can be seen as a means to reward unpaid work and to compensate for time-poverty.[9] Moreover, the implementation of a BI can fully or partially compensate for the reduction in earned income under WTR schemes where wage-rates remain constant. Furthermore, if the BI is funded through (an increase of) progressive taxation on income, wealth and capital, comparatively rich households, and owners of capital, will essentially fund their own BI as well as a large fraction of comparatively poor households. This counteracts the potential regressive distribution from labour to capital as a result of WTR (Straubhaar, 2017, p. 3; Van Parijs, 2004, pp. 12-13; Vobruba, 1990; Wright, 2004, p. 83). Finally, a BI will also guarantee income to workers who may not benefit from a WTR-induced redistribution of working hours due to their skills not matching with the skills exhibited by freed up working hours.

Scholarly literature reveals both the potential and limitations of a BI when it comes to the advancement of gender equality. Weeks (2020) argues that the feminist case for a BI can be traced back to the 1970s *Wages for Housework* movement where activists and theorists demanded an extension of the traditional wage system to account for the household-based reproductive labour and other unpaid work activities which are disproportionately performed by women (see Federici, 1975; Dalla Costa & James, 1975). A BI is then argued to support this demand since it would reward non-market forms of productivity and render invisible and unpaid work activities more apparent (Robeyns, 2001, p. 91; Weeks, 2020, p. 580; Zelleke, 2008, p. 5). Other advancements of gender equality through a BI are related to the expansion of freedom and autonomy since a BI would grant women i) more bargaining power within the household, ii) income security and iii) a fallback position which would foster the exit from both abusive relationships and badly paid jobs (Elgarte, 2008; Pateman, 2004; Schulz, 2017).

However, since both women and men receive an equal amount of income in the case of a BI, it may fail to compensate for the time-poverty gap. By contrast, an *hourly* CI would more effectively compensate for the time-poverty experienced by individuals who perform more unpaid work. As mentioned before, contemporary discussions of conditional income schemes which are explicitly based on the actual amount of unpaid work performed within households are limited. Yet, one can assume that given women's higher engagement in unpaid work, an *hourly* CI will benefit women more than men and therefore offers women a more explicit compensation for the time-poverty gap.

When it comes to the joint implementation of indirect compensation through employment and direct compensation through income transfers (BI or CI), it should be noted that the latter may diminish the effect of the former due to the negative impact of income transfers on women's labour force participation rate (Colombino et al., 2010).

2.4. Closures

Besides compensation, the potential impact of WTR, BI and CI programmes on the direct closure of the gender gap concerning time-poverty appears of greater policy relevance. To investigate and discuss this potentiality, we make a distinction between one-sided and two-sided closures. The former consists in the alleviation of women's time-constraints strictly as the result of a reduction in the hours spent on paid work. The idea behind one-

[9] The scholarly literature on BI programmes is extensive and addresses its i) advantages in light of automation and stagnant wages (Martinelli, 2019; Cabrales et al., 2020; Pulkka, 2017), ii) differences compared to other redistributive policies such as negative income taxes and guaranteed minimum income schemes in terms of outcome and funding mechanisms (Van Parijs, 2004; Gentilini et al., 2019; Reed and Lansley, 2016; Harvey, 2006), iii) the impact on climate change (Howard et al., 2019; Van Parijs, 2010; Alexander, 2012; Andersson, 2010) and iv) how the introduction of a BI can reinforce economic growth through its stimulation of open innovation (Yun et al., 2019).

sided closures is that a decrease in paid working time allows for an increase in leisure time if the newly available time is not entirely spent on unpaid work. On the other hand, a two-sided closure is achieved when the alleviation of time-constraints (or increase in leisure time) for women is the result of a higher engagement of men in unpaid work activities. In other words, two-sided closures imply a reduction in the time-poverty gap as the result of a redistribution of unpaid working time from women to men.

One can relate time-poverty gap closures to Nancy Fraser's breakdown of contemporary approaches to gender equality and the author's promotion of the *universal caretaker model*. This model stands in contrast to both the *universal breadwinner model*, promotion of women's employment, and the *caregiver parity model*, formalization (remuneration) of unpaid care work(ers). The distinguishing feature of the *universal caretaker model* lies with its demand for a re-orientation of social institutions around care such that unpaid work activities, typically performed by women, become the norm for every-one (Fraser, 1994). With respect to time-poverty gaps, the *universal caretaker model* is thus geared towards the achievement of two-sided time-poverty gap closures.

Since time-poverty is a function of what's left after engaging in income generating activities or paid work, one could expect a double effect of WTR on women's time uses. The first one concerns the reduction of working hours for employed women; the second consists in the increase of paid-work time of unemployed or underemployed women who could exploit the increase in employment opportunity due to WTR. De Spiegelaere and Piasna (2017) confirm both the effects when they highlight how WTR policies would decrease the full-time norm, making it more feasible for employed women to combine caring and household tasks with a full-time job. At the same time, new employment generated as the result of WTR is likely to result in a relatively higher increase in labour force participation for women compared to men. Accordingly, WTR policies can lead to a one-sided closure of the time-poverty gap if the reduction in women's paid work time is not fully compensated for by i) an increase in unpaid work and ii) the higher engagement of women in paid work. That is, if an increase in paid work decreases unpaid work by an equal amount, time-poverty remains constant, whereas a decrease of unpaid work which is less than the paid work increase would increase time-poverty.

Evidently, WTR affects the allocation between paid work and unpaid work differently across individuals. This difference conditions the possibility that WTR fosters a two-sided closure of the time-poverty gap. A redistribution of unpaid work from women to men, or the achievement of the *universal caretaker model* could occur if the increase in men's unpaid work as the result of WTR is greater than that for women. This redistribution depends on the coefficient between paid and unpaid work for women and men. In other words, WTR will free new time, to be potentially exploited either for new employment opportunities or for a more comfortable time at home; who will spend this new time and on which activities not only depends on structural economic factors but on (persistent) cultural norms and gender roles (Piasna & Spiegelaere, 2021).

When it comes to the BI, one can argue that it grants both men and women the opportunity to reduce time spent on paid work without facing a decrease in income levels. This results in closure mechanisms which are similar to that of WTR policies. Zelleke (2008) argues that the introduction of a BI would foster Fraser's universal caretaker model whereas care allowances would fall in line with the caregiver parity model which maintains the gendered division of unpaid work. Again, this claim depends on the impact of reduced paid work on unpaid work and how this differs across women and men. If women's unpaid work were to increase, then a two-sided closure of the time-poverty gap or the achievement of the universal caretaker model can only be attained if men were to engage in role-sharing. Otherwise, the increase in unpaid work could exacerbate time-poverty and restrict women's space for leisure, formative and other types of unpaid work beyond domestic activities (Bidadanure, 2019, pp. 492-494; Elgarte, 2008, p. 5; Gheaus, 2008, p. 4; Lombardozzi, 2020, p. 320; McKay, 2001, p. 107; O'Reilly,2008; Robeyns, 2001, p. 101).

In principle, an *hourly* CI provides a monetary and more concrete incentive for individuals who have previously refrained from unpaid work activities, mostly men, to start doing so. As such, it is reasonable to assert that compared to a care allowance and BI, a CI potentially encourages the reconfiguration of the gendered division of unpaid work to a higher extent. This is to say that an *hourly* CI potentially stretches beyond the *caregiver parity model* and towards the *universal caretaker model* which we characterize by a two-sided closure of the time-poverty gap. This potentiality depends on the given distribution of paid and unpaid work time within each gender and on their propensity to change behaviour. The latter is something that other types of policies – such as paid parental leave (Elson, 2017; Valarino, 2018), targeting gender stereotypes in advertising and raising awareness through public campaigns (Baxter et al., 2016; Knoll et al., 2011; OECD, 2017) and the promotion of care sector jobs as career options for men (Fagan & Norman, 2013; Addati, Cattaneo, Esquivel, & Valarino, 2018, p. 322) – could address to a higher extent. Unfortunately, an assessment of the potential behavioural change driven by the aforementioned policy types, remains beyond the scope of our macrosimulation exercise.

In sum, the impact of policies on closures depends on i) the pre-existing relation/coefficient between paid work and unpaid work for women and men and ii) how WTR policies in combination with a BI or CI affect changes in labour force participation. As far as compensation is concerned, whether the considered policies are able to redistribute income to economically alleviate the persistence of the time gap, also depends on their impact on labour force participation, i.e. on their impact on employment and wage distributions.

The rest of the paper is focused on two analyses. On the one hand, we explore the assumed synergy between WTR policies and universal income schemes when it comes to the compensation of the time-poverty gap by means of income redistribution, considering effects on employment, labour force participation and wage inequalities. On the other hand, we examine the impact of each policy mix (WTR and BI vs WTR and CI) on time-poverty gap closures, by assessing their direct impact on time uses across genders.

3. Methods

Two main data and methods were applied to evaluate the interaction between working time reduction (WTR) and the two universal income schemes. First, microdata from the 2013 Italian Time Use Survey (ISTAT, 2017) was used to estimate the relation between hours of paid and unpaid work, by sex[10] and age groups. Second, the estimated coefficients were applied to our macrosimulation model to understand how the combination between working time reduction (WTR) and both universal basic (BI) and care income (BI) programmes would affect economic and social indicators.

3.1. Data and estimates

The ITUS records daily activities of the individuals surveyed as well as demographic characteristics. It is also possible to connect observations in the same household, which allows us to nest indi-

[10] The 2013 ITUS data only offers an approximation of gender differences since individual participants were asked to specify their sex instead of gender.

viduals within households to perform random effects multilevel regressions. Even though data from several waves of the ITUS were collected, microdata is only available for 2013. We impute the obtained econometric results into our macrosimulation model that projects scenarios from 2010[11] to 2040.

Time use data is presented in a classification of 188 different activities. We aggregate these to five main activity types: physiological overhead, leisure and social, paid work, unpaid work and study. Then we normalise them to a representative day (24 h) weighting by the number of week and weekend days in the survey. The first activity type includes daily self-care activities such as sleeping, eating and hygiene. The second aggregates all types of leisure including sports, watching TV and movies, meeting friends as well as volunteering, religious and social activities. Paid work and study aggregate all the activities related to paid work and those involving schools and universities, respectively. Finally, unpaid work includes all activities related to care and house maintenance such as caring for children and elderly, cleaning and meal preparation, and shopping. We have opted to split transportation activities according to their final goals. For instance, commuting for work was allocated to paid work, commuting to shop groceries to unpaid work, and travelling to leisure and social.

Although no microdata is available for additional waves of the ITUS, we can use aggregate data available on ITUS main tables for the 1988, 2002 and 2008 waves to trace the trends in unpaid work between men and women of different age groups.[12] These trends are plotted in the two top panels of Fig. 1. Only minor improvements are observed. The average hours of unpaid work of women, per representative day, decreased from about 6 to slightly <5 h in panel 1a. However, the increase in average unpaid work hours for men (1b), from one hour and a half to about two hours, less than compensates for the decrease in women's unpaid work.

A more detailed representation of the distribution of unpaid work is presented in panel 1c and 1d. It uses the 2013 microdata to plot the mean and median hours of unpaid work by gender, age groups and occupational status: employed (E), unemployed (U), out of labour force (O) and retired (R). Unemployed and out of labour force individuals tend to perform much more unpaid work across all age groups.[13] Among the age groups, whose average is represented by the red lines, women over 65 years and between 45 and 64 dedicate about six hours per day to unpaid work activities, while men of the same age groups limit their unpaid work to about 3 and 4 h, respectively. The gender differences in unpaid work persist in all groups plotted. Younger women (15–24) also perform more unpaid work than men, although both groups dedicate less time to unpaid work than older ones. The total hours of unpaid work from employed women aged between 25 and 64 years are roughly equivalent, but still higher, than those of unemployed and out of labour force men of similar age.

