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Socially Sustainable Degrowth as a Social-Ecological Transformation

Work less, do less?

Working time reductions and rebound effects

Johannes Buhl[1,2] · **José Acosta**[1]

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Abstract A reduction in working hours is being considered to tackle issues associated with ecological sustainability, social equity and enhanced life satisfaction—a so-called triple dividend. With respect to an environmental dividend, the authors analyse the time use rebound effects of reducing working time. They explore how an increase in leisure time triggers a rearrangement of time and expenditure budgets, and thus the use of resources in private households. Does it hold true that time-intensive activities replace resource-intensive consumption when people have more discretionary time at their disposal? This study on environmental issues is complemented by introducing the parameters of voluntary social engagement and individual life satisfaction as potential co-benefits of rebound effects. In order to analyse the first dividend, a mixed methods approach is adopted, enabling two models of time use rebound effects to be applied. First, semi-standardised interviews reveal that environmentally ambiguous substitutions of activities occur following a reduction in working hours. Second, estimates for Germany from national surveys on time use and expenditure show composition effects of gains in leisure time and income loss. For the latter, we estimate the marginal propensity to consume and the marginal propensity to time use. The results show that time savings due to a reduction in working time trigger relevant rebound effects in terms of resource use. However, both the qualitative and quantitative findings put the rebound effects following a reduction in working time into perspective. Time use rebound effects lead to increased voluntary social engagement and greater life satisfaction, the second and third dividends.

Keywords Social acceleration · Time use · Working time · Life satisfaction · Mixed methods · Resource use

Handled by Viviana Asara, Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Spain and Research & Degrowth, Spain.

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✉ Johannes Buhl
johannes.buhl@wupperinst.org

[1] Wuppertal Institute for Climate, Environment, Energy, Wuppertal, Germany

[2] Faculty for Social Sciences, Economics and Business Administration, University of Bamberg, Bamberg, Germany

Introduction

Reducing working time is considered an essential factor in theories and models concerning degrowing economies. A significant reduction in working time is being considered to tackle issues associated with ecological sustainability, social justice and individual quality of life (Schor 2005; Jackson and Victor 2011; Coote and Franklin 2013; Kallis et al. 2013; Pullinger 2014). However, as Kallis et al. (2013: 1564) noted, advocates of working time reductions fail to take into account rebound effects ("second or third-level effects"), although this phenomenon may counteract such degrowth policies. This paper contributes to the debate on working time reductions by taking into account time use rebound effects. The main goal is, therefore, to generate a better understanding of the effects of working time reductions, as discussed in the current degrowth literature.

The comprehension of rebound effects has evolved over time. The conventional understanding of rebound effects originates from the more efficient use of a certain

technology. As soon as monetary savings occur due to efficiency gains, substitution and income effects of demand compensate for any potential savings. More comprehensively, Sorrell (2010) referred to rebound effects as "the unintended consequences of actions by households to reduce their energy consumption and/or greenhouse gas (GHG) emissions". Every action that responds to savings in resources is prone to rebound effects.

With respect to time, Greening et al. (2000: 391) noted that "…many technological advances, in addition to fuel efficiency improvement, have resulted in changes in the allocation of time. This is reflected in a change in labour force participation rates and occupational structure". Greening et al. (2000) and later Jalas (2006) classified the notion of time use rebound effects as transformational rebound effects. These transformational effects respond to changes in consumer preferences, social institutions and in the organisation of labour, e.g. a reduction in working hours. Thus, theories on time use rebound effects state that reinvested time savings may compensate for productivity gains in a similar way that monetary savings due to efficiency gains create rebound effects. It would, therefore, be important to determine to what extent a reduction in working time is prone to time use rebound effects. Either a reduction in working time managed to help people feel less time pressure, causing them to consume less resource-intensively; or gains in disposable leisure time are allocated equally resource-intensively without a change in preferences to time-intensive and low-resource practices.

In spite of rapid technological and time-saving innovations, labour productivity increases for the sake of rapid innovation cycles, expressed in work and spend cycles (see Schor 2005) by consumers. Since the various options available emerge at an increasing pace, the opportunity costs of consumer decisions increase. Consequently, the quest to reduce opportunity costs by increasing the density of actions over time accelerates lifestyles in an experience-oriented society (Rosa 2013, Schulze 2013). More generally, Linder (1970) stated that, in modern, western societies, disposable time decreases as productivity and wealth increase. Time savings become precious as (economic) life speeds up. So far, time-intensive consumption has been replaced by resource-intensive consumption. In the recent past, Watson et al. (2013, p 39f) reported that the weight of imported resources grew at the same rate as economic output in the European Union (EU-25) between 2000 and 2007, namely by 20 per cent. This rapid rise led to a 7 per cent increase in direct material input. The authors also identified the need for a behavioural change that shifts consumption and expenditure from resource-intensive products to less intensive services to reduce environmental pressures caused by consumption (Watson et al. 2013, p. 68).

In this context, the analysis of changing leisure time conducted by All et al. (2011) showed that "leisure activities are to increasing extent based on material consumption". Druckman et al. (2012) explained "that a simple transfer of time from paid work to the household may be employed in more or less carbon intensive ways". Knight et al. (2013) differentiated between a scale and a compositional effect of a reduction in working hours. They argued that a reduction in working hours may cause a scale effect that is capable of breaking a work and spend cycle and altering consumer culture. The compositional effect refers to time use rebound effects that may be triggered by a change in how households allocate their time spent and expenditure, also taking into account monetary and temporary budget constraints. The authors found that a larger number of working hours led to an increase in gross domestic product (GDP), and thus environmental degradation. Interestingly, once GDP is controlled for, it is not clear how a change in working hours affects the environment. There was no evidence that working hours contributed directly to an increase in carbon emissions, but to larger ecological footprints, drawing a quite ambivalent picture of the compositional effects of reducing working hours. In this respect, we investigate whether it holds true that significant time savings following a reduction in working hours lead to resource-intensive consumption being replaced by time-intensive, but low-resource activities—taking into account time use rebound effects.

To this end, we derive two models of time use rebound effects from the literature in the next section. In order to apply the models of time use rebound effects, we introduce a mixed methods approach, combining semi-standardised interviews with representative statistics for Germany. The third section contains a presentation of the findings gained from the semi-standardised interviews. Typical substitutions of daily practices following a voluntary reduction in working time exhibit environmentally ambiguous effects, while all respondents report an increase in life satisfaction. More strikingly, the respondents reported increased engagement in voluntary and informal work. Estimates from the stochastic analysis are presented in the fourth section. In this section, we present time use rebound effects as well as an evaluation with respect to potential voluntary engagement and an increase in life satisfaction—the second and third dividends of working time reductions. The representative analysis corroborates the findings in the qualitative exploration to a large degree. However, the dividend on life satisfaction and voluntary social engagement is less clear than in the qualitative analysis. In the fifth section, we discuss the methodological issues caused by mixing methods and data. In the final section, we summarise the findings and briefly draw conclusions

concerning the effective design of policy for reducing working time.

