WORKING PAPER

COST-SHIFTING VERSUS “FULL” ACCOUNTABILITY: DEALING WITH CROSS-TIME AND CROSS-BOUNDARY ISSUES IN THE ISEW AND GPI. AN APPLICATION TO BELGIUM.

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August 2020
2020/1003

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Cost-shifting Versus "Full" Accountability: Dealing with Cross-time and Cross-boundary Issues in the ISEW and GPI. An application to Belgium.

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Highlights

Two types of welfare measures are compiled with distinct time and boundary choices.

Contrary to narrow welfare, broad welfare includes physical capital changes.

Moreover, broad welfare includes the ecological costs shifted in time and space.

The broad welfare view illustrates there is substantial ecological cost-shifting.

Welfare improved over time, however, social and ecological conditions worsened.

Abstract

Scholars have long had difficulties when dealing with cross-time and cross-boundary issues in the ISEW and GPI. To date there are, for instance, different views on how to account for impacts of climate change that are shifted in time and space. This paper addresses the complexity involved by calculating two types of welfare measures with distinct time and boundary views for Belgium. Experiential welfare looks at what is currently experienced within domestic borders, whereas the benefits and costs of present activities also include the impacts that are shifted in time and space. The former only registers present ecological costs within borders and does not include capital changes, while the latter includes capital changes and ecological cost-shifting. Both welfare indicators improved from 1995 to 2018. Yet, social costs and ecological cost-shifting increased while aggregate welfare improved. Therefore, we suggest to account for ecological cost-shifting, but also to look beyond the aggregate welfare level and adopt a disaggregated and dashboard-like approach to evaluate economic performance in detail and to successfully debunk GDP and its growth. In future studies, a careful reflection on welfare measures' design and use is needed in order to stimulate their policy-guiding and transformative potential.

Keywords: Index of Sustainable Economic Welfare (ISEW); Genuine Progress Indicator (GPI); cost-shifting; Fisherian income; Hicksian income; beyond GDP.

1. Introduction

Stimulating GDP growth is a dominant policy goal today. Promoting sustained inclusive and sustainable economic growth is, for instance, part of the United Nation's Sustainable Development Goals (SDGs). SDG8 is about "Decent Work and Economic Growth". The fact that 'inclusive' and 'sustainable' are put in front of economic growth indicates that such growth is not always desirable. A narrow focus on economic growth overlooks that this growth, or put more generally economic activities, brings benefits and costs that may be distributed unevenly, both between current and future generations and within and between regions (now and in the future). Therefore, pursuing economic growth at all costs is counterproductive and undesirable when it comes with increasing social and ecological costs. Recent scientific evidence indicates that the costs of economic growth are substantial. Human action is causing the sixth mass extinction, which is a threat that one million species are already facing today (IPBES, 2019), whereas climate tipping points pose an increasing threat of rapid and irreversible changes in the climate system (Lenton et al., 2019) that would lead to a "Hothouse Earth" in which ecosystems, societies and economies are likely to be severely disrupted (Steffen et al., 2018). The Paris Agreement aims to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change".

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Dominant strategies to achieve Paris goals rely on green growth: i.e. absolutely decoupling carbon emissions from economic growth. Yet, this green growth strategy is risky, since it is unlikely that such absolute decoupling will happen fast enough to limit climate change to 1.5°C or 2°C (Hickel and Kallis, 2019). Alternatives to green growth are needed as it is unrealistic that further economic growth can be realized without increasing environmental pressures (Parrique et al., 2019). Furthermore, green growth may be undesirable – a recent ecological macro-economic model has illustrated that the green growth strategy results in increasing unemployment, while there are alternatives that perform better on jointly addressing climate change and inequality (D'Alessandro et al., 2020). Therefore, it is needed to move beyond green growth and target sustainability and equity directly (O'Neill, 2020). Abandoning GDP growth would also bring coherence in the SDGs as continuous GDP increases will hamper goals to reduce inequality and environmental goals (Coscieme et al., 2020). After decades of economic growth, a post-growth consensus is emerging: the OECD (2019), degrowth movement (Demaria et al., 2013) and 11.000 scientists (Ripple et al., 2019) have articulated the need to prioritize well-being, equity and sustainability. One way to stimulate these different economic goals is by designing economies to manage and prosper without growth (Jackson, 2017; Victor, 2019).

We need to reconsider the role of GDP and its (green) growth because increasing GDP is not equal to enhancing citizen's welfare. Daly and Cobb (1989) developed the Index of Sustainable Economic Welfare (ISEW) as an empirical exercise to expose GDP's many welfare deficiencies by making visible elements that remain hidden from a narrow GDP lens such as unpaid work, and the social and ecological sphere. Daly and Cobb (2007) thought a conservatively estimated ISEW, which would no longer be correlated with GDP, would be a useful tool to dethrone GDP as a guide to policy-making. Today, however, GDP and its growth are still dominant in policy-making and economics despite the fact that debunking indicators such as the ISEW and the Genuine Progress Indicator (GPI) have been calculated for many countries and regions all over the world. One of the reasons why these indicators have had little impact on policy-making is their lack of standardization (Bleys and Whitby, 2015), and this despite previous methodological improvements and ongoing attempts to make the methods used theoretically sound. One of the important issues that remains unresolved is the way(s) to account for cross-time and cross-boundary issues (Van der Slycken & Bleys, 2020). The climate change item, for instance, is treated differently in different studies: some scholars suggest to look at the present impacts of climate change within domestic borders, whereas others include future costs and costs abroad. Most welfare measures (WM) mostly do not register cross-boundary issues (well). Yet, scholars have argued to account for the environmental costs that are outsourced to other regions. In order to overcome the existing methodological shortcomings, the ISEW/GPI community needs to scrutinize how to account for cross-time and cross-boundary issues in WM.[2]

The novelty of this paper is that it calculates two types of WM for Belgium based on the narrow and broad welfare interpretation, each with different time and geographical boundaries that we introduced in a previous paper (Van der Slycken and Bleys, 2020). The more narrow 'experiential welfare' only looks at the present and within domestic borders, while the broad 'benefits and costs of present activities' also views beyond borders and adopts a forward-looking perspective. The former does not include capital changes and only registers present ecological costs within domestic borders, while the latter includes capital changes and the ecological costs shifted in time and space. The broad welfare indicator is argued to provide policy-makers with valuable welfare information as there are substantial ecological costs shifted in time and space. Besides these time and boundary improvements, this article also introduces other methodological advances: it is the first welfare study that includes the shadow economy and an inequality adjustment that accounts for the relative effects of income on welfare.

Section 2 introduces the narrow and broad welfare interpretation. Section 3 explains how these two types of WM are constructed and elaborates on other methodological novelties. Section 4 discusses Belgium's overall welfare improvement and the driving trends behind it. The paper concludes by discussing that WM should account for cost-shifting, de-emphasize consumption's influence on welfare and adopt a disaggregated approach by splitting the aggregate measure into its main welfare categories to successfully debunk GDP and effectively inform policy-making.

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[2] In this paper we refer to 'welfare measures' as the overall, general category of welfare measures that includes the ISEW, GPI and variants like the German National Welfare Index.

2. Dealing with cross-time and cross-boundary issues

Designing WM involves making choices on where to draw the system's boundaries – something particularly relevant for time and boundary issues. The choices involved are ideally made by relying on a theoretical or conceptual framework that clarifies the way scholars define welfare and what WM want to capture. However, a recent theoretical and conceptual review found that the WM community holds different views on how to deal with cross-time and cross-boundary issues (Van der Slycken and Bleys, 2020). Without going into detail on the theoretical foundation(s), we will summarize this review's key findings here and propose some boundary convention for the methodological choices in the remainder of this paper.