The availability of a single wave of ITUS microdata limits the methods we can apply to estimate the relation between paid and unpaid work. Standard ordinary least squares regressions implicitly assume that the population of individuals observed is homogeneous. However, ITUS data has a hierarchical structure with individuals nested in households. Ignoring such hierarchy often leads to biased and underestimated standard errors, hence, to properly account for this data structure we apply multilevel regressions (Snijders & Bosker, 2012). Also known as mixed effects, our regressions (see Section 4.1) account for the hierarchical structure of the data, which makes it possible to disentangle effects from covariates defined at different-individual and household-levels.

3.2. Simulation model

The second step to evaluate the effects of a joint implementation of WTR and universal income programmes is to simulate those in our model. Eurogreen is a system-dynamics macrosimulation model developed at the country level. It has been previously applied to evaluate social and environmental policies for France (Cieplinski et al., 2021; D'Alessandro et al., 2020) and Italy (Cieplinski et al., 2021). The model follows post-Keynesian economic theory and stock-flow consistent methods (see e.g. Dafermos, Nikolaidi, & Galanis, 2017; Hardt & O'Neill, 2017; Nieto et al., 2020). Aggregate demand drives output and is composed of exports and government spending, consumer spending and gross fixed capital formation. Household consumption depends on disposable income; the marginal propensity to consume depends on income and prices. Consumption is distributed among sixteen different goods according to changes in relative prices. Disposable income is determined by government transfers (such as unemployment benefits and pensions), labour and financial income, social security contributions and income taxes.

These variables vary by skill and employment status (employed, unemployed, out of the labour force and retired, with the top 1 % of individuals designated as capitalist or rentier receiving only financial income). Furthermore, as consumer behaviour depends on income and prices, the model captures the feedback effects that arise from distributional and price changes, which in turn may result from causes such as technological progress, wage increases or the introduction of monetary incentive or disincentive policies.

Employment varies by skill and is determined at industry level by labour productivity, the output of the previous period and hours worked per week. The skill composition of labour demand reflects sector-specific historical trends. Pensions and unemployment benefits are paid in proportion to wages, which in turn are influenced by labour productivity, inflation and group-specific employment rates. Financial income consists of dividends on shares and interest on government bonds.

Industries adjust their desired investments on the basis of the difference between actual and normal capacity utilisation, seeking to produce at the normal rate of capacity utilisation. However, investment expenditure is constrained by profits after debt repayment and taxes, which determine the maximum investment each industry is able to finance.

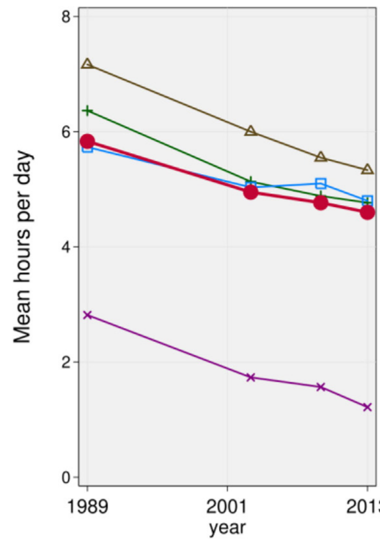
Output is obtained by multiplying domestic final demand by Leontief's inverse matrix and is constrained by fixed capital and capital productivity. The technical input–output coefficients change endogenously over time with technological progress. The innovation process can be summarised as follows. In each period, one or more new technologies may be discovered with a certain probability. Innovations may be labour-saving, intermediate input-saving or both. The probability of a new technology being discovered depends on the cost of labour and intermediate inputs. Once a technology is discovered, the extent of technological progress in each sector is determined randomly by normal distributions calibrated to historical data. Finally, a choice is made in each sector (based on cost-minimisation criteria) whether to adopt a new technology and, if so, which one. This version of the model makes it possible to improve production efficiency even in the absence of new innovations, thanks to the gradual spread of the latest available technology.

The government collects social contributions, value-added taxes and taxes on labour, financial income and corporate income. It also makes transfers to households and purchases goods and ser-

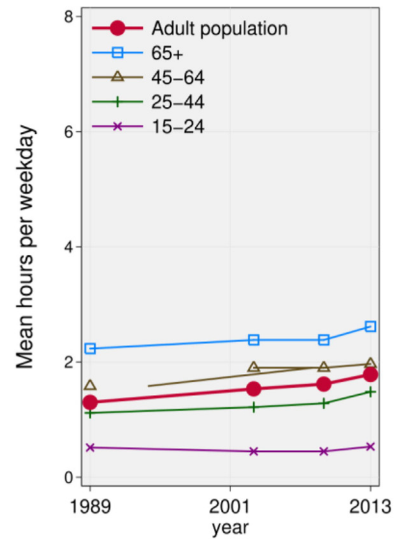
[11] The first 10 years of the simulations are used to calibrate the model to data.

[12] The tables are available at https://www.istat.it/it/archivio/52079.

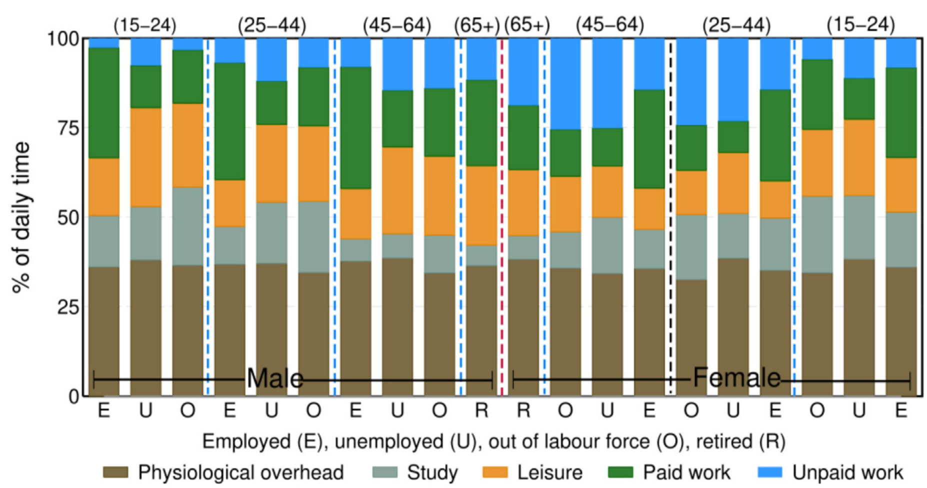
[13] Except for out of labour force men and women in the 15–25 groups.



(a) Women



(b) Men



(c) Time-use distribution

Age Group		15-24	25-44	45-64	65+
Women	mean	100	314	347	334
	sd	133	219	196	181
	N	746	1823	2240	1840
Men	mean	39	96	136	206
	sd	79	121	153	159
	N	671	1782	2094	1386
	t stat	10.74***	37.03***	39.87***	21.31***

*** p<0.001

(d) Descriptive statistics of unpaid work by sex and age group (mean daily minutes)

Fig. 1. Time use distribution: (a) long-term trends in unpaid working time for females, (b) males, (c) time use distribution by activity, gender, age groups and occupational status, and (d) descriptive statistics of average daily minutes of unpaid work by group and sex. Panels (a) and (b) are built using aggregate tables from four waves of the ITUS. The *x-axis* labels in Panel (c) represent individuals that are employed (E), unemployed (U), out of the labour force (O) and retired (R), their respective age-groups are indicated in the top of the graph. Panel (c) is based on detailed microdata for the 2013 wave of the ITUS.

vices. Prices are determined as a mark-up on unit production costs. Population dynamics are exogenous and depend on population projections.[14]

The simulations presented in the next section are based on an updated version of the model calibrated for Italy and run from 2010 to 2040. The current version of the model presents new features tailored to capture the effects of the simulated policies on macroeconomic indicators.

First, we have expanded the labour market module to differentiate labour demand and supply not only in three skill levels, but also by gender. Thus, our model captures gender differences in wages and employment at industry level and labour force participation. The division of total labour demand between skills and genders-which is a function of output, labour productivity and hours worked-follows historical trends extrapolated from the 2010–2020 period using EU-KLEMS data (Jäger, 2017). Moreover, we allow for within-skill substitution between gender as a function of gender and skill specific unemployment rates. That is, if the unemployment rate among low-skill women is greater than that among low-skill men, the demand for low-skill workers will shift towards women.

Secondly, variations in labour force participation are defined by skill, gender and age group and then aggregated to obtain total labour force participation. Fig. 2 summarizes the main causal relations in the labour market. A few remarks are worthwhile. According to the Post-Keynesian approach, given the technology and the final demand of the period, labour demand for gender and skill is determined by the output level. This demand represents the hours of labour necessary for meeting the demand (including intermediate goods). Given the average hours per industry, we obtain the number of workers demanded in the labour market for gender and skill. Labour supply (the labour force) is given by the active population multiplied by the labour force participation rate for each age group, gender, and skill. This allows us to determine the employment status of the active population for each gender and skill. Fig. 2 clarifies that labour force participation rates of each group is determined endogenously in the model. The driver of this endogenous change is the expected increase in income from joining the labour market. It is calculated as the difference between expected yearly labour market income and the public benefits distributed to individuals out of the labour force (non-labour market income). The former is given by a weighted average of average skill-gender yearly wages and unemployment benefits,[15] while the weights approximate the probability to find employment (the employment rate), and to remain unemployed (the unemployment rate). This means that the model does not account for the individual decision-making process. The decision whether to join the labour market is a discrete choice which entails a significant change in the expected individual time use distribution and thus it cannot be analysed at the margin. An increase in the difference between the expected income of joining the labour force and the expected income of being out of the labour force (e.g., due to an increase in wages or to a decrease of unemployment) would increase the labour force participation rate inducing a change in the relative groups' size. In the Appendix E we summarise the main analytical relationship involved in our characterization of the labour force participation.

It is important to highlight that modelling labour force participation as a function of expected income has meaningful consequences for the results of the simulated universal care income programme. Since non-employed individuals and women spend more hours in unpaid work activities (see panel 1c), the introduction of a universal care income would thus increase the non-labour market income of these groups and, consequently, reduce their labour force participation rates relative to men. Despite the absence of any truly universal basic or care income programme, evidence from pilot programmes and local BI schemes is inconclusive and does not provide evidence that they reduce individual's willingness to join the labour force (de Paz-Báñez et al., 2020; Koistinen & Perkiö, 2014; Somers et al., 2021). Therefore, in the absence of a clear route we have modelled the worst-case scenario, particularly for the care income programme. This is to say that increasing non-labour market income, especially for unemployed and out of labour force women, curtails the growth of women's labour force participation and can at least partially offset reductions in the income gap from the CI programme transfers.[16]

The division between three age groups –15 to 24, 25 to 44, and 45 to 64 years of age – is important for the interactions between CI and WTR since individuals in different age groups have distinct time use distributions. This relates to the simplified time use model we have added as a third new feature of the current version of Eurogreen. We use ITUS data to obtain the initial time use distributions[17] for individuals in 60 different groups defined by gender, skill, age and occupational status.[18] The amount of time allocated to unpaid work in each of these groups is then multiplied by the hourly pay of the universal CI programme to determine the total benefit. The only direct variations of these stocks of time use activities are tied to the simulation of WTR. As weekly hours are reduced from 40 to 30, the 10 h freed from paid work are distributed between unpaid work and leisure according to the age and gender specific parameters estimated in Section 4.1. However, this increase in unpaid work among those employed would also increase the total unpaid work hours in the economy. Hence, we programmed three different rules to redistribute unpaid work between distinct groups while maintaining the total hours of unpaid work fixed. The first simply detracts the same amount of unpaid work hours from every individual not employed to balance the increase in unpaid work by those employed. The second detracts the same unpaid work hours from all the non-employed women groups. In the third rule, the same total hours are detracted only from the groups that perform more unpaid work: low- and middle-skill out of labour force women in the 25–44 and 45–64 age groups as well as retired women from the three skill levels. These three rules vary which explains the large confidence intervals obtained for time use variables.