Method and material

There are two main approaches for estimating time use rebound effects in the literature. The first, explicitly referring to time use rebound, was provided by Jalas (2002). He focused on how the use of resources is distributed between different consumption activities besides working hours. He presumed that every consumption activity requires physical input and time. Thus, every consumption activity can be presented as a vector in a system of coordinates set by resource use and time use. Based on the research conducted by Jalas (2002, p. 118), we define a time use rebound effect as the relation between the new activity undertaken by a consumer and the activity replaced due to the reallocation of time savings following a reduction in working hours. More comprehensively, we study the effects of individual working time reductions on changes in daily practices in terms of time spent and the associated resources used. In this sense, the estimation considering time use rebound effects does not differ from conventional rebound studies on energy-efficiency rebound effects. For the latter, it is assumed that gains in energy efficiency lead to monetary savings by consumers, who then rearrange their expenditure due to income and substitution effects. Depending on the energy or greenhouse gas intensities of the new expenditure, rebound effects occur (see Sorrell 2010 for a comprehensive methodological introduction). For time use rebound effects, it is assumed that gains in (labour) productivity may just as well be translated into time savings in terms of increased discretionary and free time via a reduction in working time. Depending on the resource intensities of changing daily activities, time use rebound effects are observed (for a detailed description of resource intensities see Buhl (2014) or Supplementary Material 3 and Minx and Baiocchi (2010) for similar estimates). In this respect, Jalas (2002) offers a promising and compelling model of time use rebound effects in which rebound effects rely exclusively on a substitution of activities, disregarding income effects.

This is where the second approach for estimating time use rebound effect comes into play. In line with Knight et al. (2013), Nässén and Larsson (2015) argue that consumers take decisions about their temporal and monetary budget constraints, taking into account both time and income effects of a reduction in working hours. If there is no policy intervention of a reduction in working time that addresses wage parity, both time and income effects must be integrated. The time use rebound effect is then a composition or net effect of time gains and income loss due to a reduction in working hours. A composition effect takes into account the fact that people rearrange their time budgets and expenditure following a reduction in working hours. Nässén and Larsson (2015) conducted a marginal analysis of expenditure and time use to estimate a marginal net effect. However, both the study by Jalas (2002) and the analysis by Nässén and Larsson (2015) lack the data required to account comprehensively for time use rebound effects, i.e. they fail to address intra-individual change and implications concerning social equity and life satisfaction.

In order to apply these to promising models to time use rebound effects, we adopt a mixed methods approach. In order to apply the model of time use rebound effects proposed by Jalas (2002), we conducted 20 semi-structured interviews[1] with employees who had reduced their working hours. Only regular changes in daily social practices (see Shove et al. 2012) following a reduction in working hours were of interest.

The respondents were selected according to theoretically relevant characteristics with respect to time use in households. Finally, gender, age, years of schooling, household size, the number and age of children in households as well as the household equivalent net income and working time reductions were kept constant as appropriate, and matched between contrasting groups (see Supplementary Material 1 for a detailed description of the socio-economics of each interviewee).

The respondents recruited were divided into two groups: those who reported having a sufficient lifestyle (see Alcott 2008)[2] in at least two consumption fields (mobility, diet or housing), such as avoiding flights and car travel, following a vegetarian diet or pursuing an eco-friendly shopping behaviour; and those who do not. In other words, we first recruited interviewees for the sufficiency group by screening their daily practices concerning diet, mobility and housing, and matched a contrast group accordingly. Hence, we differentiate between two contrasting groups—the sufficiency group and a contrast group. By recruiting respondents with a sufficient lifestyle, we were able to test whether such lifestyles are equally prone to rebound

[1] The results of a semi-standardised analysis of time use effects are referred to below as qualitative.

[2] "Affluence is consumption (depletion) or emissions (pollution) per person; the sufficiency strategy attacks this affluence (A) factor, seeking to lower per capita resource consumption in hopes of thereby lowering total – or aggregate – consumption or impact (I). […] [The sufficiency strategy] is not the same as consumption efficiency, by which is meant behaviour that achieves a given level of utility with less (energy) input: e.g., boiling only the amount of water needed for the cup of coffee, switching off unneeded lights, or carpooling. […] Sufficiency, in contrast, means doing without the cup of coffee, getting by with dimmer lighting, and not taking the car. That is, assuming that 'environmental concern' is left out of the utility function, sufficiency implies lower utility or welfare." (Alcott 2008, p. 771).

effects. Alcott (2008) claimed that rebound effects due to sufficiency are certain to occur; others call for sufficiency to be promoted to avoid rebound effects (e.g. Irrek 2012).

Whereas Alcott (2008) considers rebound effects from sufficiency as a rise in demand by consumers entering the market due to lower prices as a result of a reduced demand from sufficient consumers, we think of sufficiency rebound effects in terms of abatement actions in daily life. Both Druckman et al. (2011) and Chitnis et al. (2014) reported rebound effects from abatement actions (such as reducing the indoor temperature, avoiding food waste and not travelling short distances by car) that differ little from rebound effects from efficiency. The survey of a small sample enabled us to show whether it holds true that sufficiency is equally prone to time use rebound effects as efficiency.

Restricted sampling was necessary to compare the groups and to attribute typical changes in daily activities to a reduction in working time rather than to individual or household characteristics. The same number of men and women were interviewed in each group; the number of respondents living with children in households was also identical in both groups (the median age of their children was 10 years in the sufficiency group and 6 years in the contrast group). Gender and family status are relevant to the allocation of time use, as Becker's (1965) introduction of household production functions suggested. Males and females allocate time use according to societal roles in separate spheres. Females tend to spend time doing the housework and caring for the children, whereas males tend to spend time doing maintenance work around the home.

The median age of the respondents was 40 years, with a minimum age of 30 and 18 years of schooling in both groups. The minimum and median age stems from the fact that we control for family status and the age of the respondents' children. The interviewees have a relatively high educational status because more highly qualified and flexible employees are more likely to be able to reduce their working time than less qualified workers. However, we only interviewed employees, and not the self-employed. For the latter, it seemed to be too subjective to differentiate between working time and discretionary leisure time. A median 30 per cent reduction in working time in the contrast group and 36 per cent in the sufficiency group, with a minimum reduction of 20 per cent in both groups, was sufficient to bring about regular changes in daily practices. A monthly median equivalent household net income of approximately €1600 in the sufficiency group and €1800 in the contrast group was close to the average German monthly equivalent net income of €1631 in 2013.

The analysis revealed two subgroups for which typical time use rebound effects are presented. The interviews focused on changes in time use after a reduction in working hours to compare and evaluate the effects of potential changes from shifts in time use.

The quantitative phase of the research was designed after the qualitative interviews were conducted. The quantitative analysis takes into account both typical and unexpected findings generated in the qualitative phase. The qualitative approach benefits from its flexibility and contextual insights, whereas the statistical approach offers stochastic benefits and is not limited to restrictive sampling when dealing with small samples. In principle, the quantitative approach validated, corrected and corroborated the findings obtained in the small sample approach.