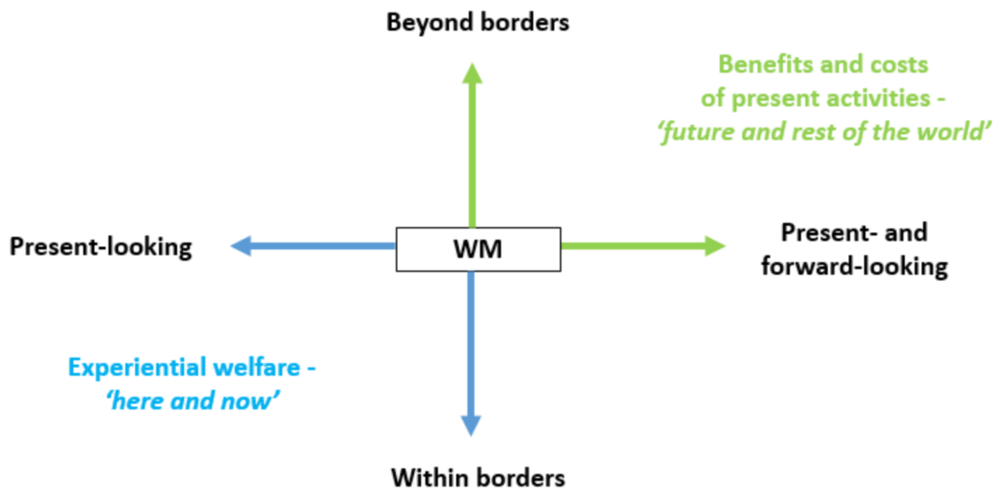
Soon after the first ISEW was calculated in 1989, it was criticized for lacking a solid theoretical foundation. However, in our conceptual review we explained how Daly and Cobb combined aspects of an extended version of Hicksian income together with Fisherian income. We explained that accounting for defensive expenditures, the costs of environmental degradation and natural capital depreciation and net capital investments are Hicksian-inspired, while Fisher's psychic income helps to explain the inclusion of for instance, household labor and the correction for income inequality and the adjustment for consumer durables.

Yet, it was only later that the ISEW was connected to Fisherian income by Lawn (2003). In his seminal paper, Lawn countered the theoretical criticism by arguing that the ISEW is solidly based on Irving Fisher's concepts of income and capital. According to Lawn, WM reveal information about the "welfare enjoyed at a particular point in time", and as a result, they should be seen as 'experiential'. After the establishment of this ex post theoretical Fisherian foundation, the methodology of WM was revised – i.e. some 'Fisherisation' took place. First, physical and financial capital changes were removed from WM as accounting for these capital changes is not compatible with Fisherian income. Experiential WM should only capture current services flowing from capital stocks and thus exclude current additions to capital stocks that will lead services experienced in future periods. Second, ecological items' boundaries were shifted: scholars aimed for maximum compatibility with Fisher's experiential concept by only including the ecological costs that are currently experienced and felt within domestic borders. Nonetheless, not all authors follow these steps as some still include capital changes and include ecological costs caused beyond borders and in the future.

The 'Fisherisation' of only looking at what is experienced in the present and within domestic borders is not the only way forward, as we argued in our previous paper, since WM can also be interpreted as the benefits and costs of present activities. Following this interpretation, WM can look at the impacts of present activities by adopting a forward-looking view that also looks beyond borders. This broad interpretation includes capital changes as these are future benefits (or costs if negative) originating from present activities. Including capital changes violates Fisher's distinction between income and capital, yet it aligns with Hicksian income, which can be approximated as the sum of consumption and capital accumulation. Furthermore, ecological costs shifted in time and space are accounted for as they are costs of present activities – here we build on Kapp's (1950) work of seeing externalities as "cost-shifting" to the poor, future generations and the ecosystem. Fig. 1 gives an overview of the experiential and cost-benefit welfare interpretation and their different time and boundary implications.[3]

[3] We only put forward two welfare interpretations in our previous paper. Nonetheless, in theory, it would also be possible to take a present-looking welfare view that looks at the impacts of present activities beyond domestic borders or a present- and forward-looking view that remains within domestic borders. Yet, a lack of available data makes it often difficult to estimate these alternative interpretations in practice.

Fig. 1: Two types of welfare measures with their distinct time and boundary dimensions.



Note: The vertical axis depicts the boundary perspective, whereas the horizontal axis reveals the time dimension. Experiential welfare implies a within border perspective and takes a contemporaneous perspective on experiences: it registers what is experienced *'here and now'*. Whereas, the benefits and costs of present activities have a beyond boundary viewpoint and take a present- and forward-looking perspective by also incorporating the impacts present activities cause to the *'future and the rest of the world'*.

3. Methodology

WM typically consist of several items, which can be grouped into welfare categories that are beneficial or detrimental to welfare. The experiential and cost-benefit welfare interpretation introduced in the previous section differ for the categories ecological costs and capital adjustments. A general representation of the narrow experiential WM (WM-) and the broad cost-benefit welfare interpretation (WM+) can be found in respectively Eq. (1) and Eq. (2):

$$WM- = UW + NC - INQ + G - SC - EC- \quad (1)$$

$$WM+ = UW + NC - INQ + G - SC - EC+ + \Delta CA \quad (2)$$

In these equations UW = unpaid work, NC = net consumption, INQ = welfare losses from income inequality, G = non-defensive government expenditures, SC = social costs, EC- = ecological costs seen from a narrow perspective, EC+ = ecological costs seen from a broad viewpoint, ΔCA = capital adjustments. Unpaid work, net consumption and non-defensive government expenditures are valued positively; the welfare losses from income inequality, social costs and ecological costs are deducted, whereas capital adjustments can be both positive or negative. Table 1 gives an overview of the used calculations methods and rationale for every item for both welfare indicators.

Table 1: Methodological overview and additional information regarding both welfare interpretations.

	Items *(category)*	**Method of calculation and** ***additional information***
A	Unpaid work *(UW)*	Total hours of unpaid work x average wages *Unpaid work covers routine housework, shopping, care for household members, care for non-household members, volunteering, travel related to household activities and other unpaid work and is valued using the opportunity cost method to count unpaid work as a valuable activity.*
B	Actual individual consumption (+) *(NC)*	B is the sum of the individual consumption expenditures by households and the individual consumption expenditures made by Non-Profit Institutions Serving Households and government.
C	Defensive private expenditures (-) *(NC)*	C involves subtracting the following from B: 25% of food and alcohol expenditures, 100% of tobacco and narcotics expenditures, 100% of insurance and financial services expenditures.
D	Cost of consumer durables (-) *(NC)*	Current expenditures on durable consumer goods are subtracted.

E	Services of consumer durables (+) *(NC)*	∑ previous 8 years' consumer durables expenditures x 0,2 *The services are equal to the depreciation and an imputed interest value of the stock of consumer durables.*
F	Shadow economy (+) (*NC)*	F approximates the value of the shadow economy. Only 50% is included as welfare-enhancing, to exclude illegal activities and avoid double counting with actual individual consumption and unpaid work.
G	Net consumption *(NC)*	Actual individual consumption - defensive private expenditures - cost of consumer durables + services of consumer durables + shadow economy (B-C-D+E+F)
H	Welfare losses from income inequality (-) *(INQ)*	Adjusted Atkinson index x net consumption *H uses an adjusted Atkinson index to account for both absolute and relative income effects.*
I	Non-defensive government expenditures (+) *(G)*	100% of government expenditures on general public services, housing and community amenities and recreation, culture and religion are included.
J	Cost of road accidents (-) *(SC)*	J is calculated by using direct and indirect costs estimates for fatalities and injuries in road accidents.
K	Cost of unemployment and underemployment (-) *(SC)*	Unprovided hours (both unemployed and underemployed) x average wages *K measures the erosion in social cohesion and captures the unprovided earnings potential. Average wages are used, despite that un(der)employed enjoy social security benefits, since unemployment has a strong negative impact on well-being. It is assumed that unemployed and underemployed would like to work the average hours worked per week.*
L	Cost of lost leisure time (-) *(SC)*	Hours of overtime x average wages *The hours of overtime are calculated for workers working more than the average hours worked per week and are equal to the difference between the hours worked and the average hours worked per week.*
M	Cost of air pollution (-) *(EC- & EC+)*	M is calculated by multiplying annual emissions with cost estimates. *M compiled from a within border (i.e. production) view captures the costs related to the following pollutants PM 2,5, NOx, NH3, SO2 and NMVOC. It is assumed the direct disamenity cost of air pollution in the narrow interpretation is equal to 20% of this within border cost. Whereas the broad perspective on air pollution adds the air pollution embodied in trade from the pollutants PM 2,5 fossil, PM 2,5 bio, NOx, NH3 and SO2 to the entire within border cost.*
N	Ecosystem costs of nitrogen pollution (-) *(EC- & EC+)*	N is calculated by linking cost estimates to annual emissions of NO2 and NH3 and with the use of inorganic fertilizer. *The cost estimates for NO2 and NH3 only cover ecosystem costs in order to avoid double counting of health costs, which are already registered in the costs of air pollution. The ecosystem cost for reactive nitrogen measures the run-off from agricultural sources to rivers and seas. This item is included in both EC- and EC+, as it reflects current ecosystem costs within domestic borders.*
O	Cost of climate breakdown (-) (*EC+)*	O captures the damages related to climate breakdown and is calculated by multiplying a time-varying marginal social cost by the amount of greenhouse gas emissions. The emissions included are domestic emissions, CO2-emissons embodied in trade, emissions from international navigation and aviation, domestic LULUCF-emissions, the emissions related to global land use emissions, and biomass emissions.