This means that we are not assuming that the distribution of time use within a group (e.g., female – middle skill – unemployed) changes endogenously. By contrast, policies can affect time use directly. For instance, working time reduction will directly modify the time devoted to paid work and change the size of the groups. Thus, it is particularly relevant to assess how policies affect the welfare of different groups taking into consideration both the possible changes in time use and the changes in the size of the groups.

These features are present in all simulations, including the baseline scenario. Moreover, we have added exogenous shocks in the main final demand components – private consumption, investments and exports – for 2020 and 2021 to consider the economic effects of the Covid-19 pandemic.

[14] For reference to the full documentation of the model, please see Supplementary Information in the contribution by D'Alessandro et al. (2020).

[15] We do not include benefits that do not vary according to one's employment status such as family and children benefits or the universal basic income programme.

[16] Note that this assumption produces an asymmetry in the impact of CI and BI on labour force participation. Indeed, since BI affects all individuals equally it does not change the difference between.

[17] In the same five categories described above: physiological overhead, leisure and social, paid work, unpaid work and study.

[18] These groups are low-, middle- and high-skill men and women that are either employed, unemployed or out of the labour force, aged between 15 and 24, 25–44 and 45–64 for a total of 54 groups. The remaining 6 groups are retired men and women of the three skill levels, all aged 65 or more.

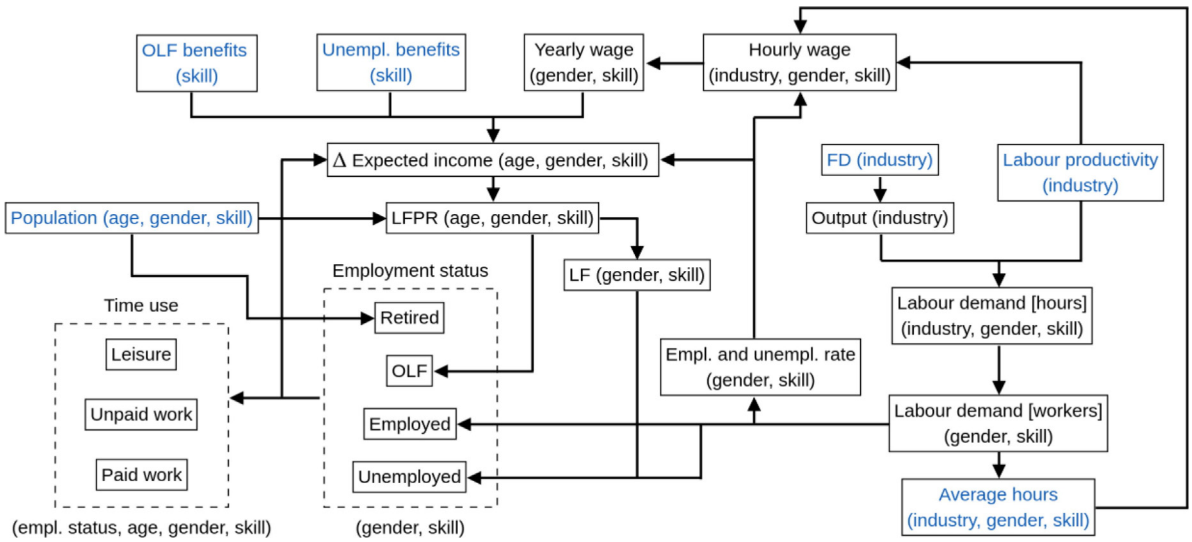


Fig. 2. The Labour Market. Causal map of the main relationship captured by the EUROGREEN model in the labour market. Variables in blue are exogenous or determined in other modules of the model. Abbreviations: LF = "labour force", OLF="out of the labour force", FD = "final demand", LFPR="labour force participation rate", Δ Ex. Income = "difference in the expected income (between LF and OLF)".

3.3. Scenarios and policies

This section describes in detail the policies and scenarios simulated as well as the assumptions made to guarantee comparability between policies. The figures in Section 4.2 plot the means and 95 % confidence interval from 200 simulations. These simulations differ in terms of the pace of technological progress,[19] of substitution between men and women in new hires, the sensitivity of labour force participation to expected income, and how unpaid working time is redistributed between different groups of individuals. The simulations run from 2010 to 2040 while policies are gradually implemented after 2023. The two universal income policies are linearly implemented in five years, between 2023 and 2028, while the 10 h reduction in weekly working hours takes place for 10 years.

The simulation results presented Section 4.2 contain two policy scenarios and a baseline. The baseline assumes no specific policy and can be considered the business as usual. The two policy scenarios combine a reduction in working time with two universal income policies: BI and CI programmes; we termed these two scenarios BIWTR and CIWTR, respectively. The three individual policies, and particularly the two universal income programmes, were designed to ensure comparability between the scenarios.

The total cost of the CI and BI programmes are the same. First, we set the hourly benefit of the CI programme to 5 euros.[20] Then, the total yearly benefit for individuals in each group is obtained by multiplying the hourly benefit by the number of yearly unpaid work hours attributed to individuals in each group in the time use module.[21] For instance, among the groups that perform the most unpaid work, out of the labour force low-skill women aged between 25 and 44 earn €7.000 per year for about 1400 h, and retired middle-skill women earn about €5.000 for 1000 yearly hours. The groups that perform the least hours of unpaid work include employed high-skill men aged between 15 and 25 and employed low-skill men aged between 45 and 64 earning 545 and 2,060 € per year, respectively. The total cost of the universal CI programme when fully implemented is of about 180 billion € per year.

For a comparable universal BI programme, we calculate the approximate yearly benefit per capita, for all individuals aged 15 or more, that amounts to the same total cost: 3500 €. Therefore, the simulated differences between the CI and BI programmes are due to the different distribution of the total benefits among groups of different ages, genders, skills, and occupational statuses.

Finally, we add two conditions together with both universal income programmes. First, when introduced they substitute family and children benefits, sickness and disability benefits and direct transfers for lower income, low-skill out of labour force and unemployed individuals. Second, income tax rates are increased, maintaining the same level of progressiveness, to assure the universal income programmes are budget neutral. Income tax rates are raised from 0.23, 0.27, 0.38, 0.41 and 0.43 to 0.35, 0.4109, 0.5783, 0.6239 and 0.6544 while maintaining the same income brackets of (0, 8000, 15,000, 28,000, 55,000, 75,000) which are adjusted over time according to mean wage growth. A comparison between the baseline and the two policy scenarios in terms of GDP and government deficit is presented in appendix Fig. B.1. The two policy scenarios only have a small effect on GDP with transitory increases in growth rates after the programmes' introduction. Those results are not unexpected since the increase in aggregate demand from the BI and CI programmes is almost fully compensated by the increase in income taxes. The small positive effects on GDP are due to greater marginal propensities to consume from the low-income groups that benefit the most from the universal income programmes with respect to those whose income taxes increase the most. The deficit-to-GDP ratios grow about 1 % above the baseline values, on average, after the universal income policies are introduced. However, the two policy scenarios show a decreasing trend in the public deficit due to WTR for two reasons: an increase in social contribution revenues due to an increased gross wage bill and a reduction in unemployment benefits paid.

4. Results

4.1. Econometric analysis

The regressions confirm the partial substitution between paid and unpaid work. The results are summarized in the five models

[19] New technologies that increase labour productivity and the technical coefficients of the input–output matrix are extracted randomly at every simulation period.

[20] This is a rather uncharitable hourly wage in light of a recent study that estimates the average hourly wage for childcare and household work in Austria at 11€ and 12€ respectively (Jokubauskaitė & Schneebaum, 2020).

[21] Time use activities are defined by the representative weekday. Thus, to obtain yearly hours by activity we multiply by five workdays, 4 weeks and 11 months.

presented in Table 1.[22] Column one presents an ordinary least square (OLS) regression for the full sample of 12,582 observations while column two estimates a multilevel model (MLM) for the same sample with the same 12,582 nested in 6,338 households. Columns three to five are also multilevel regressions for the three sub-samples of the working age population: 15–24, 25–44 and 45–64 years of age.[23]

Data for the dependent variable, unpaid work, and our main covariate, paid work, are in minutes per day. Thus, in column one an additional minute of paid work reduces unpaid work by 0.249 min or about 15 s on average. Alternatively put, an extra hour of paid work substitutes 15 min of unpaid work. The coefficient remains relatively unchanged in the multilevel regression of column two (−0.251) but varies among the three age groups. The reduction in unpaid work for an extra minute of paid work is much smaller (−0.075) for the younger group (15–24), roughly the same for the middle one (−0.266) and larger for the older group in column five (−0.346).

We also consider the interaction between paid work and gender. With the single exception of the 15–24 age group, the substitution between paid and unpaid work is larger for women. In the full sample multilevel regression, column two, an extra hour of paid work reduces unpaid work for women by 0.398 or about 24 min. The same reduction of women aged between 24 and 44 and 45–64 are of 30 and 31 min, respectively.

The categorical variable for females in models two and three also confirms that they perform, on average, about 83 more minutes of unpaid work per day compared to men. The last three variables of Table 1 are also categorical and indicate the presence of domestic workers, babysitters and elder care workers in the household, respectively. While domestic workers are associated with a reduction of unpaid working time, on average, babysitters tend to increase it. Elder care workers are associated with meaningful reduction of unpaid work, but only in the first two models. Hence, we interpret this as an indication that elder care workers reduce unpaid work among individuals aged 65 or more. These variables suggest an important relation between income and time use inequality.[24] Higher income households can reduce time-poverty by accessing market services to substitute activities commonly performed as unpaid work in most of the households.

The regression results summarized in Table 1 also point to an interaction between working time reduction (WTR) and unpaid work. The reduction of working time of employed individuals would increase their participation in care and house activities. Simultaneously, an increase in the number of individuals employed, previously unemployed and out of the labour force, would also substantially reduce the time spent in unpaid work activities of individuals in the groups that more intensely engage in care and housework. Thus, improving the distribution of working hours among different groups of individuals may also improve the distribution of unpaid work. Even though WTR may reduce time-poverty among women, the regressions results also alert us to a limited possibility for a two-sided closure of time gaps since the reduction of unpaid work by women is not met by an equivalent increase by men.

For the simulation results in the following section, we plug-in the estimated values of the paid work coefficients for men and women to the time use model of Eurogreen.[25] Therefore, the simulated reduction of working time from about 40 to 30 weekly hours results in the same variations of unpaid working time presented in Table 1. For instance, an employed man aged between 25 and 44 will increase weekly hours of unpaid work by about 2 h and 40 min[26] for a 10-hour decrease in paid working time. Meanwhile, employed women aged between 45 and 64 will increase unpaid working hours by 5 h and 13 min for a similar reduction of paid working time.[27] The difference between reductions in paid work and increases in unpaid work are allocated to leisure activities.[28]

4.2. Simulation results

The simulation results represent plots of the means and 95 % confidence intervals of 200 simulations for the baseline (black), BIWTR (orange) and CIWTR (blue) scenarios described in Section 3.3. The substitution between paid and unpaid work, as a function of WTR, is based on the coefficients of models (3), (4) and (5) in Table 1, for men and women in the three age groups of the working age population.[29]

Fig. 3 summarizes the main labour market results for women (top row) and men (bottom column).[30] The two left panels plot unemployment rates, the two centre panels employment rates and the two right panels plot labour force participation rates. The bad performance of the Baseline in terms of unemployment rate is mainly due to the pace of technological progress which favour labour saving technology increasing labour productivity by about 36 % (at the end of the simulation period) and a quite low GDP growth rate (about 1 % per year).

In both policy scenarios WTR results in a long-term reduction of unemployment rates, increase in the number of individuals employed, and an increase of labour force participation rates relative to the Baseline. Hence, WTR can better distribute total working hours among the working age population.