Time composition effects are, therefore, analysed (Knight et al. 2013). These are estimated by a marginal analysis of the propensity to time use versus the marginal propensity to consume. Estimates of marginal propensities enable us to derive a net effect of time and income effects to estimate rebound effects following a reduction in working hours. This approach was more or less adopted from Nässén and Larsson (2015), although they fit cross-sectional regressions. However, Gershuny (2003) was right in stating that "[T]here is really only one way to see effects of change: to take repeated measures of the behaviour patterns of the same individuals. We can only ultimately identify change, by measuring changes" (Gershuny 2003). We calculate the marginal propensity to time use by applying a regression analysis of time use. Data were taken from the longitudinal German Socio-Economic Panel between 2008 and 2009 (see Table 1). The coefficients were derived from a Hausman-Taylor estimation (1981). Such an estimation fits well when benefits of fixed effects are used, while time-invariant characteristics are of interest (see Supplementary Material 4 for a comprehensive description of the estimation). Theoretically, gender is crucial from a household production theory perspective. Druckman et al. (2012) considered time use and potential time use rebound effects as a gender issue that is potentially disadvantageous to those who take care of potentially resource- and carbon-intensive reproduction activities. For this reason, we account explicitly for gender differences in the quantitative analysis. In order to derive a concise and equally differentiated picture of the substitution of expenditure, expenditure is estimated by a marginal analysis of the National Survey on Income and Expenditures in Germany for 2008. The data on resource use relies on calculations in an environmentally extended input output analysis of the total material requirements induced by the consumption of private households in Germany in 2005 (see Moll and Acosta 2006; Watson et al. 2013).

Qualitative results

In the subsections below, we present the two time use profiles (for the sufficiency group and a non-sufficiency contrast group) with each three typical shifts in time use

associated with a reduction in working hours by the respondents. We draw typical substitutions in daily activities reported by the respondents. In order to compare the effects between substitutions and across groups, the baseline of time use and associated resource use is based on average time use in Germany reported in the most recent national time use survey for 2001/2002. The dashed line represents the average resource intensity of time use. Accordingly, substituting time use below the dashed line with time use above the dashed line is associated with rebound effects above 100 per cent (i.e. a backfire, that is an overcompensation of expected savings). Vice versa, a substitution of resource-intensive activities (above average) with time-intensive activities (below average) is also prone to rebound effects, but does not lead to a backfire. Although substitutions that do not lead to a backfire exhibit a loss in relation to expected savings, they indicate savings in absolute terms. Ultimately, substitutions that exhibit rebound effects, but not a backfire are considered to be environmentally beneficial effects.

Contrast group

Respondents in the contrast group reported that the time they spent doing activities such as watching TV, listening to the radio and using the computer dropped to a relevant extent (see Fig. 1). Time was typically reallocated in favour of hobbies, sleep and rest. The figure below shows such ambiguous substitutions: respondents reported that they substituted media consumption for relatively time-intensive rest and sleep which, by nature, are relatively low-resource activities and thus accompanied by low time use rebound effects. At the same time, respondents reported that they reinvested time savings to restart, readopt and intensify a wider range of hobbies, from cultural to sport activities.[3] In sum, both effects create rebound effects, whereas a reallocation of time use from relatively low-resource media consumption (TV, radio and computer) to more resource-intensive hobbies such as motorsports, indoor sports or visits to the theatre (for a more detailed overview of the resource intensities of leisure activities, see Kotakorpi et al. 2008, p. 150) is environmentally non-beneficial.

For non-sufficient lifestyles with children in the household, time savings are exclusively re-invested to time use with the children. Some report additional time being spent for media consumption. Either way, substituting time use in favour of spending time with the children is ecologically beneficial due to the relatively minor time use rebound effects. Spending time with the children refers to time spent playing, cuddling and caring. Reproduction activities that belong exclusively to resource use involving children, such as nappy changing, are not allocated to the respondents. Time spent with children is, therefore, only associated with resource use for energy in housing and mobility. Time spent on childcare involving a provision of products exclusively for children (e.g. nappy changing) is not allocated to resource use for time with children (e.g. spending time together playing).

Sufficiency group

The same differentiation between households with and without childcare is made for sufficiency lifestyles. The question arises whether sufficiency lifestyles are equally prone to rebound effects as non-sufficiency lifestyles, as recent empirical findings suggest. Or could advocates of sufficiency, who claim that sufficient lifestyles do not trigger relevant rebound effects, be right?

Childless respondents who lead sufficient lifestyles reported different preferences on how to substitute activities following a reduction in working hours than their non-sufficient counterparts. Instead of going out or undertaking trips, they have social contacts with their friends or neighbours (see Fig. 2). Most noteworthy, voluntary engagement in organisations and clubs became more important. Voluntary engagement is allocated equally to the resource use of social contacts for two reasons: first, both work and voluntary work that are not household production do not belong to potential rebound effects. Second, respondents seek to intensify their social contacts through social engagement.

Another frequently mentioned topic is a change in dietary practices. These changes include time shifts in the amount of time people reserve for eating and drinking, as well as for preparing meals and running errands. People do not only change how they spend their time, but also the quality of their dietary practices. Ultimately, substituting restaurant services and highly efficient processed convenience food for locally grown organic produce triggers ecologically non-beneficial rebound effects. At the same time, a reallocation of time use for intensifying social contacts is associated with environmentally beneficial rebound effects. Respondents state that instead of going on trips and pursuing leisure events, they spent more time with friends, primarily in relation to voluntary engagement, and providing informal assistance, e.g. to neighbours.

A rather similar picture evolves when regarding respondents with a sufficient lifestyle who have children in their household. These respondents tend to spend more time outside with their children on bikes, in parks and on playgrounds. Reallocating time use from trips, going out

[3] Both are equally associated with relatively high resource use, as differentiated life cycle assessments of activities show (see Kotakorpi et al. 2008).

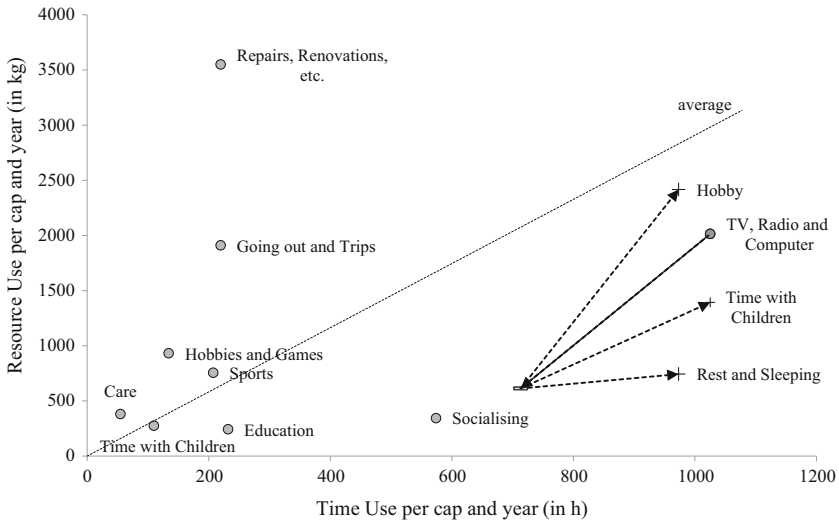

Fig. 1 Profile of typical time use rebound effects for the contrast group. Data: National Survey on Time Use 2001/2002 for Germany, Acosta and Schütz for Watson et al. (2013), own calculations

and doing sports to time spent with the children is ecologically beneficial.

Time reallocations in the two subgroups exhibit typical time use rebound effects following a reduction in working hours. The profiles resulting from an application of the model of time use rebound effects by Jalas (2002) depict a concise picture of typical substitutions of practices. Substitutions associated with rebound effects are identified in all subgroups.