		O is forward looking and looking beyond borders. It is only included in the broad welfare interpretation.
P	Cost of extreme weather events (-) *(EC- & EC+)*	P is equal to the total amount of uninsured losses as insurance (subtracted as defensive expenditures) helps to 'reduce' the costs from extreme weather events. *P covers uninsured losses to approximate the damages suffered in the present from extreme weather events for the narrow and broad welfare interpretation.*
Q	Transition costs due to the use of non-renewable resources (-) *(EC+)*	Q is calculated by multiplying the primary energy consumption by a transition cost that is needed to replace non-renewable resources and achieve an energy efficiency target of 33% by 2030. *Q is only included in the broad interpretation. Using non-renewable energy resources means that countries already need to make transition costs in the present to achieve energy and climate targets.*
R	Costs of use of nuclear power (-) *(EC+)*	R is calculated by multiplying the amount of nuclear electricity generated by a cost estimate from the German welfare study. *R is forward looking and only fits in the broad interpretation.*
S	Net capital growth (+) *(ΔCA)*	S is calculated by taking the difference between this year's and previous year's net capital stock. *S only fits in the broad WM as the narrow WM does not include capital changes.*
T	Benefit of consumer durables (+) *(ΔCA)*	Current expenditures on consumer durables are multiplied by 0.875 (to capture the non-depreciated part). *T is only incorporated in the broad WM as the narrow WM does not include capital changes. The non-depreciated part of current expenditures on consumer durables is included as these are to be seen as changes in the stock of consumer durables.*
*	Change in net international investment position	This item is omitted. It is excluded from the broad WM as it is unclear how this financial capital invested, it could be either used for defensive or non-defensive purposes.
*	Cost of commuting	Commuting is often seen as a defensive expenditure so fuel and vehicle expenditures and time lost due to congestion are deducted. In this index, the ecological costs related to the combustion of fuels are deducted, while a portion of the consumption expenditures (including expenditures on car purchases) are not included by using an adjusted Atkinson index to account for income inequality.
*	Cost of water pollution	An approximation of this item is incorporated in the item cost of nitrogen pollution as reactive nitrogen losses.
*	Cost of noise pollution	This item is not included because of a lack of available data.
*	Cost of loss of farmlands	This item is not included because of a lack of available data.

Note: * indicates items that we previously included in welfare measures but that are not included in this study.

In contrast to previous studies, we do not include the services from agricultural land, forest, grasslands and wetlands nor their losses if they are destroyed, because of a lack of available data. We agree with Talberth and Weisdorf's (2017) suggestion to subtract the discounted value of forgone future benefits related to marginal land losses of these biomes and to positively value the services from the remaining ecosystems. Following our dual interpretation, both suggestions do, however, not equally apply to both interpretations. Tracing current services fits both interpretations as they are both present-looking. However, subtracting the forgone benefits related to marginal losses is forward-looking and thus should only be included in the broader interpretation.

In this methodological section, we will explain in detail the time and boundary differences between both welfare interpretations by focusing on capital adjustments in Section 3.7 and scrutinizing two examples of ecological costs in Sections 3.5 and 3.6. Furthermore, we will also comment on the methodological changes in unpaid work (Section 3.1), consumption (Section 3.2), the inequality adjustment (Section 3.4), while Section 3.3 describes how we account for the shadow economy. We won't go into detail on every item's valuation method explained in Table 1. A detailed explanation for all items (including data sources) can be found in the Appendix.

3.1 Unpaid work

Feminist economists have long expressed their dissatisfaction with the exclusion of unpaid household work from the System of National Accounts (see for instance Waring, 1999, 2003). To date, unpaid household services remain invisible, even though the production boundary of GDP has expanded over time to also include financial services and the informal sector (Derock, 2019). In contrast to GDP, unpaid work is visible in WM since the first ISEW was compiled in 1989.[4] WM typically account for unpaid work as activities like cooking, cleaning or giving childcare are not necessarily commodified and often remain outside the formal market space.

Similar to GDP, private consumption expenditures take a central place in WM. Most WM take final consumption expenditures as a starting point after Daly and Cobb's (1989) initial compilation. Yet, Ziegler (2007) argues that Daly and Cobb proposing an index centered around personal consumption in the appendix of a book in which they describe humans as persons-in-community is paradoxical as increasing consumption and commodification in market societies not only tends to erode social relationships, but also reduces them to merely monetary exchanges (Polanyi, 1957). The decision to take consumption as base is contradictory for another reason. Daly and Cobb created the ISEW to dethrone GDP as a policy tool, however, by choosing consumption as baseline, they reintroduce GDP's main component (albeit corrected for defensive expenditures and income inequality) in the ISEW. Therefore, we propose to go beyond GDP by also going beyond consumption as a baseline for WM. The consumption paradox is addressed in this paper by taking unpaid work as baseline to reveal its pivotal role in a society's welfare. Jochimsen and Knobloch (1997) argue that the "maintenance economy", consisting out of the productive and creative (reproductive) activities like ecological processes and the maintenance of physical and social relationships (i.e. "caring activities"), is a key foundation of the current industrial economic system. Proposing an indicator based on unpaid (care) work would be more consistent with seeing humans as "persons-in-community", as caring activities are about maintaining physical and social *relationships*.[5]

Previous studies value unpaid work at a replacement cost, i.e. the hourly wage to find a market substitute. Yet, valuing wages at low market wages devalues the importance of unpaid work. Feminist economists have critiqued this low replacement cost method as anti-female and anti-care work (Berik, 2018).[6] WM should not treat unpaid work as another tradeable market commodity, but instead should value unpaid care work as a valuable, average economic activity as such. After Brown and Lazarus (2018), we also use the opportunity cost method, in which unpaid work is valued at average wages. Fig. 2 illustrates that the opportunity cost method values unpaid work almost twice as high as the replacement cost method.

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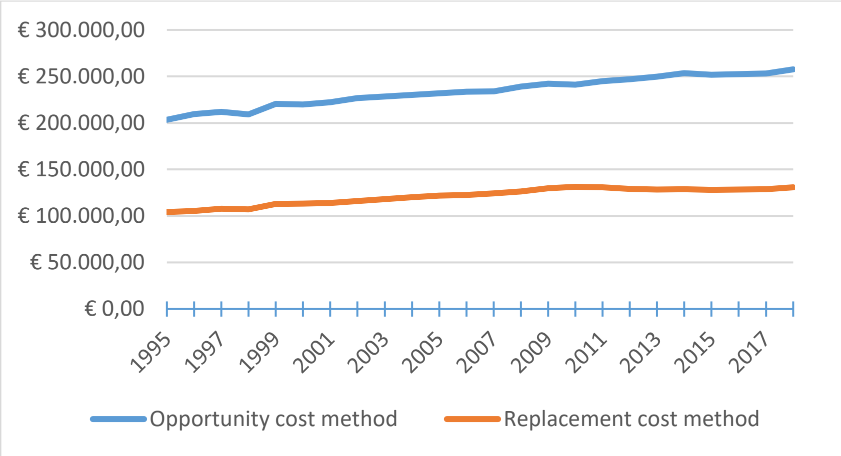
[4] Nordhaus and Tobin's (1972) measure of economic welfare, the ISEW's predecessor, already included an imputation for 'nonmarket activities'.
[5] Furthermore, unpaid work plays a significant role in a person's well-being (Nierling, 2012).
[6] The replacement cost method is anti-care and anti-feminist since Belgians, for instance, performed on average more unpaid work compared to paid work and women perform more unpaid work than paid work, in contrast to men who spend more time on paid work (see Appendix).

Fig. 2: The value of unpaid work using the opportunity cost and replacement cost method (million, 2010 prices).



3.2 Actual individual consumption

To this base, actual individual consumption (AIC) is added. Previous studies mostly started from household's individual consumption expenditures, which is equal to household's final consumption expenditures on individual services and goods, and deducted half of the private expenditures on health and education, whereas half of the public expenditures on health and education were added.[7] Yet, subtracting (adding) a certain fraction of these private (public) expenditures on health and education may be seen as arbitrary. Therefore, this study measures consumption by using the amount of AIC instead of households' individual consumption expenditures.