Still, we observe distinct dynamics between the two policy scenarios, particularly in the years after the introduction of the universal income policies. Section 3.2 makes it clear that we model the effect of the care income (CI) programme on labour force participation as a worst-case scenario in which increasing benefits for out-of-labour-force individuals reduces, ceteris paribus, labour force participation rates. Moreover, we do not assume that the basic income (BI) programme has any effect on labour force participation since, as explained in Section 3.2, the same amount is paid to all individuals independently from whether they are employed, unemployed or out of the labour force.

Therefore, the sharp decrease in women unemployment rates (3a) in CIWTR right after the introduction of the policies is almost fully explained by the decrease in women's labour force participation rates (3c). In contrast, the initial decrease in men's unemployment rates (3d) in CIWTR with respect to BIWTR can be attributed to an increased employment rate. In other words, while both

[22] The complete regressions results are available in appendix Table A.1 We also repeat the regressions for a sub-sample of employed individuals in Table A.2 with small variations in the coefficients.

[23] As mentioned in Section 3.1, the presence of correlation between observations that are nested within a group (households), could result in inefficient standard errors in OLS regressions. Since Table 1 indicates that the coefficients of OLS and MLM regressions are similar, we confirm that inefficient standard errors are not an issue in our sample.

[24] ITUS data does not provide any information on the income of individuals or households surveyed.

[25] More specifically, we use estimates from the MLM regression across age-groups found in Table 1. For men, we use the Paid Work coefficients and for women we use Paid Work*Female coefficients.

[26] This is equivalent to −10 h multiplied by the coefficient −0, 266 or 2.66 h or 2 h and 40 min.

[27] This is equivalent to −10 h multiplied by the sum of the paid work coefficient and its interaction with variable female −0.346–0.175 or 5.21 h or 5 h and 13 min.

[28] The allocation of total unpaid working hours in the economy from individuals in other groups (unemployed, out of labour force and retired) to employed ones is explained in section 3.2.

[29] Since one less hour of paid work results in less than an hour increase of unpaid work, the remaining minutes are allocated to leisure.

[30] Further labour market results are displayed in Fig. B.2 and Fig. C.1 in the Appendixes.

Table 1
OLS and multilevel regressions of unpaid work (uw) on paid working time, full sample (1–2) and by age group (3–5).

	OLS (1)	MLM (2–5)			
	(1) All uw	(2) All uw	(3) 15–24 uw	(4) 25–44 uw	(5) 45–64 uw
Paid Work	−0.249***	−0251***	−0.0748***	−0266***	0.346***
	(0.005)	(0.005)	(0.012)	(0.013)	(0.011)
Female	82.61***	82.60***	46.88***	117.3***	146.5***
	(4.578)	(4.597)	(5.60)	(10.23)	(10.47)
Paid Work*Female	−0.148***	−0.147***	−0.0204	−0.238***	−0.175***
	(0.009)	(0.008)	(0.022)	(0.017)	(0.014)
Domestic Worker	−29.92***	−29.84***	−25.18*	−9.769	−28.71***
	(5.434)	(5.419)	(11.01)	(10.68)	(8.523)
Babysitter	64.30***	64.58***	−21.56**	40.88*	57.04**
	(14.07)	(16.29)	(7.166)	(18.29)	(19.69)
Elder Care Worker	−118.4***	−121.4***	14.05	−7.259	−28.10
	(11.76)	(11.60)	(21.69)	(22.71)	(24.07)
Controls	Yes	Yes	Yes	Yes	Yes
Random Effects					
level 2: σ_households^2		820.9	2,009	2430	2,316
		(249.5)	(924.8)	(531.3)	(549.1)
level 1 σ_e^2		18,551	7,783	12,051	13,865
		(395.8)	(956.4)	(615.5)	(648)
N	12,582	12,582	1,417	3,605	4,334
Groups		6,338	1,100	2,605	3,006
R2	0.524				
Intraclass correlation coefficient		0.042	0.205	0.168	0.143

Robust standard errors in parentheses.
+ p < 0.010, * p < 0.05, ** p < 0.01, *** p < 0.001.
Additional controls include the household position of the respondent (head, spouse or child), region and period in which the survey was answered.

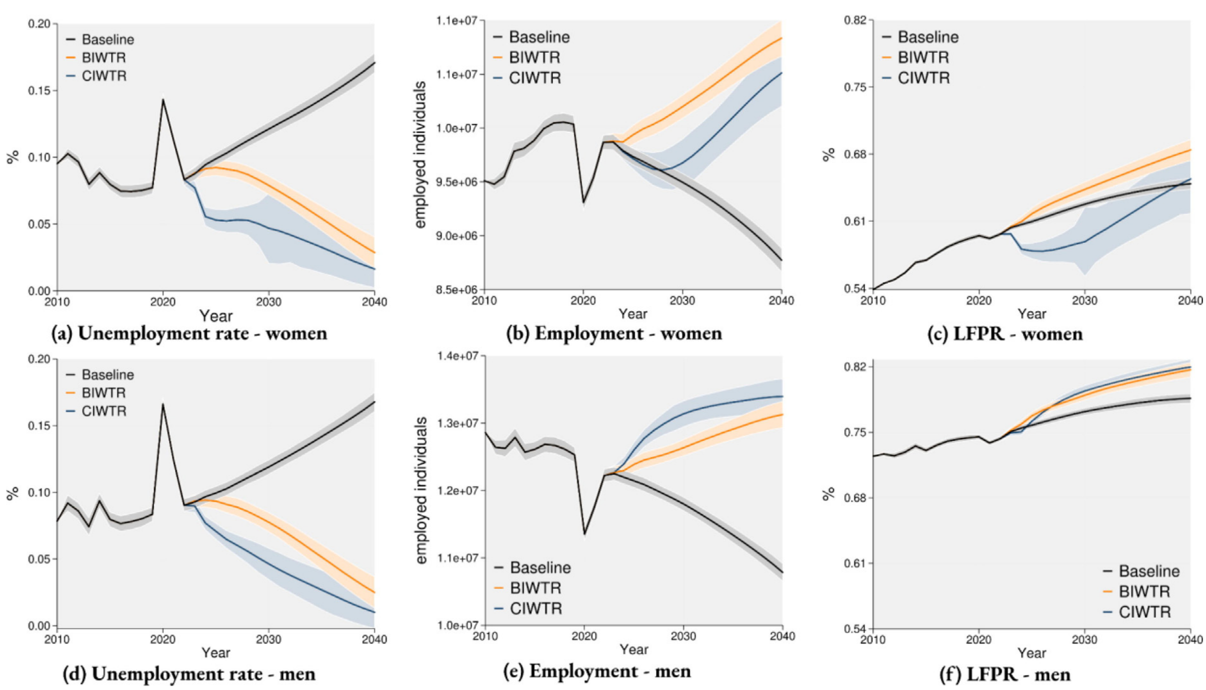


Fig. 3. Main labour market indicators for women (top-row) and men (bottom-row). The panels plot unemployment rates (a) and (d), total employment in number of individuals (b) and (e), and labour force participation rates (c) and (f). The lines plot the means from 200 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

CIWTR and BIWTR exhibit improving long-term trends of increasing employment and labour force participation, due to WTR, they differ in the short-term because of the differences between the universal CI and BI programmes. The increase in transfers for those who perform more hours of unpaid work, such as out-of-labour force and unemployed women seems to initially direct most of the newly created employment positions to men. Even though these trends do not persist, women's employment rates are lower under CIWTR when compared to BIWTR (3b), while men's employment rates are higher (3e). Still, when compared to the baseline scenario, CIWTR reaches much higher employment rates with similar labour force participation for women.

These gendered differences in labour market outcomes have further consequences for the gender wage gap. Although the CI programme in CIWTR redistributes income towards women that perform more hours of unpaid work, it also tightens labour markets in such a way that favour higher men's hourly wages. In Eurogreen, hourly wages are defined by gender, skill and industry. Their variation depends on labour productivity and employment rates. Therefore, by jointly decreasing women labour force participation and increasing men's employment, CIWTR results in a higher increase of men's wages with respect to BIWTR. Fig. B.3 plots the accumulated growth of average hourly wages by gender and skill during all the simulation period (2010–2040). Hourly wages for middle- and high-skill men grow more in CIWTR than BIWTR whereas only high-skill women also reach higher hourly wages in CIWTR. However, when compared to the baseline, hourly wages always increase more in the two policy scenarios. Such an increase is more pronounced in categories that traditionally face tighter labour markets such as high-skill workers, while hourly wages of low-skill men and women grow only slightly above the baseline. In particular, low-skill women's hourly wages in CIWTR grow slightly less than in the Baseline due to the adverse effects on women's labour force participation.

If labour market results provide a warning on unintended consequences of a CI, the dynamics of the gender distributions of total gross non-financial income favour CIWTR instead of BIWTR. The top row of Fig. 4 plots the evolution of the women's share of total gross non-financial income (4a), the percentage of all unpaid work performed by women (4b). The bottom-row shows two Gini coefficients. The first for income distribution (4c) and the second for unpaid working time (4d).[31]

The introduction of the CI programme promotes a meaningful and lasting increase in women's share of total earnings (4a), while the universal BI results in a women's share of income only slightly higher, on average, than in the baseline simulations. This reduction of the gender income gap, however, partially dissipates throughout the simulation period, particularly after 2025, due to the adverse labour market effects mentioned above.

The accumulated growth rates (2010–2040) of gross non-financial income by gender, skill and occupational status is available in appendix Fig. B.4. The total yearly income of employed men and women of all skills grows much less in the two policy scenarios with respect to the baseline due to the reduction in total labour income after the reduction of working time. On the other hand, the two policy scenarios result in higher income growth for almost all retired and out of labour force individuals. Nonetheless, some groups of individuals experience income growth similar to or below the baseline values in the two policy scenarios, particularly those whose direct social transfers were substituted by the BI or the CI such as low-skill out-of-labour-force and unemployed individuals.[32] If the CI programme favours the reduction of gender income gaps, the two policy scenarios have a similar performance in terms of the Gini coefficient for overall income distribution (4c). A sharp reduction in income inequality is observed after the introduction of the two universal income programmes. At first, the CI programme outpaces BI as it directs a largest share of its transfer towards lower income groups such as out-of-labour force men and women. However, adverse labour market trends offset these initial gains and the combination of BI and WTR results in the lowest Gini coefficient, on average, by the end of the simulation period. Still, both policy scenarios sustain significant reductions in income inequality throughout the simulations when compared to the baseline.

The fraction of total unpaid work performed by women decreases in the three simulated scenarios (4b). Even though this reduction is stronger in BITWTR and CIWTR due to WTR, improvements in the gender distribution of unpaid work are limited. The fraction performed by women falls from about 69 % in 2010 to around 66.5 %, on average, in 2040 in the BIWTR and CIWTR scenarios. The larger confidence intervals of the two policy scenarios plotted in Fig. 4b are due to the three different rules to redistribute unpaid work (see Section 3.3) which vary randomly in the 200 simulations that compose every scenario. Nevertheless, even at the lower bound of the confidence intervals, the fraction of unpaid work performed by women is higher than 64 %.

Fig. 5 illustrates the separate development of total women (5a) and total men (5b) unpaid work. In relation to time-poverty gaps, the limited reduction of women's unpaid work does not necessarily indicate a one-sided closure. This is because the reduction is the result of an increase in paid work and is therefore not accompanied by an increase in leisure time for women. Since the uptake of paid work by women is stronger under BIWTR compared to CIWTR, one can argue that the likeliness of time-poverty for women is higher in presence of a BI compared to a CI. At the same time, Fig. 5b indicates an increase in the amount of unpaid work performed by men which represents a limited presence of a two-sided closure of the time-poverty gap. In this case, the uptake in unpaid work performed by men is stronger under BIWTR than CIWTR since the latter creates more employment opportunities for men which negatively affects their engagement in unpaid work.[33]

However, variations in which groups of individuals perform unpaid work are not limited to differences by gender. A different picture on the overall distribution of unpaid work is presented by its Gini coefficient (4d). The significant increase in the share of individuals employed due to WTR also redistributes unpaid working time within men and women. When compared to the baseline, by the end of the simulation period, a lower fraction of unpaid work is performed by out-of-labour force and unemployed men and women, and a greater fraction by employed and retired individuals. This larger contribution of employed men and, mostly, women is a combination of more unpaid working hours per capita after WTR (intensive margin) and a larger number of individuals employed (extensive margin), Thus, the distribution of paid work hours within men and women improves. The increase in unpaid work performed by retired individuals is due to the demographic trends and the relative increase of individuals aged 65 or older in the population.