Ultimately, the hypothesis that sufficiency lifestyles are immune to rebound effects cannot be supported. All changes in everyday practices undertaken by people who lead sufficient lifestyles are accompanied by rebound effects. Nevertheless, sufficiency respondents report that they lead a more active and even more deliberate lifestyle involving voluntary work, education and changing their dietary practices. It must therefore be concluded that rebound effects create "co-benefits" (Hertwich 2005) with regard to voluntary engagement compared to statements by the contrast group. In sum, the typical rebound effects, as depicted, do not differ between the contrasting groups to a relevant extent. Altogether, the respondents exhibit substitutions consisting of time use rebound effects from 9 to 129 per cent in the contrast group and from 14 to 75 per cent in the sufficiency group.

Nonetheless, the implications of a change in practices must be taken into account with respect to social engagement and an increase in life satisfaction. All respondents reported an increase in life satisfaction due to the reduction in working hours. Discretionary time and a "time composition effect" were evaluated positively (see Knabe et al. 2010). The new composition of time use following a reduction in working time was evaluated positively, disregarding environmental implications. Intensified social

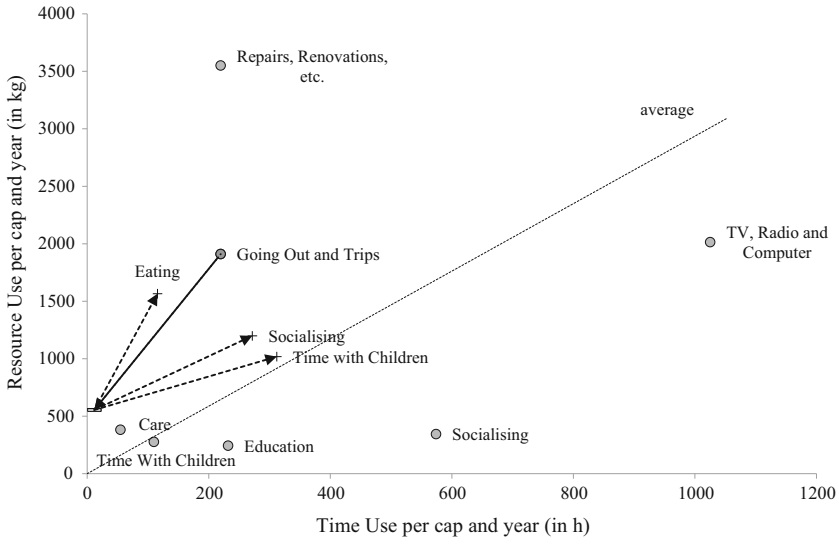

Fig. 2 Profile of typical time use rebound effects for the sufficiency group. Data: National Survey on Time Use 2001/2002 for Germany, Acosta and Schütz for Watson et al. (2013), own calculations

relationships and a less stressful daily life due to less hectic daily schedules were seen in a positive light. The negative associations included risks to occupational status and potential financial insecurities with respect to social security. The respondents reported that German workfare is designed for full-time employment. Part–time employees may be at risk when it comes to retirement and pensions. Moreover, any decision to reduce working hours is associated with a loss in recognition and approval among colleagues at the workplace as well as friends, possibly endangering social capital and status.

Quantitative results

The qualitative approach revealed substitutions associated with relevant rebound effects and, in some, non-typical observations that overcompensated for the initial savings. However, substitutions are made in favour of discretionary and social time associated with increases in life satisfaction and increased social engagement. The findings generated from the small sample are investigated further in representative surveys. First, the effect of a change in working hours on the allocation of time use is analysed (time effects). Second, the effect of a change in working hours on income and consumption patterns is analysed (income effects). Both time and income effects are then integrated in order to derive the net effect. The net effect of time and income effects constitutes the time use rebound effect in the stochastic analysis. Finally, the quantitative study also involves analysing potential co-benefits in terms of life satisfaction and voluntary work.

Time effects

The coefficients in Table 1 below show the marginal propensity for spending time in 8 time use categories depending on working hours and socio-economic covariates that improve the fit of the model. All of the models derived demonstrate negatively correlated and highly significant effects of working hours on the time use categories. This result supports the predicted relationship between working hours and time use. A marginal increase in working hours leads to a reduction in leisure time, suggesting a potential for time use rebound effects. Free time following a reduction in working hours is reinvested in the major time use categories. The greatest effects of reallocation are visible in hobbies and child care, followed by housework, educational activities and sleep. A higher household net income leads to a reduction in time spent on child care and repairs, suggesting that higher income levels tend to outsource these household services. Once again, family status has a major influence. In particular, if children are still living in households, the parents have less time for hobbies and leisure activities, but more time for household production, such as household chores and child care. Gender exhibits

Table 1 Marginal propensity to time use in Germany from 2008 to 2009

	Sleep	Hobbies	Housework	Errands	Childcare	Repairs etc.	Education	In care
Job	−0.052***	−0.131***	−0.078***	−0.012***	−0.105***	−0.019***	−0.066***	−0.013***
	(0.004)	(0.006)	(0.004)	(0.003)	(0.008)	(0.004)	(0.004)	(0.002)
Household net income	−0.000	0.000	−0.000	−0.000	−0.000*	−0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household size	0.013	−0.096**	0.007	−0.004	0.078	0.064**	−0.029	0.029
	(0.028)	(0.042)	(0.026)	(0.020)	(0.054)	(0.025)	(0.021)	(0.018)
With partner in household	−0.074	−0.423***	0.008	−0.000	0.174	0.001	−0.082	−0.038
	(0.070)	(0.104)	(0.066)	(0.051)	(0.136)	(0.062)	(0.053)	(0.044)
Children under 16 in household	−0.062	−0.216***	0.104**	−0.012	1.306***	0.018	−0.166***	−0.022
	(0.054)	(0.082)	(0.052)	(0.040)	(0.108)	(0.049)	(0.043)	(0.035)
Schooling (in years)	0.039	0.087*	−0.124***	−0.059***	−0.028	0.021	−0.505***	−0.005
	(0.027)	(0.047)	(0.027)	(0.019)	(0.057)	(0.024)	(0.026)	(0.017)
Year of birth	0.001	−0.006	−0.012***	0.001	−0.040***	−0.029***	0.057***	−0.003
	(0.004)	(0.007)	(0.004)	(0.003)	(0.011)	(0.004)	(0.006)	(0.003)
Male	−0.073***	0.303***	−0.890***	−0.139***	−0.695***	0.372***	0.105**	−0.031**
	(0.024)	(0.034)	(0.020)	(0.015)	(0.056)	(0.020)	(0.045)	(0.014)
n	16,590	16,590	16,590	16,590	16,590	16,590	16,590	16,590

Hausman–Taylor estimates, constant suppressed, standard errors in parentheses

Data: German Socio-Economic Panel v29 (waves 2008 and 2009)

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

highly significant effects in all of the time use categories, suggesting a major influence of gender on time use patterns. Females spend more time on household production such as errands, household chores and child care, whereas males spend more time on leisure, doing repairs and pursuing hobbies. This finding is consistent with Druckman et al. (2012), who reported significant differences in resource implications between men and women.