AIC is defined as individual consumption expenditures made by households plus individual consumption expenditure by government plus individual consumption expenditures by Non-Profit Institutions Serving Households (NPISHs) (see Fig. 3). AIC is equal to what households actually consume to meet their individual needs. Using AIC has several advantages. First, it is a better measure of material well-being compared to GDP and household's individual consumption expenditures, because it captures all of the goods and services consumed by the households, irrespective of whether households pay for it themselves or benefit from it via the expenditures made by NPISHs or the government (Eurostat, 2012). Second, it fosters comparability between countries. This is needed because of country differences in who pays for health and education, for instance. In some countries individuals mostly pay for health and education expenses, whereas in other countries these services are provided to households as social transfers in kind by government in NPISHs (Eurostat, 2012). Finally, it avoids making arbitrary decisions on the defensive fraction of health and education expenses. The defensive expenditures that we deduct from AIC to obtain the welfare category net consumption are, however, determined based on a solid rationale as explained in the Appendix.

Fig. 3: From final consumption expenditure to actual final consumption.

Who pays	Final consumption expenditure	Actual final consumption	Who consumes
Households	Individual consumption expenditure by households	Actual individual consumption	Households individually
NPISHs	Individual consumption expenditure by NPISHs		
General government	Individual consumption expenditure by government		
	Collective consumption expenditure by government	Actual collective consumption	General government (households collectively)

Source: Eurostat (2012).

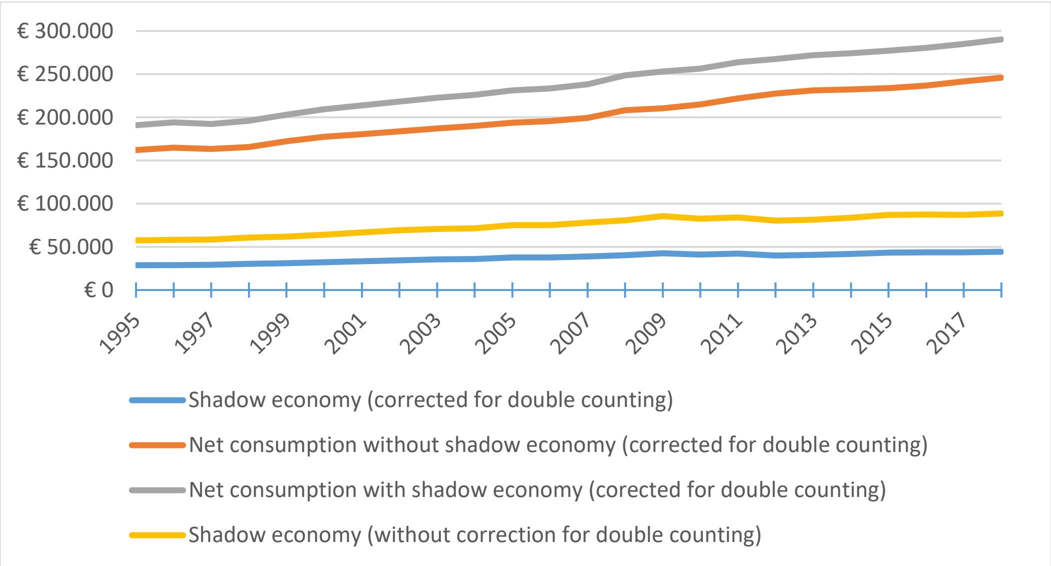
[7] See for instance the welfare measures in Daly and Cobb (1989) and Bleys (2008).

3.3 Shadow economy

So far, while WM made unpaid work visible, however, the shadow economy remained invisible. From a welfare perspective, it is important to account for informal market activity too. Therefore, the new item *shadow economy* is introduced in the category net consumption. Including this item is needed for meaningful welfare comparisons over time and between countries since the size of the shadow economy declined over time and since there are substantial differences in the size of the informal economy between countries (Kelmanson et al., 2019).

This item is estimated based on a study by Kelmanson et al. (2019), in which the size of the Europe's shadow economy is estimated as a percentage of GDP. Yet, a correction is needed for double counting. Medina and Schneider (2019) illustrate that between 2009 and 2015 35.7 % Germany's shadow economy consists of legally bought material for shadow economy and do-it-yourself activities, illegal activities (smuggling etc.) and do-it-yourself activities and neighbors' help. That is why, in order to conservatively approximate the welfare contribution of the shadow economy, we have halved the size of the shadow economy. This can be thought of as a conservative estimate to exclude illegal activities, avoid double counting with actual individual consumption and unpaid work and exclude defensive expenditures. As the shadow economy is also treated as consumption and included in net consumption, the value of the shadow economy is also corrected for income inequality using the adjusted Atkinson Index. Future research could investigate ways of refining this item's valuation methods, for instance distinguishing between consumption and investment. Part of the shadow economy that is included as consumption here, but that is in fact an investment should be factored back in as capital adjustments in the broad welfare interpretation in a similar was as was done with the benefits of consumer durables (see Section 3.7). Fig. 4 illustrates the quantitative importance of the shadow economy and shows that including the shadow economy increases the value of net consumption by on average 18.5%.

Fig. 4: The value of the shadow economy (million, 2010 prices).



3.4 Welfare losses from income inequality

WM account for the welfare losses from income inequality. Daly and Cobb (1989) used the principle of diminishing marginal utility of income to argue that a redistribution of income from a rich family to a poor family would benefit overall welfare as the reduction of the rich's utility levels would be lower than the increase in the poor's utility levels.[8] Most welfare studies account for income inequality by weighing consumption expenditures via an index, based on the Gini coefficient.[9] Yet, this procedure has been criticized as being ad hoc and for not making explicit the scholars' assumption on a society's aversion to inequality (Neumayer, 2000). Moreover, using the Gini coefficient lacks a clear welfare-theoretic interpretation (Dietz and Neumayer, 2006). In contrast, the Atkinson index does take into account society's aversion to inequality, which is why it is the preferred procedure to account for income inequality in welfare

[8] What is more, evidence shows that more equal societies perform much better compared to unequal ones on public health, education, well-being, mental ills, violence, etc. (Wilkinson and Pickett, 2009, 2018).

[9] See, for instance, the recent studies by Kenny et al. (2019) and Held et al. (2018).

measures (Neumayer, 2000; Stymne and Jackson, 2000; Dietz and Neumayer, 2006). This suggestion has been picked up by some scholars (Jackson et al., 1997; Bleys, 2008; Bleys and Van der Slycken, 2019).[10]

The methodology proposed in this paper uses the Atkinson Index (AI) to calculate the welfare losses from income inequality. A first advantage of this method is that it is expressed directly in terms of well-being (Stymne and Jackson, 2000) as the AI is based on a social welfare function (Atkinson, 1970). The Atkinson index can be interpreted as "the proportion of the present total income that would be required to achieve the same level of social welfare as at present if incomes were equally distributed" (Atkinson, 1975). Atkinson's (1970) index is calculated as follows:

$$\mathrm{AI} = 1 - [\sum_{i=1}^{n} (y_i/\mu)^{1-\varepsilon} * f(y_i)]^{\frac{1}{1-\varepsilon}} \tag{2}$$

In this equation, y_i is the mean income of the *i*-th group, μ is the mean income of the total population, $f(y_i)$ is the proportion of the population of the i^{th} group, and ε is the weight society gives to the inequality of the income distribution. A value of ε equal to 0 would mean that society does not care for inequality, while positive values indicate that society is averse to inequality. A value for AI of 15% indicates that the same level of social welfare could be achieved with only 85% (1-0.15) of the present total income, if incomes were equally distributed. In previous welfare studies a value for ε of 0.8 was used (Jackson et al., 1997; Stymne and Jackson, 2000; Bleys, 2008). Yet, a review of various methods to estimate ε indicates that a mid-point value of 1.5 aligns with literature (Latty, 2011).