To further investigate the potential of the selected policy mixes to overcome time and income gaps, we perform a welfare analysis. Indeed, the impacts of the two policy mixes on paid and unpaid work measure their capacity to redistribute income from wages. But at the same time, the change in employment status and the redistribution of time uses strongly affect leisure time and consequently well-being derived from it. Furthermore, the increase

[31] See Fig. C.3 for the single policies results of these indicators. The two Gini coefficients are calculated over different groups. The first (4c) is calculated based on the net income of the 13 different groups of individuals in the model categorized by the three skill levels and four occupational status (employed, unemployed, out-of-labour force and retired) and capitalists which constitute a small, fixed portion of the population. It does not consider gender because we are not able to disaggregate financial income and asset ownership by gender. The Gini coefficient for unpaid working time (4d) instead is calculated based on 60 different groups defined by gender, skill, occupational status, and age groups.

[32] Notice that here we refer to the growth rate - not the level - of income. The BI and CI programmes result in high income growth for middle- and high-skill out of labour force individuals because in the baseline these groups only receive small benefits that are split between all the groups such as family and children benefits and sickness and disability benefits. Low-skill men and women out of the labour force, in contrast, receive specific direct transfers in the baseline that are substituted by CI and BI and. Despite the lower growth rate, the level of women's low-skill out of labour force income remains above that of middle- and high-skill women, while men experience a decrease in their income with the CI programme.

[33] See Fig. C.2 for single policy results of total unpaid work by gender.

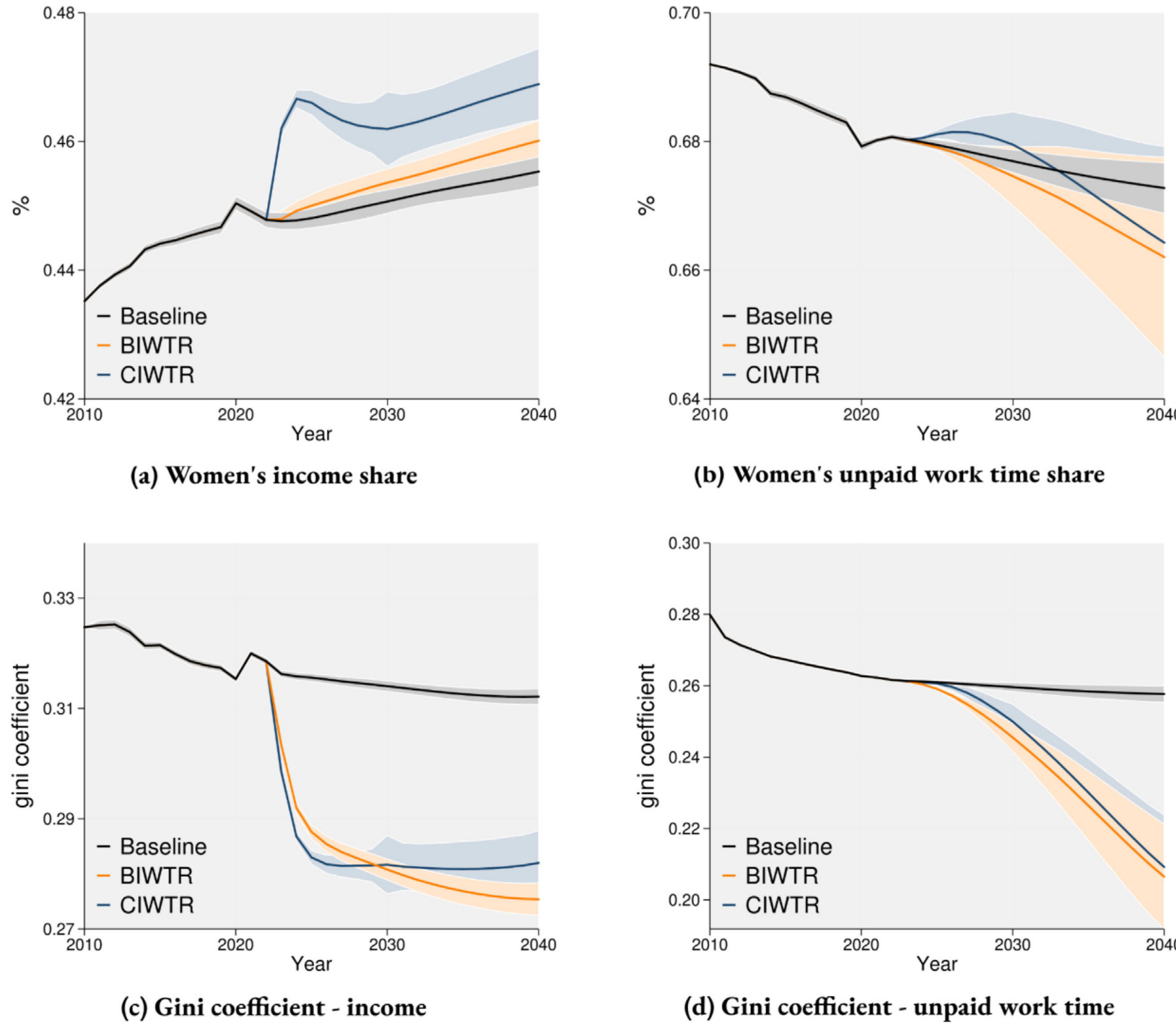


Fig. 4. Income and time use inequality. (a) Women share of gross non-financial income and b unpaid work hours, (c) Gini coefficient for net income and (d) unpaid work time. Panel (a) considers all non-financial sources of income for working age and retired individuals, namely wages, unemployment benefits, old age pensions, family and children benefits, sickness and disability pensions, as well as basic and care income according to the scenarios. The lines plot the means from 200 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

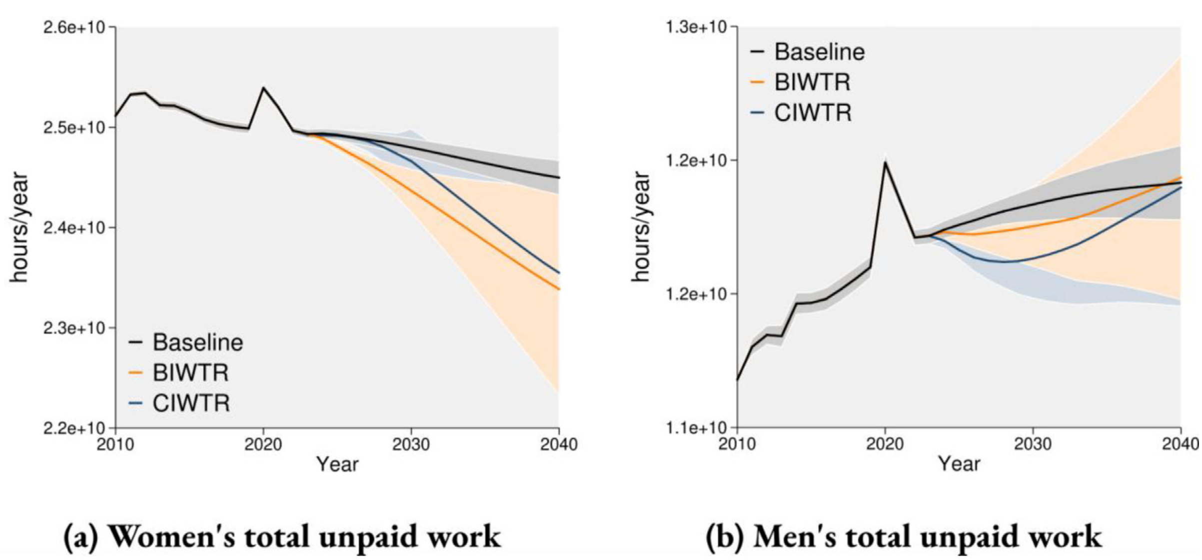


Fig. 5. Unpaid work trends for (a) women and (b) men. The panels consider trends in the total amount of unpaid work projected in each scenario calculated as the yearly amount of unpaid work performed by each individual according to age–group, sex, skill and occupational status multiplied by the number of individuals from that group in the adult population. The lines plot the means from 200 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

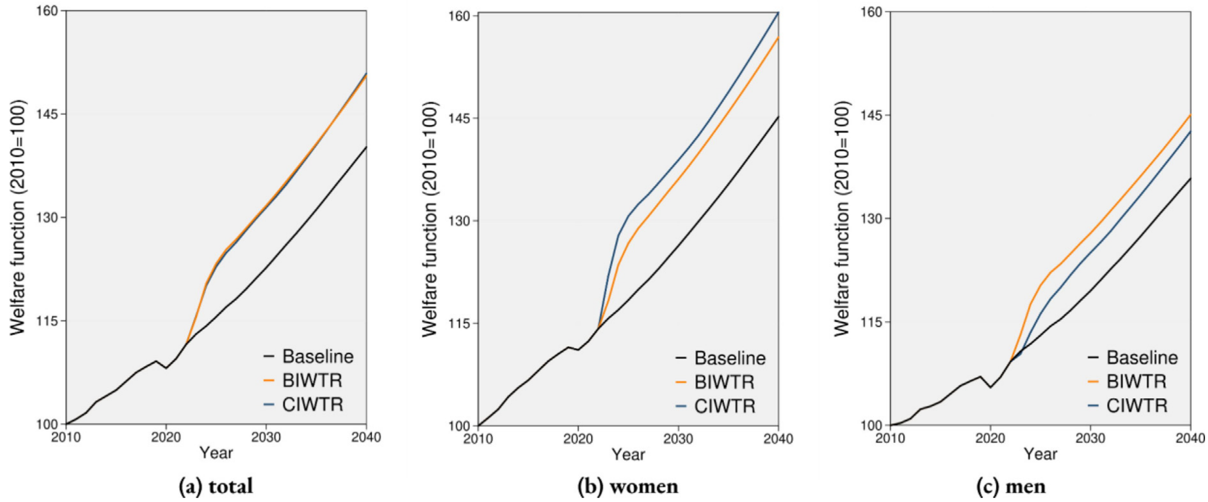


Fig. 6. Development of welfare for a) all individuals, b) women and c) men. The panels show trends in welfare normalized to 100 in 2010 for (a) all individuals, (b) women, (c) men for the two alternative policy mixes and the Baseline.

in leisure time may also induce a reduction of employees' income. To measure the impact of all these changes on individual welfare, we build the average leisure time and income per employment status, gender and skill (24 groups), and calculate the utility levels of each group assuming a Cobb Douglas utility function.[34] Fig. 6 shows the results of the simulation for total welfare and per gender. The two policy mixes significantly increase total welfare (panel a). The results in terms of gender welfare gaps are interesting. For women (panel b), welfare under CI + WTR is significantly higher than BI + WTR, while the opposite holds for men (panel c). When it comes to employed individuals, the two policy mixes increase welfare in the short run while the baseline induces an increase of welfare in the long run only if the employed attribute a sufficiently high weight to income w.r.t. leisure. However, since the employed have a higher welfare than other categories and the relative amount of employed individuals increase significantly with the two policy mixes, the result in terms of overall welfare is positive. Thus, these results are not sensitive to the preference for income vs leisure.