As the qualitative insights indicate, time savings following a reduction in working time are diversely re-invested in leisure activities. It makes sense to take a closer look at the kind of hobbies for which time is spent. People spend more time with their friends and neighbours, followed by time spent for media, TV, radio and going out, eating and sports. It is worth mentioning that spending more time on hobbies does not lead to more trips being undertaken or family and relatives being visited more often (for a detailed presentation of effects, see Supplementary Material 2).[4]

Income effects

According to both Nässén and Larsson (2015) and Knight et al. (2013), account has to be taken not only of potential time effects, but also of potential income effects following a reduction in working time. The assumption that a reduction in working time only results in a reallocation of time use does not hold true when the reduction in working time is accompanied by a loss of income. More realistically, a relevant and voluntary reduction in working time is associated with income loss, which potentially alters the consumption patterns of such households. Households reallocate both monetary and temporal savings. Income and time effects are most probably correlated, i.e. the change in income affects the way time is spent. In our analysis of time effects, we control for income effects, meaning that a change in time use refers exclusively to a change in working hours, and explicitly not to an associated change in income. However, we do not know exactly how consumption patterns change due to a change in income.

The cross-sectional analysis shows that a marginal rise in income is associated with greater expenditure in all consumption categories along the internationally harmonised Classification of Individual Consumption by Purpose (COICOP) (see Table 2). Most income gains are spent on transport goods and services, followed by consumption in leisure, culture and entertainment.

[4] The coefficients help us to differentiate and deal with the heterogeneous leisure activities of respondents. Since no time units are given for differentiated leisure activities, the coefficients serve as differentiating weights for the resource implications of changes in time use for hobbies when calculating marginal time use rebound effects.

Table 2 Marginal propensity to consume along COICOP in Germany for 2008

	Food	Housing etc.	Transport	Clothing	Furnishing etc.	Health	Communication	Education	Recreation and culture	Restaurants and hotels	Miscellaneous
Disposable income	0.030***	0.125***	0.425***	0.036***	0.081***	0.074***	0.008***	0.006***	0.120***	0.048***	0.039***
	(41.23)	(36.17)	(40.18)	(40.85)	(19.50)	(24.51)	(36.62)	(8.89)	(24.99)	(39.65)	(22.61)
Household size	247.155***	239.581***	−422.542***	54.413***	−44.987***	−93.651***	26.828***	41.977***	−23.680***	−30.010***	−1.729
	(118.19)	(36.34)	(23.11)	(27.30)	(5.81)	(16.34)	(39.57)	(27.52)	(2.77)	(10.93)	(0.49)
Schooling	−3.189***	16.069***	−21.346***	7.011***	−3.644***	−18.644***	9.092***	1.973***	0.870	7.887***	2.017***
	(7.15)	(12.35)	(8.06)	(16.73)	(2.96)	(16.48)	(54.79)	(5.70)	(0.65)	(13.27)	(3.06)
Age	3.451***	12.401***	−15.758***	−1.779***	−1.242***	4.312***	−0.525***	−1.624***	0.767***	−0.928***	0.562***
	(38.67)	(48.40)	(29.90)	(21.65)	(5.54)	(20.75)	(17.24)	(27.06)	(3.11)	(7.46)	(3.84)
Male	34.128***	70.001***	−147.478***	−24.972***	−15.950*	14.499*	−4.292***	−14.347***	−0.910	91.386***	−28.838***
	(9.35)	(6.57)	(7.40)	(7.35)	(1.88)	(1.85)	(3.21)	(5.78)	(0.08)	(19.44)	(5.56)
R^2	0.89	0.87	0.58	0.63	0.28	0.25	0.76	0.15	0.56	0.49	0.38
n	44,088	44,088	44,088	44,088	44,088	44,088	44,088	44,088	44,088	44,088	44,088

OLS estimator, robust standard errors in parentheses

Data: National Survey on Income and Expenditures 2008

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

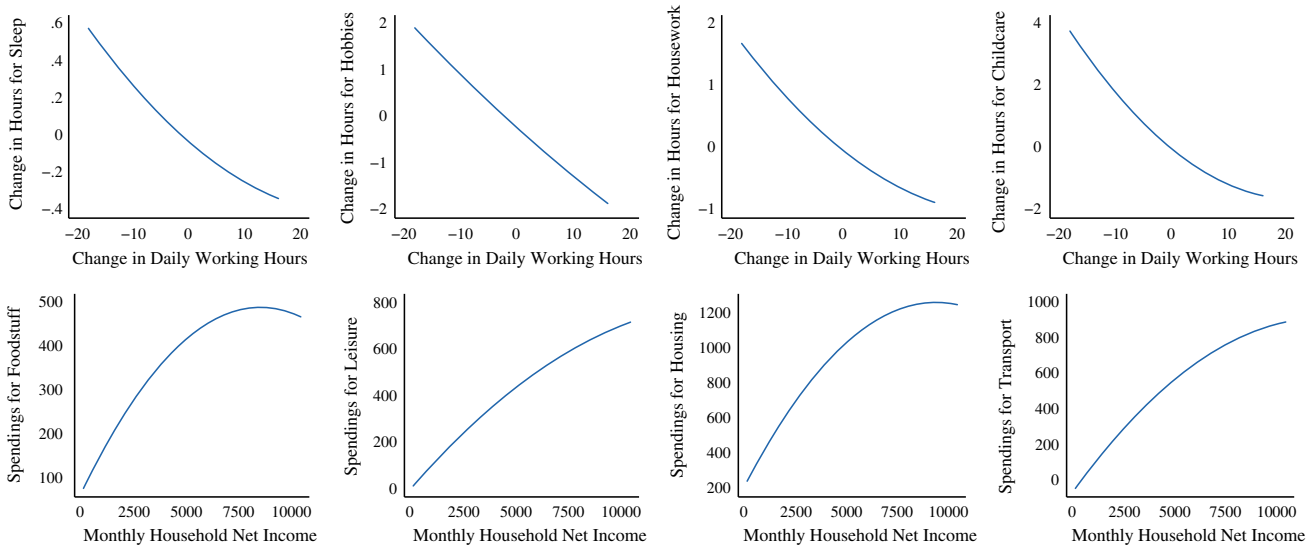

Fig. 3 Selection of predictions of the marginal propensity to time use (*top row*) and the marginal propensity to consume (*bottom row*). Note: Quadratic prediction plots without confidence intervals. Data: German Socio-Economic Panel v29, National Survey on Income and Expenditures 2008

Time use rebound effect or the first dividend

The net effect of time savings and income loss following a reduction in working hours constitutes the rebound effect. The bottom row in Fig. 3 shows Engel curves, presenting the relationship between a consumer's income and the goods bought. The slope of the Engel curve at any point is known as the marginal propensity to consume; for a marginal change in income, it measures the ratio of the resulting change in consumption. The very same is calculated for a change in daily working hours (see top row in Fig. 3). Based on the concept of Engel curves and the corresponding marginal propensity to consume, we call the effect of a marginal change in working hours on time use the marginal propensity to time use. We assume that a reduction in working hours leads to a proportional drop in income. The drop in income then suggests a drop in expenditure. In contrast, a reduction in working hours leads to an increase in time use. Basically, a marginal decrease in the propensity to consume due to a loss of income is then balanced out by a marginal increase in the propensity to time use due to time savings.