So far, only the direct effects of income inequality on welfare are discussed. Next to these effects, indirect effects such as relative and positional dynamics also affect the welfare level obtained from a given income distribution. An individual's level of well-being does not only depend on one's absolute level of consumption or income, but also on the relative position compared to others. Easterlin (2003) explained that due to social comparison, the effect of consumption increases on well-being are lower than expected. Since each individual's consumption impacts the reference frame others use to compare their consumption, this frame is a public good (Frank, 1997). Therefore, it is important for WM to account for relative income effects. A second benefit of the AI is that it can be adjusted to also account for these effects. Howarth and Kennedy (2016) propose using an adjusted Atkinson index (AAI) that not only corrects for inequality in itself, but also for the impacts of relative income on social comparison and individual well-being. This approach involves a slight expansion of Eq. (2):

$$\mathrm{AAI} = 1 - [\sum_{i=1}^{n} (y_i/\mu)^{1-\varepsilon} * f(y_i)]^{\frac{1}{(1-\alpha)(1-\varepsilon)}} \tag{3}$$

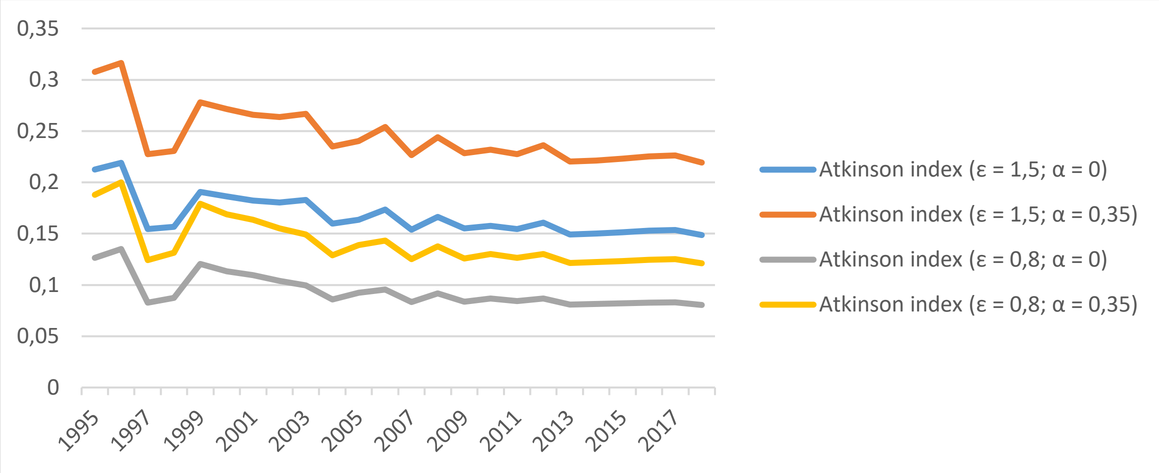
In this equation, α is a parameter that reflects the weight people give to relative income. It is clear from Eq. (3) that if a society gives no weight to relative income and α is 0, Eq. (3) collapses to Eq. (2). In a relative income experiment among Swedish students, Johansson-Stenman et al. (2002) found that the median weight given to positionality lies between 0.2 and 0.5. Howarth and Kennedy (2016) use the center of this range, i.e. 0.35, as value for α in their numerical illustration of the AAI.

To date, no welfare study has made deductions for the diminishing marginal utility of total income growth. Yet, the subjective well-being literature indicates that, in contrast to mainstream economists' belief, higher incomes and increases in consumption of goods do not always lead to improvements in well-being (Easterlin, 2003; Frank, 2000). This study is the first that uses the AAI to also account for relative income effects to calculate the welfare losses from income inequality in WM. The procedure that is used – reducing total consumption expenditures to account for relative effects – is explicit and less arbitrary compared to labelling and deducting a certain fraction of all consumption categories as defensive (see Section 2.2 in the Appendix). After Latty (2011) and Howarth and Kennedy (2016) values for respectively ε and α of 1.5 and 0.35 are used, while decile data on household's disposable incomes are used to calculate the adjusted Atkinson Index (as explained in the Appendix). Fig. 4 gives an overview of the effect of these parameter choices on the Atkinson index, and provides a sensitivity analysis compared to the values that were previously used (ε = 0.8 and α = 0). Putting ε equal to 1.5 results in a comparable, yet slightly higher value for the index

[10] Recently, Talberth and Weisdorf (2017) proposed another, explicit method that uses estimates on the declining marginal utility of income from a global dataset by Layard et al. (2008).

compared to the case where ε = 0.8 and α = 0.35. Including the parameter α leads to a larger increase: the index rises more sharply when ε = 1.5 compared to when ε = 0.8 because of the relative income parameter.

Fig. 4: The Atkinson index given various parameter choices.



3.5 Costs of climate breakdown

This item, previously referred to as the 'costs of climate change', has been modified significantly over the years – see O'Mahony et al. (2018) for an overview.[11] Most studies valued this item by linking the emissions related to the domestic consumption of fossil fuels with a social cost of carbon (SCC). Nevertheless, scholars are still discussing how to properly account for 'climate change'. Bagstad et al. (2014) suggested to leave out this item and use substitutes linked more directly to climate change impacts (e.g. the costs of natural disasters and water scarcity), whereas O'Mahony et al. (2018) stipulated the need for a separate approach to distinguish between the future global impact costs related to current domestic emission activities and the current national impacts stemming from past global emissions.

The appropriate approach to account for climate disruption depends on the welfare interpretation used. The broad perspective includes future and distant costs and thus can make use of a SCC to capture damages caused. However, the narrow perspective cannot and should focus on the local and current costs arising from climate change, i.e. the damages suffered. That is why, the item *costs of climate breakdown* is only included in WM+. Yet, the new item *costs of extreme weather events,* which approximates the damages suffered 'here and now', is to be included in the both narrow and broad perspective (see Table 1).

Other methodological novelties regarding the calculation of this item are a broader set of emissions beyond territorial GHG-emissions. The quantity of emissions is based on the data countries send to UNFCCC and includes: territorial GHG emissions (with Land Use, Land-Use Change and Forestry (LULUCF), without indirect CO_2), the emissions from international bunkers (aviation and navigation), and CO_2 emissions from biomass. Furthermore, two types of footprint emissions are added to register the emissions beyond domestic borders that can be related to national consumption. The first type involves the carbon dioxide emissions embodied in goods and services.[12] The second type of footprint emissions relates the land-use change emissions from the Global Carbon Project to Belgium's share in the global land-use consumption footprint using the SCP-HAT provided by UN Environment (2020). A detailed explanation on the quantity of emissions can be found in the Appendix. Fig. 5 provides an overview of the emissions from these different sources and illustrates that total emissions do not follow the steadily decreasing trend of territorial emissions.

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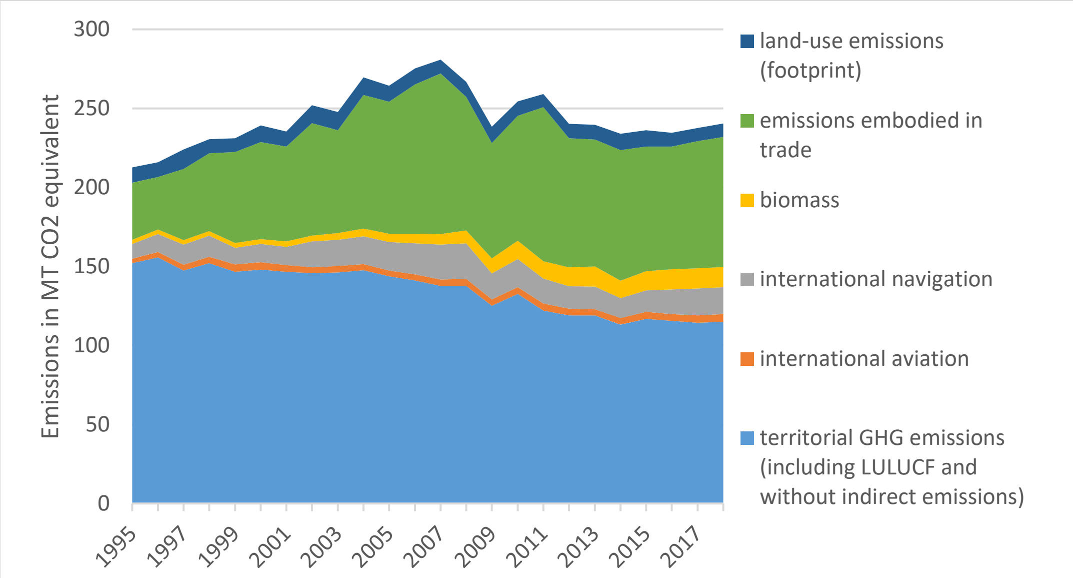
[11] We prefer to use the term climate breakdown instead of a mere change in climate as recent evidence on climate tipping points indicates the threat of rapid and irreversible changes in the climate system that would severely disrupt ecosystems, societies and economies (see Introduction).

[12] These transfer emissions are updated from Peters et al. (2011) in the Global Carbon Project by Friedlingstein et al. (2019).

Fig. 5: Greenhouse gas emissions by category.