5. Discussion

This work explored the potential synergies between working time reduction (WTR) and universal income schemes (UIS) against the backdrop of time-poverty gaps between women and men. In particular, we focussed on the potential of a basic income (BI) and of a care income to compensate and/or close time-poverty gaps when combined with WTR. To this purpose, we performed a macro-simulation exercise referring to the case of Italy. Even if the external validity of our simulations is only moderately representative for socio-economic systems in the Global North, the results we obtain reveal key causal factors and effects that appear of general relevance for policy making.

When it comes to compensation, the simulation results show that compared to the baseline scenario, WTR significantly increased the amount of employed women by the end of the simulation period. Hence, the economic compensation for women's time-poverty through new employment opportunities is confirmed. Furthermore, the introduction of universal income schemes (UIS), coupled and funded with an increase in progressive taxation, resulted in the reduction of income inequality as presented by the Gini coefficient. In other words, UIS addresses limitations related to involuntary WTR with fixed hourly wages.

Evidently, the basic income (BI) and care income (CI) activate time-poverty compensation mechanisms in and of themselves, but their interaction with WTR differ in two important ways. First, the higher income transfers for women under the CI reduced women's labour force participation which counteracted compensation through new employment as the result of WTR. Indeed, under CI and WTR (CIWTR) most new employment opportunities were fulfilled by men and, together with reduced women's labour force participation, this results in tighter labour markets. Wage growth was therefore limited to men and high skilled women. Second, compared to the BI, an hourly CI resulted in higher gross income growth for unemployed, out of labour force and retired women. Employed women, however, experienced lower income growth under both income schemes and compared to the baseline. Both of these results indicate an imperfect compensation for women's time-poverty through income transfers.

Compared to the baseline scenario, women's total unpaid work decreased under both BI and WTR (BIWTR) and CIWTR. Most of this reduction is driven by new employment opportunities for women as the result of WTR. Therefore, the decrease is more pronounced under BIWTR where the women's labour force participation rate is higher. Since our empirical results suggest that the elasticity of unpaid to paid work time is below unit, the reduction in women's unpaid work does not imply a one-sided closure of the time-poverty gap. If an extra hour of paid work would decrease unpaid work by more than one hour, one could argue that new employment opportunities for women imply-one-sided closures due to newly freed up time.

Men's unpaid work at the end of the simulation period is relatively unchanged compared to the baseline scenario, but BIWTR is subject to a slightly higher value of men's unpaid work due to the higher women's labour force participation rate. Indeed, the women's fraction of unpaid work experienced a slight decrease from 69 % in 2010 to 66.5 % in 2040. This indicates the limited presence of a two-sided closure of the time-poverty gap under both policy mixes where the two-sided closure is slightly higher under BIWTR. A more pronounced two-sided closure is hampered by our estimators which suggest that the elasticity of unpaid to paid work time is higher for women compared to men. Hence, employed women will engage in more unpaid work as a result of WTR.

Simulation results also indicate that variations in unpaid work are not limited to differences by gender. WTR increased the amount of unpaid work performed by employed individuals and reduced that of out of labour force, retired and unemployed indi-

[34] The utility function is defined in Appendix D.

viduals, especially for those who transit into new employment opportunities. Furthermore, the CI directed a larger proportion of transfers to out of labour force and unemployed individuals since they perform more hours of unpaid work on average.

The statistical and simulation analyses conducted are not without flaws and significant uncertainties remain. The lack of longitudinal data does not allow us to estimate the variation of unpaid work, as a function of paid work, *within* individuals. The modelling of labour force participation and redistribution of unpaid work time, explained in Section 3.3, also carries a certain lack of accuracy. Rendering labour force participation as a function of the difference between labour and non-labour market incomes, despite the lack of consistent evidence either for or against this hypothesis related to UIS, seriously tilts our results against the CI scheme. Hence, the adverse labour market effects on wage inequality and women's participation rate might as well be exaggerated in our results.

It is also hard to model the redistribution of unpaid work, which is why we opted to vary between three redistribution rules. This may also explain why both scenarios only resulted in minor decreases in women's total unpaid work and women's share in unpaid work. In a real setting a monetary benefit coupled with proper framing and communication strategies could significantly increase men's willingness to increase unpaid work and contribute to the two-sided closure of time-poverty gaps or the achievement of the universal caretaker model.

Taking stock of the considerations above, the modelling choices that underpin our results are fairly conservative and should not be far from a worst-case scenario for the simulated policy mixes, and for the CI programme in particular. At the same time, it is important to mention that WTR and monetary incentives are not sufficient to advance gender equality along the lines of the universal caretaker model. UIS which either replace or fail to promote collectively provided universal public services are bound to increase the purchase of household services and goods on the market, e.g., child and adult care (Huws, 2019). Since paid domestic workers in the EU and UK are over-represented by underpaid migrant women (King-Dejardin, 2019; Peterson, 2007; Triandafyllidou, 2013) various gender equality gains achieved by universal income schemes are likely to be offset.

Complementary policy proposals will need to focus on the provision and maintenance of collectively provided universal public services. One can think of the universal basic services (UBS) proposal introduced by scholars from the Social Prosperity Network in London (Portes, Reed, & Percy, 2017). Advocates of UBS in the areas of health care, education, legal assistance, shelter, food, and transport argue that these guarantee a minimum standard of life to a higher extent than isolated UIS (Büchs, Petit, & Roman, 2020; Gough, 2019; Lombardozzi, 2020; Portes et al., 2017). The collective and public provision of child and adult care would grant women more independence to decide whether/when to engage in different types of work activities without offloading the experience of time-poverty onto vulnerable domestic workers. However, whether these large and ambitious policies are feasible or conditioned by barriers to their implementation is beyond the scope of our analyses.

All in all, this paper highlights policy options that, together, have the potential to tackle time and income gaps between genders. We see the development of simulated scenarios, despite their limitations, as a valuable tool to explore policy strategies and to anticipate their benefits and unexpected drawbacks. We hope this work can shine a light on the significant challenges presented by the interconnections between income and time use inequalities, and that the policy combinations put forth may foster further debate on ways to tackle these twin-problems.

CRediT authorship contribution statement

André Cieplinski: Conceptualization, Data curation, Methodology, Software, Visualization, Writing – original draft. **Simone D'Alessandro:** Conceptualization, Funding acquisition, Methodology, Writing – review & editing. **Chandni Dwarkasing:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Pietro Guarnieri:** Conceptualization, Writing – review & editing.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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André Cieplinski and Simone D'Alessandro acknowledge funding for the LOCOMOTION project from the European Commision's Horizon 2020 research and innovation programme (grant agreement no. 821105), and financial support from P. Lamberts (member of the Greens/EFA group in the European Parliament). Simone D'Alessandro, Chandni Dwarkasing and Pietro Guarnieri acknowledge funding for the Ecoesione project from the Italian Ministry of Ecological Transition, as part of the National Sustainable Development Strategy (project no. N.P.2.73). We thank Giacomo D'Alisa for putting us on the path of this research.

Appendix A Full regression table and employed sub-sample

Table A1
OLS and multilevel regressions of unpaid work (uw) on paid working time, full table.

	OLS (1)	MLM (2–5)			
	(1) All uw	(2) All uw	(3) 15–24 uw	(4) 25–44 uw	(5) 45–64 uw
Paid Work	−0.249***	−0251***	−0.0748***	−0266***	0.346***
	(0.00543)	(0.00535)	(0.0122)	(0.0132)	(0.0107)
Female	82.61***	82.60***	46.88***	117.3***	146.5***
	(4.578)	(4.597)	(5.600)	(10.23)	(10.47)
Paid Work*Female	−0.148***	−0.147***	−0.0204	−0.238***	−0.175***
	(0.00862)	(0.00816)	(0.0225)	(0.0175)	(0.0144)
Foreigen	−0.843	−0.0970	16.80	−3.941	−19.12
	(4.909)	(4.931)	(12.99)	(6.816)	(7.445)
Household level variables					
Domestic Worker	−29.92***	−29.84***	−25.18*	−9.769	−28.71***
	(5.434)	(5.419)	(11.01)	(10.68)	(8.523)
Babysitter	64.30***	64.58***	−21.56**	40.88*	57.04**
	(14.07)	(16.29)	(7.166)	(18.29)	(19.69)
Elder Care Worker	−118.4***	−121.4***	14.05	−7.259	−28.10
	(11.76)	(11.60)	(21.69)	(22.71)	(24.07)
Household Position					
Head	135.2***	135.2***	228.1***	166.0***	71.20***
	(4.212)	(4.25)	(31.77)	(7.554)	(7.114)
Spouse	2.347	2.654	81.17	28.19***	11.14
	(4.180)	(4.182)	(69.37)	(6.064)	(7.211)
Child	−128.7***	−128.5***	−37.38*	−72.29***	−21.64*
	(4.101)	(4.29)	(16.44)	(6.053)	(10.87)
Region					
North-East	3.470	3.418	4.149	0.72	0.0222
	(3.772)	(3.913)	(9.371)	(6.376)	(6.133)
Center	0.261	0.208	−7.832	2.729	9.723
	(3.935)	(4.022)	(8.912)	(6.41)	(6.547)
South	0.0385	−0.282	−0.285	2.465	2.942
	(3.539)	(3.661)	(7.753)	(6.049)	(5.778)
Islands	8.7678^+	8.810^+	6.749	−5.14	8.702
	(4.797)	(4.922)	(11.42)	(8.433)	(7.722)
Survey Date					
Feb-Apr	−6.548^+	−6.640^+	−7.887	−1.793	−6.372
	(3.430)	(3.399)	(7.608)	(5.661)	(5.443)
May-Jul	−5.455	−5.686	−0.0130	−9.145	−13.86*
	(3.417)	(3.541)	(7.349)	(5.484)	(5.655)
Aug-Oct	−8.147*	−8.432*	1.782	−9.759	−19.86***
	(3.580)	(3.666)	(7.773)	(6.230)	(5.786)
Constant	230.9***	231.3***	82.44***	224.2***	264.9***
	(5.285)	(5.337)	(17.49)	(10.05)	(10.04)
Random Effects					
level 2: σ^2$_{_household}$		820.9	2,009	2430	2,316
		(249.5)	(924.8)	(531.3)	(549.1)
level 1: σ_e^^{2}		18,551	7,783	12,051	13,865
		(395.8)	(956.4)	(615.5)	(648)
N	12,582	12,582	1,417	3,605	4,334
Groups		6,338	1,100	2,605	3,006
R^2	0.524				
Intraclass correlation coefficient		0.042	0.205	0.168	0.143

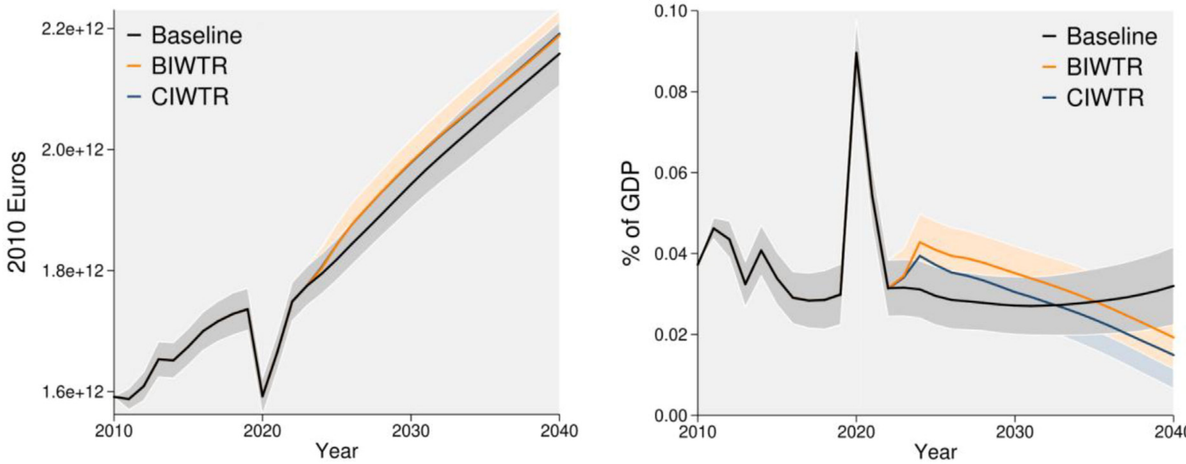
Robust standard errors in parentheses
+ p < 0.010, * p < 0.05, ** p < 0.01, *** p < 0.001.