Finally, we add the triggered resource use of the marginal propensity to consume to the triggered resource use of the marginal propensity to time use. A marginal increase in time use due to a marginal decrease in working hours is responsible for a rise of 1.37 kilogrammes of resources used per hour. A marginal decrease in expenditure due to a marginal decrease in working hours is responsible for a decrease of 1.67 kg/€. In relative terms, this equals a marginal increase of 0.48 of resource use in relation to average time shares and a marginal reduction of 0.80 of resource use in relation to average expenditure shares. In other words, a marginal reduction in working hours is accompanied by a rebound effect of 59 per cent, which is in line with the substitutions determined in the application of Jalas (2002) model of time use rebound effects. Ultimately, a reduction in working hours is associated with environmentally beneficial compositional effects, i.e. no backfire.

Life satisfaction or the second dividend

The qualitative analysis alone showed that reinvesting time resources may lead to a significant increase in life satisfaction beyond ecological implications. As discussed above, respondents highlighted the positive effects of discretionary time that can be reallocated freely according to time use preferences. On the other hand, a loss of income and social status is evaluated negatively.

We hypothesise that a reduction in working hours leads to greater life satisfaction. We analysed data from the German Socio-Economic Panel, now spanning 1992–2012. The study applies the concept of overall life satisfaction. Respondents ranked their overall life satisfaction on an 11-point bipolar scale from completely dissatisfied (0) to completely satisfied (10). Figure 4 shows that a reduction in contracted and actual working hours is not related to greater life satisfaction. Leaving aside the insignificant effect of increasing implausible daily working hours of 10 h and above, the figure shows a decrease in life satisfaction for contracted working hours below full-time employment and a rather non-linear decrease in actual working hours below full-time employment.

The same applies when focusing on a higher resolution of changes between 2008 and 2009, comparable to the estimation of time use rebound effects (see Fig. 5). Accounting for potential non-linear effects, a reduction in reported working hours, i.e. a negative change in working hours, is not associated with greater life satisfaction for the whole sample (a), nor for a high reduction of 3 h or more daily (29 per cent quantile in b) or 1 and 2 h daily (71 per cent quantile in c).

The multivariate analysis supports the finding that a reduction in working hours is not correlated with greater life satisfaction *per se*. We test the hypothesis by estimating pooled ordinary least squares (OLS), random and fixed effects of life satisfaction regressed on time use. Relevant covariates concerning life satisfaction are controlled. Mainly subjective health and satisfaction concerning work, leisure and family life as well as income and other relevant socio-demographics (e.g. age and schooling) are introduced as covariates. We concentrate on the results of the fixed effects estimation [see Table 3, model (3)]. The multivariate analysis supports the bivariate predictions and recent rather explorative research on Canadian downshifters, who reported no significant effect on subjective well-being (Kennedy et al. 2013). Being at work is likely to be associated with social and occupational status. So far, a so-called "reverse social multiplier effect" (see Kallis et al. 2013) encourages people to stay in work rather than to pursue life satisfaction in unpaid leisure. A more differentiated look at the results reveals that expected satisfaction with family and health is positively correlated with overall life satisfaction. More strikingly, working hours show a robust influence throughout the models, even when controlling for satisfaction with work. In contrast, satisfaction with leisure is mediated through time for leisure, as the changing significance of random and fixed effects shows.

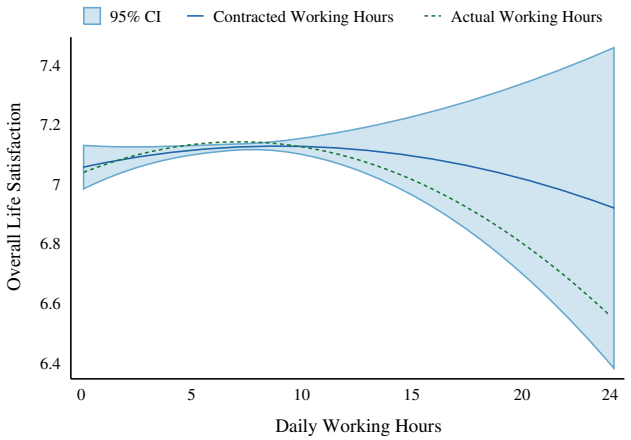

Fig. 4 Bivariate prediction of working hours (actual and contracted) on life satisfaction between 1992 and 2012. Data: German Socio-Economic Panel v29

Spending time at work and pursuing hobbies is significantly related to increases in life satisfaction. The results suggest that life satisfaction is dependent on the "smart" allocation of working and leisure hours, i.e. a reduction in working hours is only favourable until a particular threshold is reached. This is in line with recent research in happiness economics (see Layard 2005 for a general overview). Dunn and Norton (2013) argue that an increase in income does not *per se* contribute to life satisfaction, but rather depends on how the money gained is spent. The same line of argumentation may hold true for gains in free time. The relationship between working hours and life satisfaction is usually analysed without taking into account how the freed up time is spent. The findings suggest that time may be reallocated to more favourable activities than working hours such that time composition benefits (according to Knabe et al. 2010) take effect.

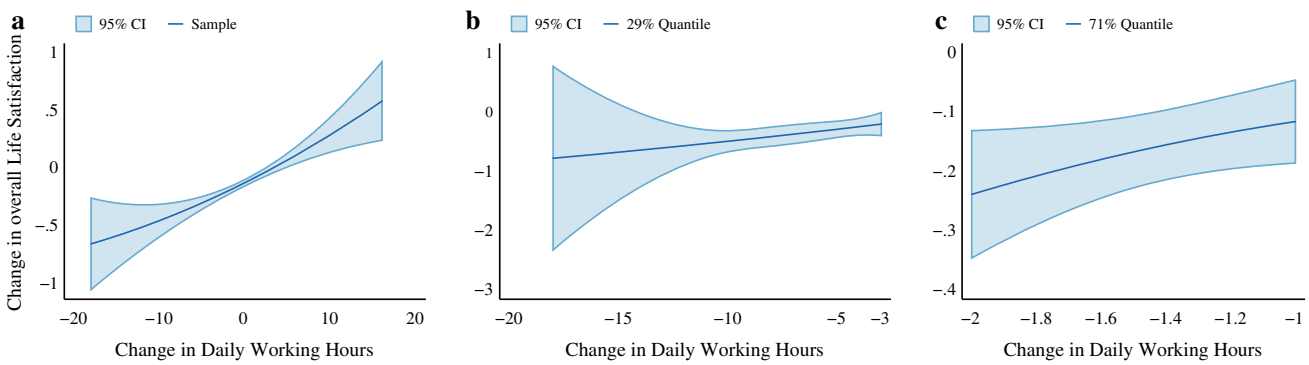

Fig. 5 Bivariate prediction of changing working hours on life satisfaction between 2008 and 2009. Data: German Socio-Economic Panel v29

Table 3 Pooled OLS, random and fixed effects regression of life satisfaction on time use