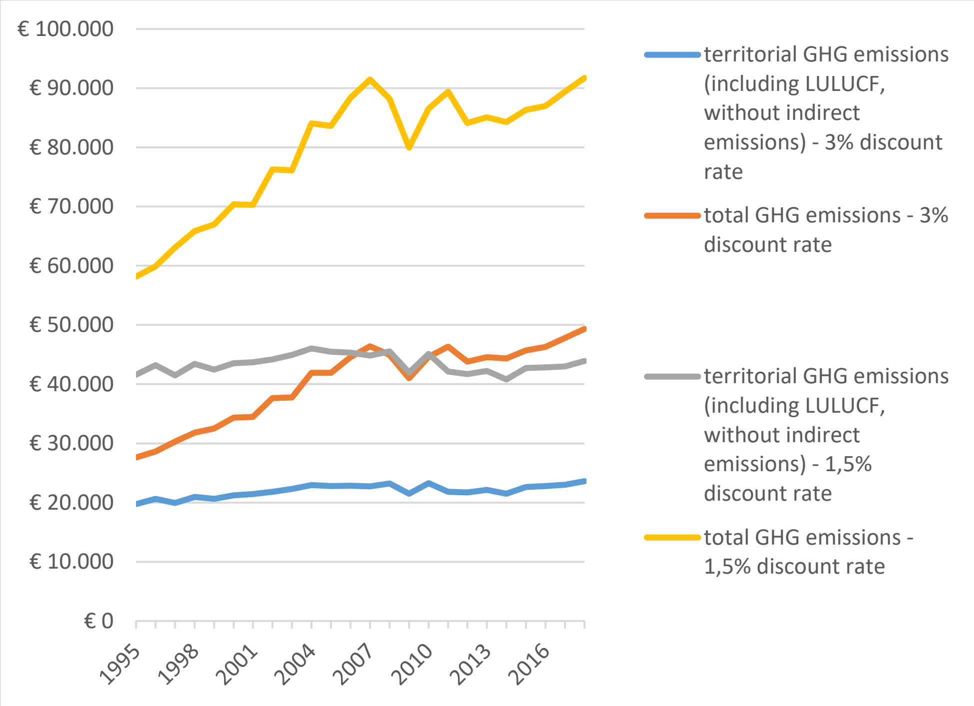


These broader set of emissions are linked to a SCC estimate to calculate the damage caused by climate disruption. The SCC estimates available in literature differ significantly depending on the specific parameters (i.e. damage functions, discount rate, climate sensitivity). Ackerman and Stanton's (2012) estimates of the SCC in 2010 vary between \$28 and \$892 in 2007\$ per tonne. O'Mahony et al. (2018) use in the Spanish ISEW-study an estimate of \$232 in 2010\$ or €175.37 in 2010€ per tonne of CO_2 (equivalent), which is based on a 3% discount rate, 95^{th} percentile climate sensitivity and Hanemann-Weitzman damage functions. Stern (2006), however, argues in favor of a lower discount rate based on intergenerational equity. In order to suitably measure the future costs and thus discount future costs less, we suggest to use a lower discount rate than O'Mahony et al. Using the same damage functions, a 1.5% discount rate would lead to SCC-estimates of \$445 and \$892 in 2007\$ (or €340.23 and €681.98 in 2010€), for respectively average and 95^{th} percentile climate sensitivity (Ackerman and Stanton, 2012). As the lowest of these SCC's is almost the double of O'Mahony et al.'s estimate, we use the estimate based on average climate sensitivity and apply a compound growth rate of 1.45% to compute the estimates in the years before and after 2010.[13] This discount rate of 1.5%, is similar the 1.4% discount rate proposed by Stern (2006).[14] Fig. 6 illustrates the cost of climate breakdown given various parameter choices.

[13] The compound growth rate of 1.4452407% is obtained by extrapolation Ackerman and Stanton's (2012) 2010 values to 2050.

[14] Stern (2006) obtained a 1.4% discount rate as the sum of a 0.1% pure time discount rate and the growth rate of per capita consumption. According to Stern (2006) a 0.1% discount rate indicates a 91% probability for humanity to survive 100 years. Given that more consumption is not desirable from a well-being perspective, one could use Stern's case to argue for using a discount rate of 0.1%. As Ackerman and Stanton (2012) only provide 1.5% and 3% discount rates, this is left for future refinements.

Fig. 6: Comparison of the effect of alternative approaches to the cost of climate breakdown (million, 2010 prices).



3.6 Transition costs due to the use of non-renewable resources

In the past, scholars have adopted a production or a consumption perspective in order to calculate the depletion of non-renewable resources. The former traces the depletion related to the extraction of a country's domestic energy stocks, while the latter measures how a country's domestic resource consumption contributes to the depletion of global energy stocks. The production view looks within borders, whereas the consumption counterpart looks beyond borders. Yet, the key difficulty lies in connecting this item to the experiential welfare foundation. Talberth and Weisdorf (2017), for instance, wondered if future studies should still include this item if it is not better linked to current welfare. Nonetheless, including resource depletion is compatible with the broad welfare interpretation as it is a cost originating from present activities that is passed on to the future. For future generations not to suffer from resource depletion, investments are needed in renewable resources to build-up a capacity that can replace the use of non-renewable resources.

This study builds on the transition cost method by O'Mahony et al. (2018), in which the depletion issue as a gradual transition away from non-renewable energy resources in order to meet the climate targets agreed upon in the Paris Agreement.[15] Yet, O'Mahony et al.'s method is updated as their cost estimate is based on a not so ambitious scenario to halve global CO_2-emissons by 2050. A recent report by the IPCC (2018) illustrates that more drastic emission cuts are needed in the near present to limit global warming to 1.5°C: global net emissions need to decline by 45% in 2030 (compared to 2010) and the net zero target should be reached in 2050.[16]

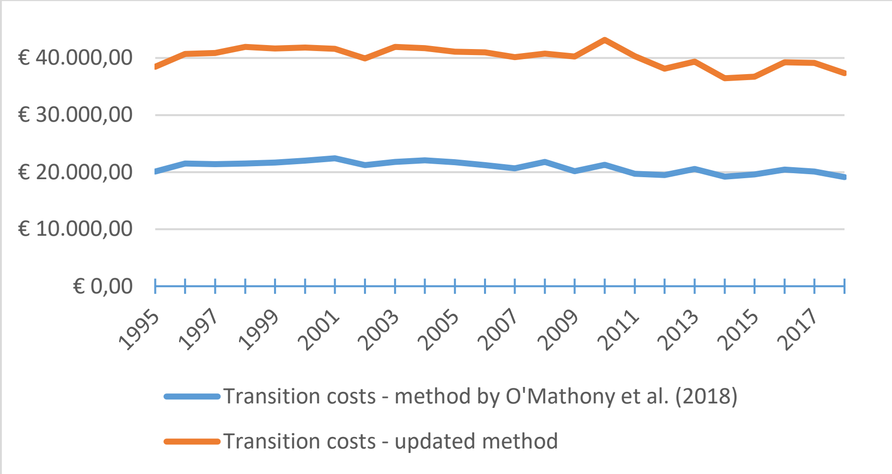
The valuation of this item is based on the total energy investments expenditures needed in the European Union under the requirement of meeting certain climate goals agreed upon by the European Council. These targets include an overall GHG emission reduction of at least 40% compared to 1990 and a share of renewable energy in final energy consumption of at least 27%. Moreover, the European Council agreed on the following minimum ambition level for the energy efficiency target: a 27% reduction of primary energy consumption compared to 2007. The investments

[15] Recent evidence has shown that the remaining carbon budget related to climate change goals of limiting global heating to 1.5 or 2 °C – see, for instance, McGlade and Ekins (2015) and IPCC (2018) – imposes a more imminent limit on using non-renewable resources compared to their depletion. Achieving climate goals requires drastic and rapid reductions in human carbon emissions and phasing out fossil fuels (Rockström et al., 2017; Jackson, 2019), which can be met by an expansion of renewable energy resources (Rockström et al., 2017) together with a lower energy demand (Grubler et al., 2018), or a degrowth scenario (D'Alessandro et al., 2020; Victor, 2012).

[16] As early-industrialized countries have a higher historical responsibility, their net zero targets should be sooner. Jackson (2019), for instance, argues that the United Kingdom should set its target for net zero emissions by 2030 or earlier.

needed are calculated, given the various policy options for 2030 energy efficiency targets (European Commission, 2016). A mid-value of 33% efficiency target was chosen, which leads to an investment cost of €797.45 (in 2010 prices) per ton of oil equivalent of primary energy consumption. Fig. 7 compares this updated method with the transition cost method by O'Mahony et al. (2018).

Fig. 7: Comparison of the updated and previous transition cost method for the depletion of non-renewable resources (million, 2010 prices).