Table A2
OLS an multilevel regressions of unpaid work (uw) on paid working time, employed individuals, full sample (1–2) and by age group (3–5).

	OLS (1)		MLM (2–4)		
	(1) All uw	(2) All uw	(3) 15–24 uw	(4) 25–44	(5) 45–64 uw
Paid Work	−0.291***	−0.299***	−0.0449**	−0.233***	−0.325***
	(0.0125)	(0.0124)	(0.0141)	(0.0147)	(0.0145)
Female	119.9***	116.6***	148.1***	117.0***	168.6°**
	(10.57)	(10.04)	(23.22)	(11.25)	(12.33)
Paid Work*Femalec.pw	−0.163***	−0.156***	−0.199***	−0,220***	−0,215***
	(0.0187)	(0.0173)	(0.0496)	(0.0203)	(0.0190)
Foreign	−5.486	−5.029	19.87	−4.262	−18.08*
	(5.038)	(5.104)	(21.00)	(7.066)	(7.389)
Household level variables					
Domestic Worker	−12.43*	−11.75^+	30.82	−10.78	−31.38***
	(6.134)	(6.357)	(27.66)	(10.11)	(9.001)
Babysitter	64.32***	−64.00***		53.54	59.13**
	(13.60)	(15.87)		(19.76)	(19.72)
Elder Care Worker	42,52*	44.47*	−16.97	21.25	−0.961
	(17.52)	(17.44)	(27.96)	(19.77)	(27.11)
Household Position					
Head	91.26***	89.89***	139.0***	152.1***	66.17***
	(4.962)	(4.962)	(37.92)	(7.530)	(7.609)
Spouse	9.333*	8.967*	−4.983	22.99***	7.471
	(4.143)	(4.198)	(28.14)	(5.888)	(6.625)
Child	−59.13***	−58.25***	−12.80	−70.56***	−24.73*
	(4.441)	(4.576)	(17.61)	(5.867)	(10.53)
Region					
North-East	3.407	3.153	16.58	0.875	2.463
	(4.114)	(4.386)	(15.74)	(6.388)	(6.255)
Center	5.575	5.826	−8.194	−3.802	11.77+
	(4.303)	(4.514)	(15.66)	(6.442)	(6.767)
South	−2.457	−2.692	2.641	−5.493	4.570
	(3.945)	(4.188)	(13.25)	(6.072)	(6.098)
Islands	0.0426	−0.250	−4.366	−9.624	11.06
	(5.402)	(5.810)	(20.73)	(8.584)	(8.294)
Survey Date					
Feb-Apr	−2.051	−1.690	−13.74	−3.701	−1.331
	(3.720)	(3.868)	(16.58)	(5.756)	(5.637)
May-Jul	−7.948*	−8.707*	−25.25^+	−9.398^+	−13.93*
	(3.720)	(3.945)	(13.90)	(5.482)	(5.988)
Aug-Oct	−5.730	−6.595	−25.33*	−8.659	−14.68*
	(4.001)	(4.232)	(12.32)	(6.246)	(6.033)
constant	237.2***	241.6***	58.53*	211.0***	252.0***
	(8.727)	(8.819)	(24.41)	(10.91)	(11.17)
Random Effects					
level 2: $\sigma^2_{\text{hosehold}}$		1,958	2,831	1,985	2,111
		(269.1)	(921.1)	(527.0)	(590.5)
level 1: σ^2_e		8,671	2,670	10,513	11,631
		(316.4)	(638.1)	(647.6)	(673.9)
N	5,750	5,750	237	3,094	3,391
Groups		3,931	219	2,338	2,473
R^2	0.572				
Intraclass correlation coefficient		0.184	0.515	0.159	0.154

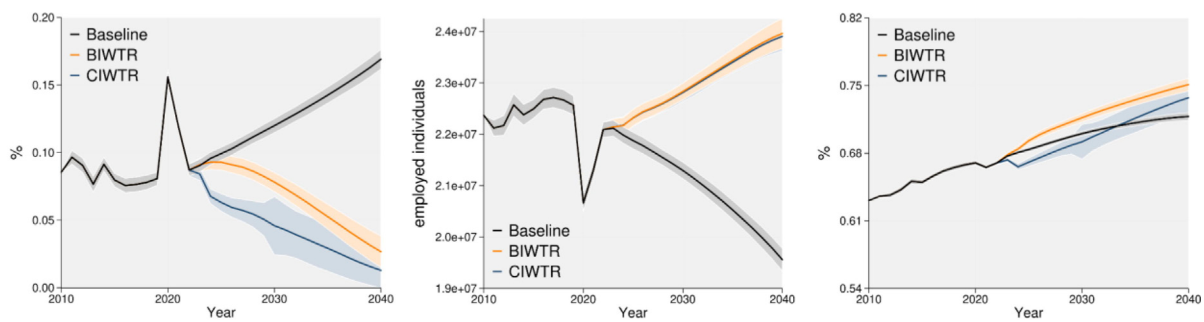
Standard errors in parentheses.
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Appendix B. Additional results



(a) real GDP (b) Deficit-to-GDP ratio

Fig. B.1. Macroeconomic indicators. The lines plot the means from 200 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.



(a) unemployment rates (b) total employment (c) labour force participation rates

Fig. B.2. Aggregate Labour market indicators. The lines plot the means from 200 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

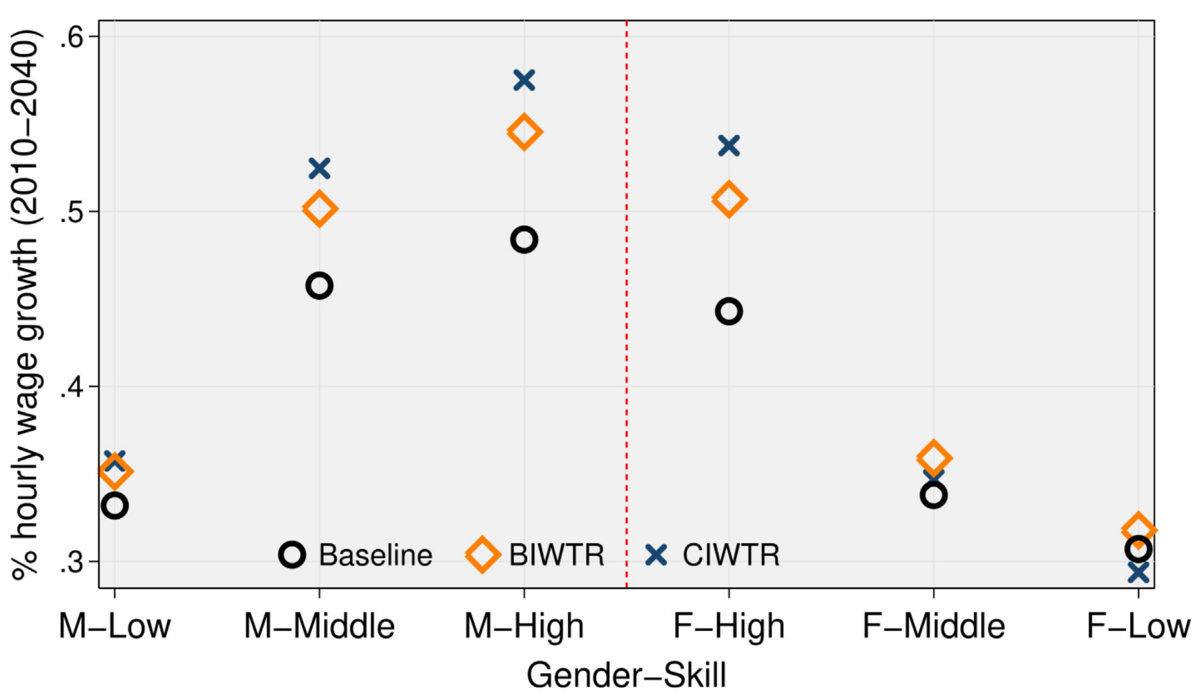


Fig. B.3. Accumulated real hourly wage growth by gender and skill (2010–2040). The graphs plot the mean real hourly wage growth rates from 200 simulations for each scenario.

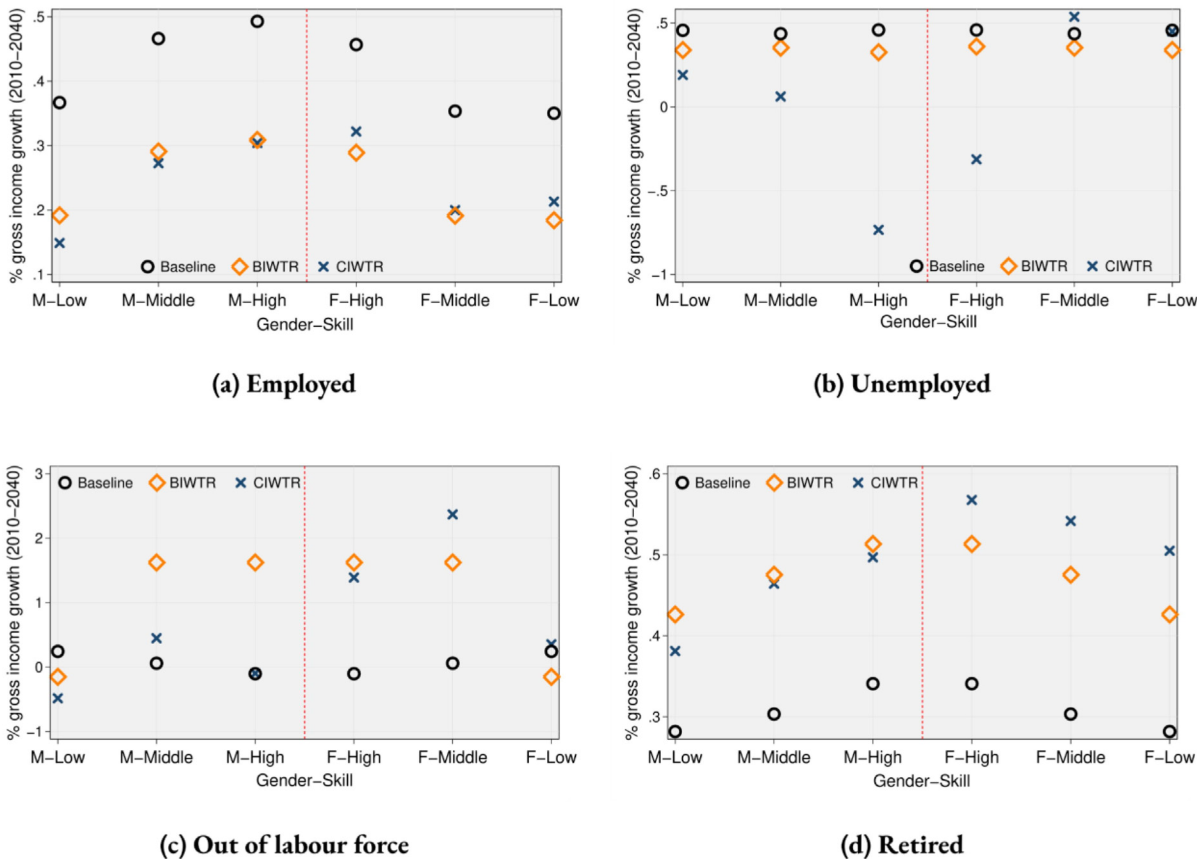


Fig. B.4. Accumulated nominal non–financial income growth rate by gender and skill (2010–2040). The graphs plot the mean gross non-financial income growth rate from 200 simulations for each scenario.