	(1) Life satisfaction	(2) Life satisfaction	(3) Life satisfaction
Job	0.017***	0.016***	0.018*
	(0.005)	(0.005)	(0.010)
Sleep	0.046***	0.051***	0.044**
	(0.011)	(0.010)	(0.018)
Hobbies	−0.016**	−0.009	0.022*
	(0.008)	(0.007)	(0.013)
Housework	0.019	0.013	−0.004
	(0.012)	(0.012)	(0.019)
Errands	−0.056***	−0.058***	−0.056**
	(0.017)	(0.017)	(0.025)
Childcare	0.003	0.002	−0.008
	(0.004)	(0.004)	(0.010)
Repairs etc.	0.007	0.010	0.035*
	(0.014)	(0.013)	(0.021)
Education	0.027**	0.025**	0.005
	(0.012)	(0.012)	(0.022)
In care	0.001	0.012	0.083***
	(0.018)	(0.016)	(0.028)
Vountary Work	0.004	0.048	−0.027
	(0.151)	(0.157)	(0.575)
Satisfaction work	0.188***	0.179***	0.123***
	(0.007)	(0.006)	(0.009)
Satisfaction leisure	0.081***	0.075***	0.031***
	(0.006)	(0.006)	(0.009)
Satisfaction health	0.220***	0.207***	0.118***
	(0.007)	(0.006)	(0.010)
Satisfaction family	0.224***	0.214***	0.145***
	(0.008)	(0.006)	(0.010)
Household net income	0.000***	0.000***	0.000
	(0.000)	(0.000)	(0.000)
Schooling	0.008**	0.010**	−0.063
	(0.004)	(0.005)	(0.065)
R^2	0.44	0.41	0.12
n	15,742	15,742	15,742

Constant suppressed, (robust) standard errors in parentheses. (1) Pooled OLS, (2) random effects, (3) fixed effects (R^2 within). Controlled for leisure activities and socio-demographics, not shown (see Supplementary Material 2 for full model runs)

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Social engagement or the third dividend

A reduction in working hours potentially provides enhanced social equity by first, re-distributing working hours between the overworked and the unemployed and second, by promoting voluntary work and social engagement (see Pullinger 2014). We concentrate on the second hypothesis that time use following a reduction in working time may be substituted by voluntary and informal work. Sociological theory on voluntary work suggests that people who apply to do voluntary work not only have the time and income resources that allow them to invest time in voluntary work, they also have the social and cultural capital required to enable them to assume honorary offices (Wilson and Musick 1997).

A bivariate prediction suggests an increase in voluntary work caused by a reduction in reported working time, which is a negative change in daily working hours (see Fig. 6). The sample (a) shows a significant increase in weekly voluntary work. However, an analysis of the data

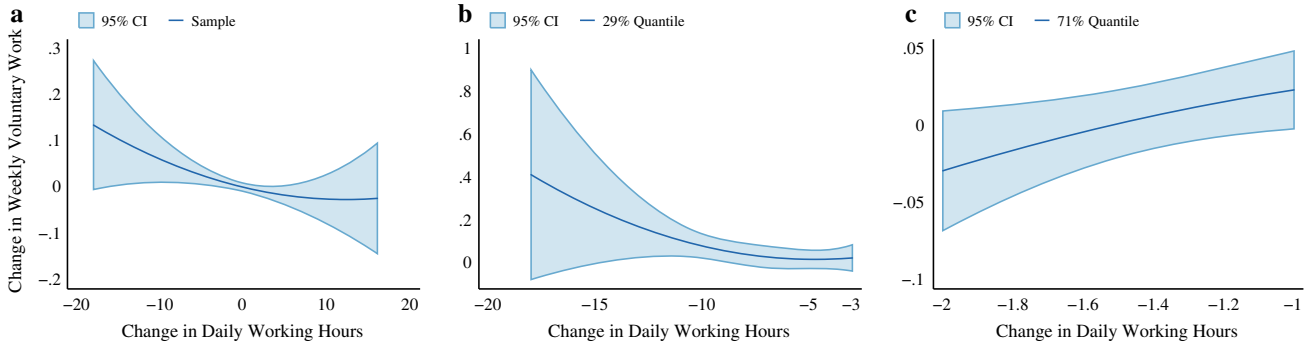

Fig. 6 Bivariate prediction of a change in weekly voluntary work from changing working hours in Germany between 2008 and 2009. Data: German Socio-Economic Panel v29

suggests that an increase in voluntary work is marginal and is probably not associated with a relatively low yet common reduction in working hours of 1–2 h a day (71 per cent quantile in c), but a reduction in working hours of 3 to about 10 h (29 per cent quantile in b).

The multivariate analysis supports this bivariate finding. The table provides odds ratios of a logistic regression of time use on weekly voluntary work in the short run (between 2008 and 2009). When we take into consideration the results of the random effects estimation, a reduction of one working hour leads to a slight increase (approximately 8 per cent) in the propensity to engage in regular voluntary work (see Table 4).

A rather ambivalent picture evolves when taking into account the fixed effects model, which yields an insignificant chance to increase voluntary work when working hours are increased, but a robust increase in the chance to perform weekly voluntary work when leisure time increases. However, the interpretation of fixed effects is limited due to the slight increase in voluntary work, leading to high standard errors and insignificant effects due to missing within-variance between years.

The positive correlation of the performance of cultural work supports the cultural capital hypothesis as well as the positive effect of income and schooling. If social capital is proxied by household size and family status, it holds true that voluntary engagement is supported by social capital. More importantly, we do not support the assumption that an increase in voluntary work crowds out informal help. This corroborates the findings from the qualitative study. A reduction in working hours leads to an increase in voluntary work and informal help at the same time.

Discussion

A comprehensive analysis across dimensions naturally involves compromises and limitations. In order to integrate income and time effects, we had to rely on different data sets. In order to introduce leisure activities such as voluntary work in the stochastic analysis, we had to deal with different types of information, from ordinal to cardinal data. Leisure activities are only differentiated by frequency, not by time use. The analysis of time use is again restricted to 9 aggregated time use categories. Data on resource use are restricted to 12 main consumption categories along COICOP. For future research, consistent resource use and time use data with differentiated information, particularly about leisure activities, should be favoured. Furthermore, the estimation of the marginal propensity to consume relied on a cross-sectional analysis. However, a panel analysis would result in more efficient estimates of income effects, and event history data would yield more accurate results of the effects of a reduction in working time on time budget reallocations. Moreover, the identification of resource intensities is static. In the wake of relevant shifts in time use patterns, a dynamic identification of the relationship between resource use and time use to corresponding intensities would result in an appropriate dynamic interpretation of time use shifts. Changing time use for practices that merely rely on durables (such as outdoor sports) is unlikely to exhibit a proportional increase in resource use.

It is worth mentioning that the time composition effect does not take into account the overall scale effect of work-time reductions as a policy. A comprehensive reduction in working time may affect overall production and resource use in addition to domestic consumption. Knight et al. (2013) argue that a combination of scale and composition effects may result in more beneficial effects of reduced working hours. Considering this, the comparison of the effects of reduced working hours on life satisfaction in the qualitative and quantitative analysis is limited. Whereas the semi-standardised interviews revealed evaluations of a voluntary reduction in working time, we did not differentiate between a voluntary and forced reduction in working hours, e.g. as a result of a corporate policy dealing with demand shocks, in the quantitative analysis. As a result, we assumed mixed