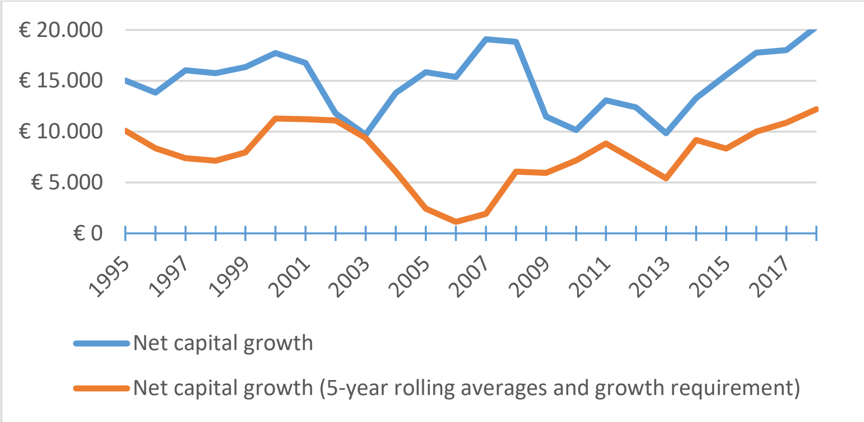
3.7 Capital adjustments

As explained in Section 2, WM+ should include changes in physical capital stocks like *net capital growth* and *the benefits of consumer durables* as these are impacts originating from present activities.

In contrast to previous studies, this study's net capital growth only traces mere capital adjustments: it breaks with taking 5-year rolling averages and by including the growth requirement in this item. Following Hicks' income concept, capital changes should be counted as income. However, by taking 5-year rolling averages to smooth out fluctuations, one is actually treating this item as the services flowing from a stock that would last five years. Furthermore, the net capital growth required to keep the capital stock per worker intact is removed as this procedure is inconsistent with Hicksian income in which raw capital changes are counted. Daly and Cobb (1994) included the capital requirement as they assumed that economic sustainability requires that the amount of capital available for each worker remains constant or even increases. We believe the growth requirement can be omitted based on the grounds that we are not trying to capture sustainability but merely the benefits and costs of present activities and that Hicksian income only includes 'raw' capital changes. Fig. 8 gives on overview of the impact these methodological changes.

Furthermore, an adjustment is needed for the expenditures on consumer durables expenses for a consistent treatment of different types of capital stocks. Similar to net capital growth, expenses on durables are also capital changes that should be included. That is why, the part of the current expenditures on consumer durables that is not depreciated and not used up (i.e. 87.5%) – labelled as the item *benefits of consumer durables* – is an addition to the stock of consumer durables that should be included. Furthermore, the services from consumer durables also need to be included in WM+, as Hicks was well aware that these durables require a special treatment. While discussion consumer durables, Hicks (1939) argued that his central income notion is about the maximum amount an individual can consume, not about the maximum amount of expenditures. This means that the computing the services from consumer durables is also a valid approach to capture their 'true consumption'. Here, no adjustment is needed as these services are already included in the net consumption category.

Fig. 8: Comparison of the effect of an alternative valuation method to net capital growth (million, 2010 prices).



4. Results

This section presents Belgium's economic performance from 1995 until 2018 using the narrow and broad WM and analyses the relative importance and changes over time of the various welfare categories. The per capita results of Belgium's welfare and GDP are shown in Fig. 9. Hereafter, we will only focus and report per capita values without explicitly referring to it. A comparison of both WM, illustrates the WM+ is more volatile, but much smaller than WM-. This indicates that adding capital adjustments and the broader ecological costs reduces the welfare level and introduces more variability in time series. Over the entire period, GDP and WM+ improved by about 30%, as illustrated in Table 2. WM- increases only by 25% because it starts at a higher level as only minimal ecological costs are deducted.

Besides these comparable relative improvements over time, there are notable absolute differences between these WM and GDP at certain time periods. The difference between both WM – indicated by ΔWM in Fig. 10 – shows there is a big absolute difference between them, that first slightly increases over time, but then decreases again toward the end of the time period. Throughout the entire period, GDP is higher in absolute terms than WM+, however, it is smaller than WM- as in the latter only minor ecological costs are deducted (compared to WM+) while also positive categories like unpaid work are added. This results in a positive gap between GDP and WM+ and a negative gap between GDP and WM- as shown in Fig. 10. We hereby defined the gap of a WM as the difference between GDP and this WM.

Looking at the gaps illustrates that the WM- gap is less volatile than the WM+ gap. Since both gaps move in the same direction, we will focus only on the positive gaps between GDP and WM+.[17] The gap was rather low in 1995 compared to the rest of the period and reached a minimum in 1997, but then almost continuously increased until peaking in 2006. The gap plummeted from 2006 to 2009 and jumped up in 2010. The gap decreased between 2010 and 2014, increased subsequently between 2014 and 2017. The gap fell in 2018, which made the gap go below its period average at the end of the period. Based on this increasing or decreasing gap over time, we divided the studied period in 4 periods: an increasing gap in the build-up to the financial crisis (1995-2007), a decreasing gap during the financial crisis (2007-2010) and subsequent Eurocrisis (2010-2014) and an increasing gap during the post-crisis recovery (2014-2018).

4.1 Period 1: 1995-2007

In the first period from 1995 to 2007, GDP and WM both improved albeit at a different pace. GDP's average annual growth was higher: GDP improved by 1.9% versus 1.4% for WM- and 1.1% for WM+. In 1997, WM increased sharply because inequality measured by the adjusted Atkinson Index decreased by 28.1% while GDP stagnated. The overall welfare trends were driven by increases in unpaid work (+10.1%, + €2,035) and net consumption (+19.5%, + €3,683) and lower losses from income inequality (- 11.9%, - €691). More net consumption was translated into welfare since inequality measured by the adjusted Atkinson Index decreased by 26.3%. WM+ improved less because the broad ecological costs increased sharply (+22.2%, + €2,575).

[17] The negative gap between GDP and WM- moves in the opposite direction than the positive gap. If WM outperform GDP, the WM+ gap is reduced as it catches up with GDP. In this case, however, the WM- gap increases as the latter is higher than GDP in absolute values.

4.2 Period 2: 2007-2010

Amid the financial crisis, GDP dropped by 3% in 2009, while the welfare response was delayed. When GDP recovered in 2010 by 2%, WM fell: WM- decreased by 1%; WM+ even dropped by 3.8%. Over the entire period from 2007 to 2010, part of the gap between GDP and WM was closed. GDP decreased annually by on average 0.5%, while WM had positive average annual growth rates and improved by 0.6%. These positive welfare evolutions are explained by net consumption growth (+5%, + €1,117), which was however partly off-set by higher welfare losses from income inequality (+7.3%, + €374). For WM+ other important drivers were sharply falling ecological costs (-11.1%, - € 729), but this reduced ecological impact was more than compensated by plummeting capital adjustments (-27.6%, - €821).

4.3 Period 3: 2010-2014

During the Eurocrisis following the financial crisis, GDP stagnated from 2010 until 2013. Between 2010 and 2014, GDP grew annually by on average 0.4%. WM-'s annual growth was twice as high as GDP's, while WM+ annually improved by 2.4% because broad ecological costs dropped by €1,495 (-11.1%). Other important welfare drivers were increases in net consumption (+3.7%, +€884) and unpaid work (+1.9%, + €425). This positive welfare evolution was slightly tempered by an increasing social burden as social costs rose (+4.5%, + €129).

4.4 Period 4: 2014-2018

From 2014 to 2018 GDP grew annually by on average 1.5%, which is much higher than WM's improvements. The annual growth in WM- and WM+ were respectively 0.5% and 0.8%. These welfare evolutions were caused by net consumption growth (+3.8%, + €934) and lower social costs (-14.4%, - €428) despite lower government contributions (-8.4%, - €288). The economic recovery resulted in increasing broad ecological costs (+3.7%, + €438), yet this increasing ecological impact was in WM+ outweighed by soaring capital adjustments (+29%, + €667).

Fig. 9: Welfare and GDP per capita, in million 2010 €.