Appendix C. Single policy results

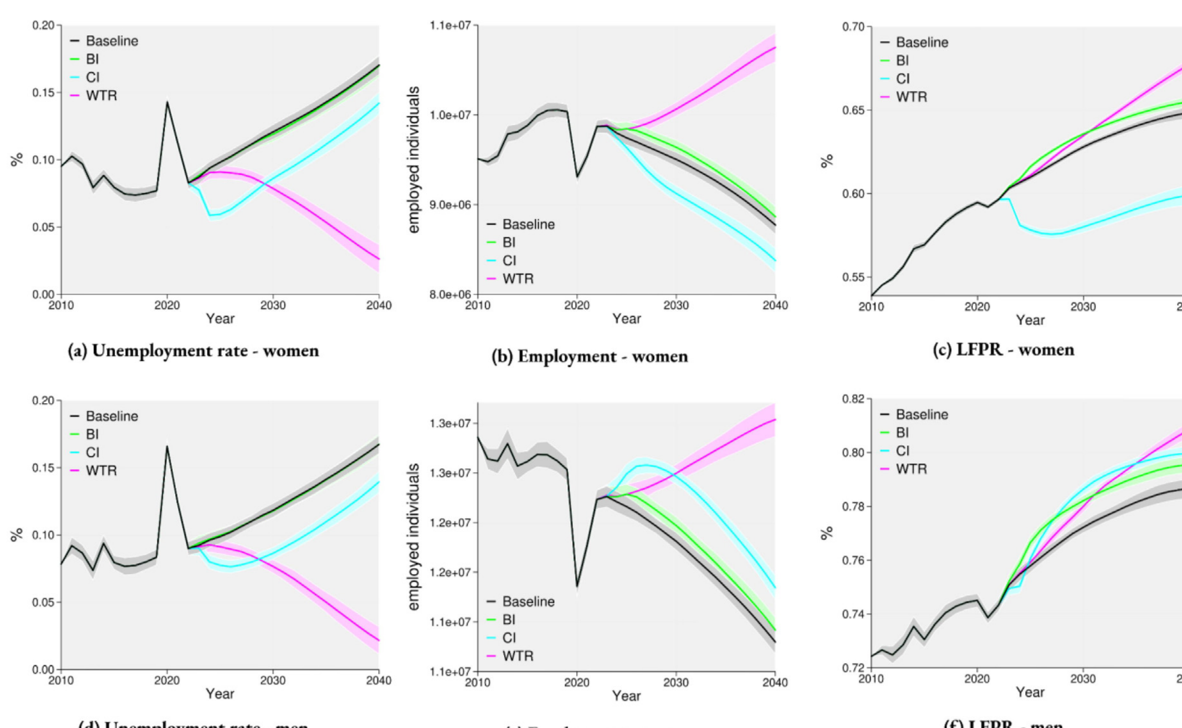


Fig. C.1. Main labour market indicators by sex for single policies. The lines plot the means from 50 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

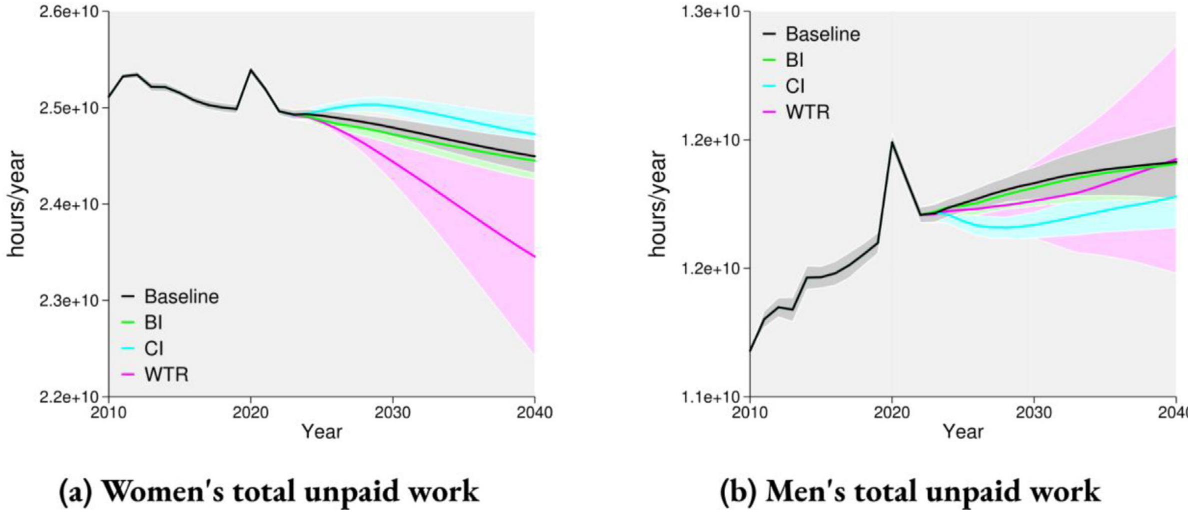


Fig. C.2. Unpaid work trends for single policies. The graphs consider trends in the total amount of unpaid work projected in each scenario calculated as the yearly amount of unpaid work performed by each individual according to age-group, sex, skill and occupational status multiplied by the number of individuals from that group in the adult population. The lines plot the means from 50 simulations for each scenario.

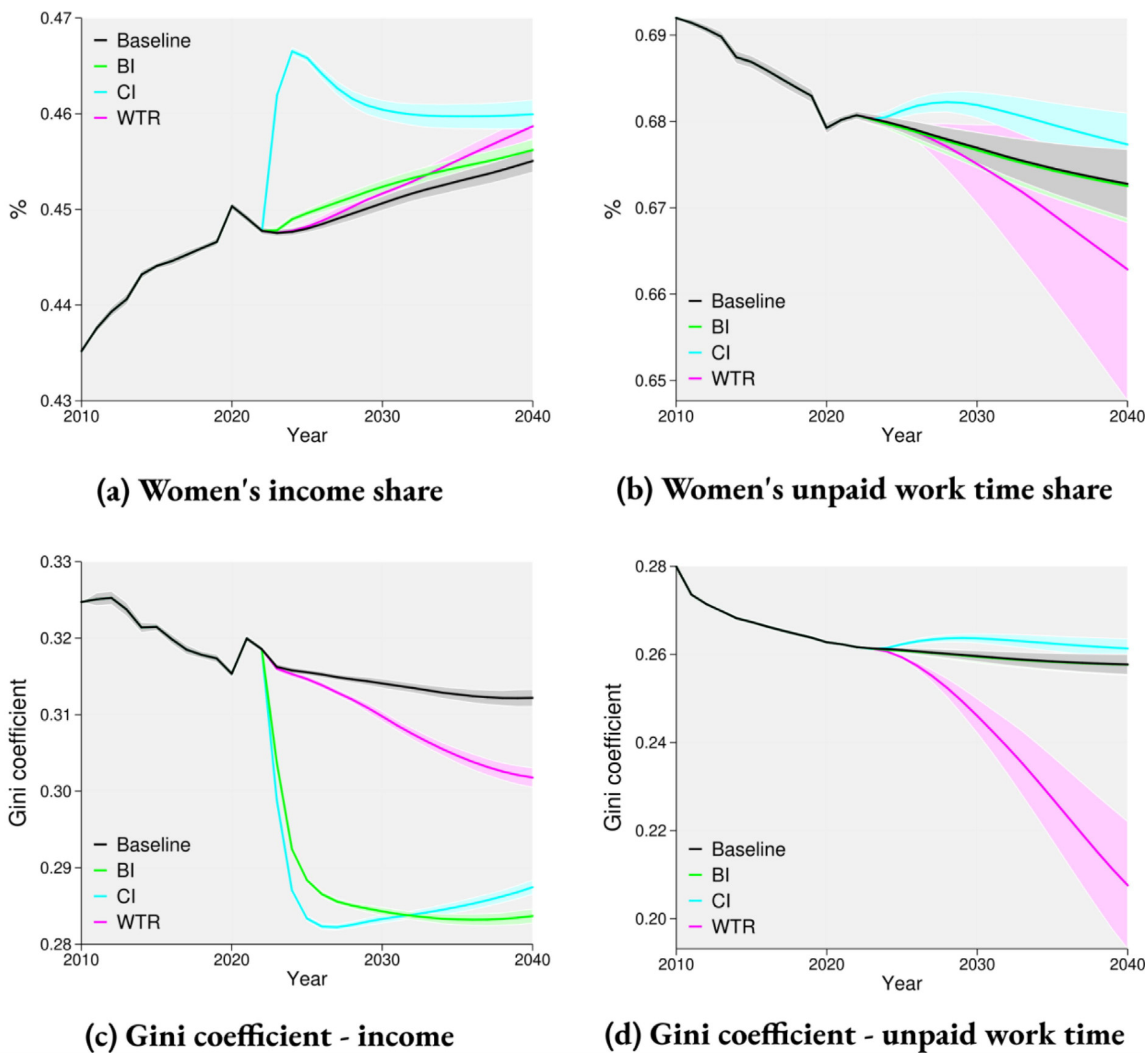


Fig. C.3. Income and time use inequality for single policies. (a) Women's share of gross non-financial income and (b) unpaid work hours, (c) Gini coefficient for net income and (d) unpaid work time. Graph (a) consider all non-financial sources of income for working age and retired individuals, namely wages, unemployment benefits, old age pensions, family and children benefits, sickness and disability pensions, as well as basic and care income according to the scenarios. The lines plot the means from 50 simulations for each scenario and the shaded areas around them their respective 95% confidence intervals.

Appendix D. The drivers of labour force participation rate

As Fig. 3 clarifies, changes in the labour market affect the labour force participation rate. Within each group of individuals (distinguished by age, gender and skill), preferences for leisure and income can be different. Each person has to choose whether to join the labour market or stay out of the labour force. We assume that the utility function depends on income and leisure. However, the expected income and leisure of a person joining the labour force would depend on the probability of finding a job, represented by the unemployment rate of the group. Thus, the expected utility function of joining the labour force is

$$U_{LF} = (uw_u + (1-u)w_e, ul_u + (1-u)l_e),$$

where u is the unemployment rate, w_u is the income of being unemployed, w_e is labour income, l_u and l_e are the leisure time of unemployed and employed respectively. The utility of staying out of labour force is

$$U_{OLF} = (w_o, l_o)$$

where w_o and l_o represent the income and the leisure time in the case of being out of the labour force. The individual will join the labour force if the expected utility of joining the labour force is bigger than the the utility of being out of the labour force, that is$U_{LF} > U_{OLF}$. Given the preference distribution within the group, we define as the labour force participation the share of individuals for whom$U_{LF} > U_{OLF}$who join the labour market.

Thus, any increase in w_u and w_e or a reduction in w_o will induce a larger share of individuals to join the labour market and an increase in the labour force participation rate, since these changes do not affect leisure. By contrast, an increase in the unemployment rate has two opposite effects, since on the one hand it decreases the expected income of joining the labour force but on the other hand it also induces an increase in the expected leisure. If the person has a strong preference for leisure, the utility of joining the labour force could increase and, in principle, U_{LF} can becomes greater than U_{OLF}, and the person could decide to move from being out to enter the labour force. However, we assume that the distribution of preferences is such that the majority of the individuals in each group will face a reduction in the expected utility U_{LF} when unemployment increases. Under this condition, any increase in the difference between the expected income of joining the labour force and the income of being out of the labour force will increase the labour force participation rate, as discussed in Section 3.2. Note that, ex-post, the individual participating in the labour market will have different utilities depending on being unemployed or employed. To evaluate the results we simply assume that within each group there is a representative agent with an utility function in the form$U = (w, l) = w^{\alpha} l^{(1-\alpha)}$. The welfare analysis provided will assess how the policy mixes, which affect income, leisure and group size, will change the utility of each group and the social welfare.

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