Table 4 Logistic regression of weekly voluntary work on time use

	(1) Voluntary work	(2) Voluntary work	(3) Voluntary work
Job	0.947***	0.916***	1.019
	(0.011)	(0.023)	(0.051)
Sleep	0.919***	0.885**	0.897
	(0.024)	(0.051)	(0.099)
Hobbies	1.074***	1.153***	1.118*
	(0.017)	(0.044)	(0.071)
Housework	0.995	1.025	1.041
	(0.031)	(0.064)	(0.113)
Errands	0.971	0.981	1.003
	(0.042)	(0.088)	(0.150)
Childcare	0.988	0.973	0.995
	(0.013)	(0.029)	(0.070)
Repairs etc.	1.135***	1.216***	1.030
	(0.034)	(0.082)	(0.109)
Education	1.080***	1.138**	0.950
	(0.026)	(0.064)	(0.104)
In care	1.064**	1.157*	1.519*
	(0.033)	(0.097)	(0.361)
Attend concerts, cinema, etc.	1.616***	2.030***	1.120
	(0.065)	(0.174)	(0.142)
Subjective health	0.930**	0.885*	1.008
	(0.030)	(0.061)	(0.122)
Household size	1.115***	1.265***	0.994
	(0.031)	(0.086)	(0.296)
With partner in household	1.277***	1.503**	0.360
	(0.086)	(0.256)	(0.331)
Children under 16 in household	0.992	0.998	2.188
	(0.078)	(0.183)	(1.157)
Household net income	1.000***	1.000***	1.000
	(0.000)	(0.000)	(0.000)
Schooling	1.012	1.063**	0.456
	(0.010)	(0.026)	(0.304)
Year of birth	1.319	0.318	
	(0.884)	(0.500)	
Male	1.928***	3.631***	
	(0.129)	(0.601)	
n	16,572	16,572	1,002

Odds ratios, constant suppressed, (robust) standard errors in parentheses. (1) Pooled OLS, (2) random effects, (3) fixed effects

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

motives for reducing working hours in the quantitative sample. Likewise, we encountered mixed motives for reducing working hours in the qualitative sample. Respondents reduced their working hours on an individual and voluntary basis, but simultaneously for the sake of their children or health. We considered mixed motives for reducing working time in the qualitative sample by ensuring that respondents differ in motivation for their voluntary reduction to compare the findings. For the analysis of rebound effects, a differentiation of motives is not essential. Working less in favour of the environment is, therefore, not a condition for analysing rebound effects after a reduction in working time. People opt to reduce their working time to gain leisure time, just as consumers opt for energy-efficient

(product) solutions to save money. However, an interesting strand of future research would be to differentiate rebound effects according to motives. Ultimately, the findings fail to fully provide a deeper understanding of working time reduction as an extensive policy. The findings rely on individual and rather voluntary reductions in working hours that can be observed empirically.

Moreover, we assumed a proportional drop in income due to the reduction in working hours. In a progressive wage taxation system, a reduction in working hours would reduce income loss disproportionally. Considering the shortcomings, our analysis slightly overestimates the magnitude of time use rebound effects. Nevertheless, the analysis suggests that time use rebound needs to be taken into account when evaluating environmentally driven policies involving a change in the working hours regime.

Summary and conclusions

In our study, we analysed the widely promoted benefits of reducing working time in terms of environmental, social and life satisfaction aspects. The literature on working hours within the scope of degrowth policies suggests reducing working hours to tackle environmentally unfriendly consumption patterns and job-related stress and to achieve a satisfactory work-life balance. Hence a reduction in working hours would enhance social equity by redistributing working hours to informal and voluntary social engagement. We opted to analyse micro data from semi-standardised interviews and national surveys on income, expenditure and time use to test for such a triple dividend of working time reduction. An analysis of micro data is suitable for comprehensively understanding potential substitutions of daily practices and activities following a reduction in working hours while considering individual life satisfaction in institutional contexts.

In our paper, we primarily analysed whether it holds true that a reduction in working hours leads to more low-resource activities and practices in everyday life by applying two models of time use rebound effects. It is assumed that a gain in free time fosters a change in consumption patterns towards more time-intensive but low-resource activities.

The first semi-standardised survey involved applying the model of time use rebound effects proposed by Jalas (2002) as transformational effects. This model facilitates the observation of substitutions of activities by vectors depending on physical and temporal input. The sample was clustered into two contrasting groups. Sufficiency lifestyles and a contrast group were equally matched with regard to gender and family status, whilst other relevant socio-economic characteristics such as age, education and income were kept more or less constant. In general, the analysis showed that a reduction in working hours leads to more informal, voluntary work and care. In addition to time for child care, the respondents reported shifts in time use from media consumption, going out and short trips to intensifying social contacts and social relationships. The respondents typically described greater social engagement, not only on an informal basis in neighbourhoods and with friends, but also in a more organised way in honorary offices and clubs. However, taking leisure substitutions into account, the substitutions are in sum rather ambiguous from an environmental point of view. Substitutions in favour of resource-intensive hobbies and sports may lead to relevant time use rebound effects in terms of the use of resources. Both groups, which contrasted in terms of lifestyle, are prone to time use rebound effects. Nonetheless, in spite of non-trivial rebound effects, substitutions typically result in environmentally beneficial net effects due to reduced working hours. Generally, respondents do not report of any substitutions of time use that overcompensate for savings in resource consumption.

Disregarding environmental implications, all of the respondents reported a gain in life satisfaction in spite of a potential loss of income, occupational and social status. The respondents reported severe shortcomings in terms of income, careers and social standing among friends due to a voluntary reduction in working time.

In this respect, the aim of the quantitative study was to account for both time and income effects. A marginal estimation of the propensity to time use and to consume supports the findings that time effects may compensate for income effects to a relevant extent due to a reduction in working hours. The composition effect reveals relevant time use rebound effects. Time use is reallocated in favour of caring activities and household production, supporting the qualitative finding that hours of paid work were substituted by informal work. In addition, the representative analysis revealed that a reduction in working hours does indeed lead to an increase in social engagement. The propensity to perform voluntary work on a regular, weekly basis increases slightly in the short run. The qualitative findings are principally supported by the analysis of representative data from national surveys on time use, income and expenditure with regard to time use rebound effects and voluntary social engagement.

Last but not least, the analysis of the effects of time use on life satisfaction showed that a reduction in working hours does not correlate with greater life satisfaction *per se*. Rather, the findings support the reported barriers of a reduction in working hours in the qualitative study. Nonetheless, full-time employment provides social recognition and status, whereas part-time work leads to a loss of economic and symbolic capital, i.e. a loss of income and occupational status. However, the effects suggested that a

smart recomposition of time use may be associated with greater life satisfaction.

Overall, the analysis showed that the environmental implications are not as clearly beneficial as expected when time use rebound effects are taken into consideration. The analysis revealed environmentally ambiguous effects due to time use rebound effects. Increases in free time following a reduction in working hours do not necessarily lead to sufficient environmental relief. Shifts in time use are still associated with resource-intensive consumption patterns. It should, therefore, be debated whether policies that aim to price leisure activities and consumption goods according to their resource intensity should assist policies on reduced working hours (see Kallis et al. 2013, p 1560).

Nevertheless, the analysis shows that a reduction in working time could have positive effects on the environment. More time is typically spent pursuing leisure activities and, more strikingly, in favour of informal work and social engagement, which is indeed associated with a triple dividend—low-resource, socially beneficial and individually satisfying activities. Working hours are substituted for voluntary work and care activities, intensified social contacts and social engagement in favour of strengthening community practices. The co-benefits of rebound effects are an increase in life satisfaction since people have more time for their hobbies and leisure activities. More importantly, a reduction in working hours results in increasing voluntary engagement. In this regard, the paper found evidence suggesting that it led to a more "amateur economy" (Nørgård 2013). Time use rebound effects show that even amateurs are unlikely to live idly.

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