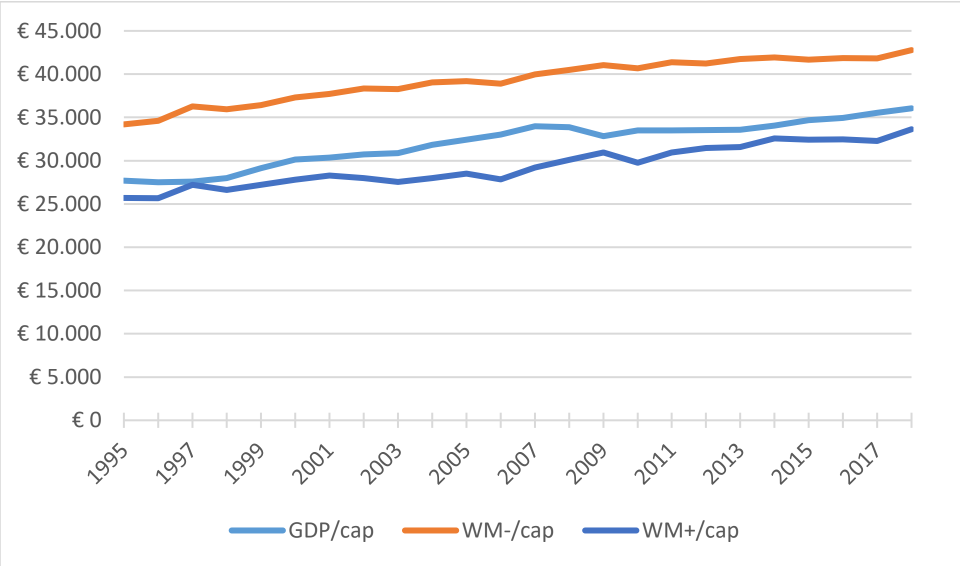
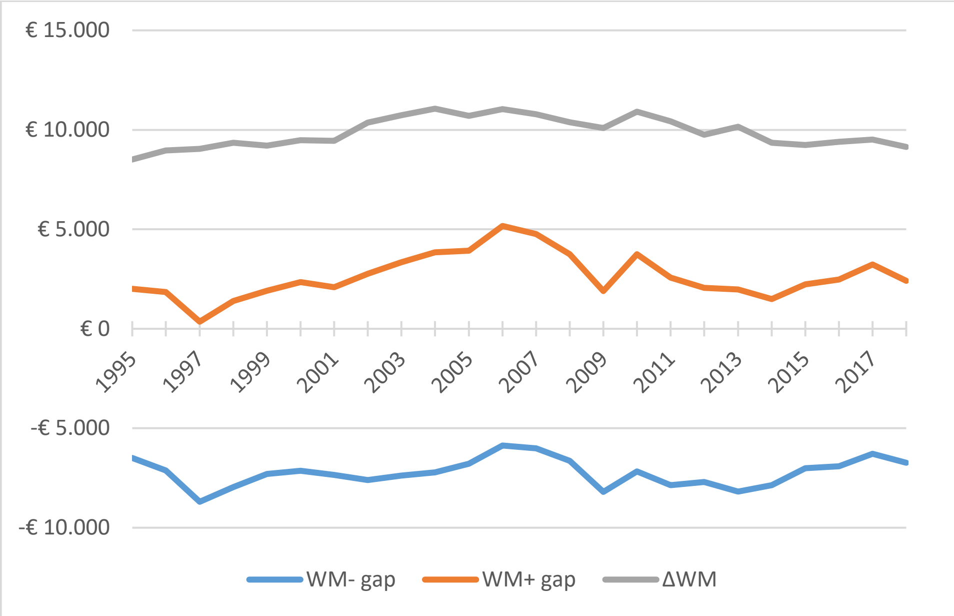


Table 2: Average annual and total growth rates of welfare and GDP per capita.

Time period	GDP/cap	WM-/cap	WM+/cap
1995-2007	1,89	1,41	1,14
2007-2010	-0,46	0,57	0,62
2010-2014	0,41	0,77	2,36
2014-2018	1,47	0,51	0,82
1995-2018*	30,14	25,09	30,93

Note: * indicates the total growth rate over the entire period, in contrast to the average annual growth rates in the subperiods.

Fig. 10: Gaps between welfare measures and GDP per capita (2010 prices).

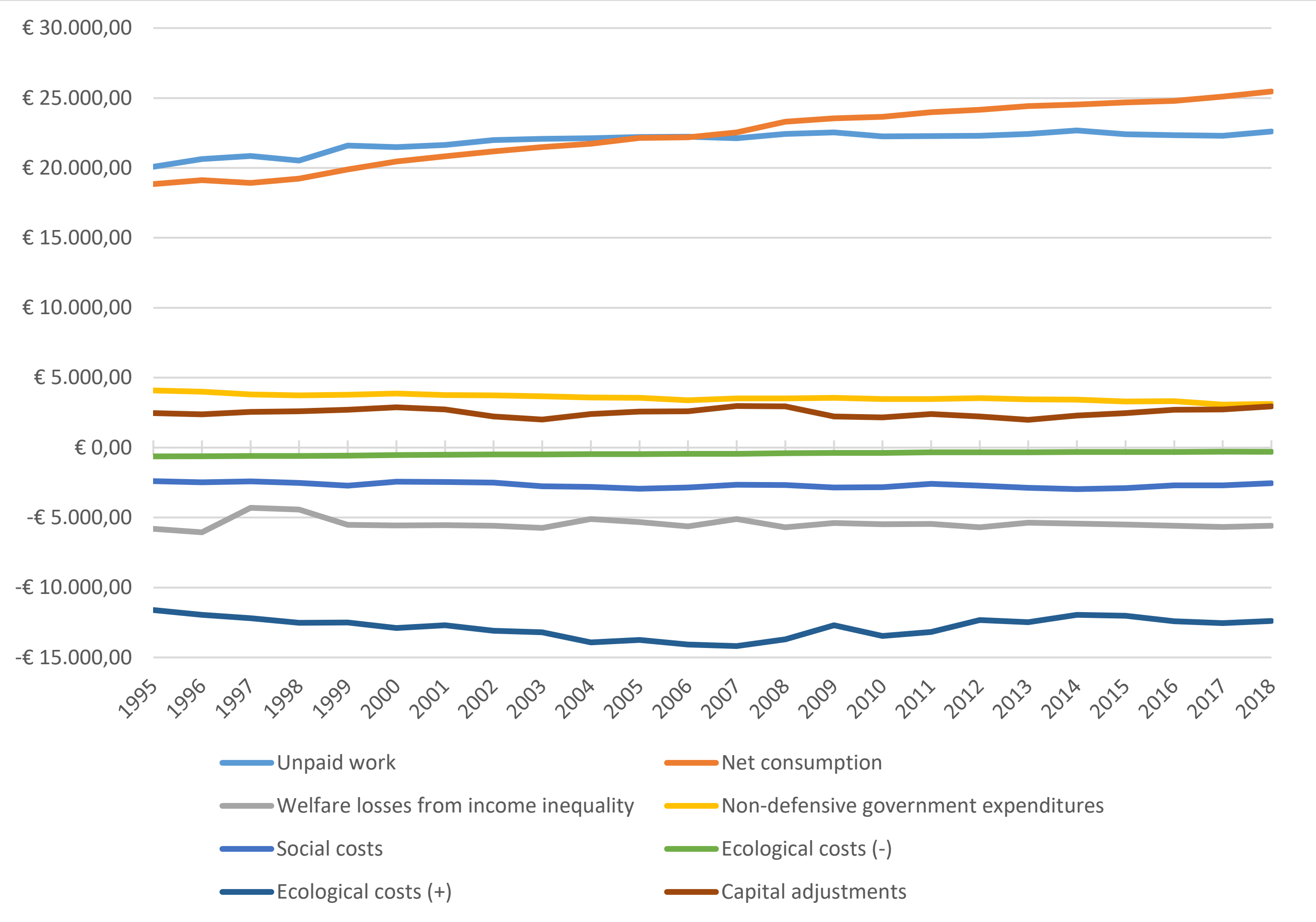


4.5 Overall trend in welfare categories

Since GDP and WM- and WM+ increased over the considered time period, the Belgian results do not provide evidence in favor of the 'threshold' hypothesis formulated by Max-Neef (1995), which states "for every society there seems to be a period in which economic growth (as conventionally measured) brings about an improvement in the quality of life, but only up to a point – the threshold point – beyond which, if there is more economic growth, quality of life may begin to deteriorate". Nonetheless, aggregate welfare trends hide crucial information about evolutions in the different welfare categories (introduced in Eq. 1 and Eq. 2) – especially of those categories that are of minor quantitative importance.

Fig. 11. illustrates that unpaid work and net consumption are the most important welfare components. The value of unpaid work increased over the studied time period by 12.6% (as shown in Table 3) since increasing average wages more than compensated a reduction in the time devoted to unpaid work. Net consumption was initially below unpaid work, but became more important than unpaid work from 2007 onwards. Net consumption outpaced unpaid work as it surged by 35.1% over time. If the shadow economy was not included, unpaid work would still have been the most substantial welfare category throughout the entire period. The net consumption growth was translated into welfare because the welfare losses from income inequality decreased over time by 3.7%, as inequality measured by the adjusted Atkinson index decreased by 28.7%. The government's welfare contribution became less important (-23.4%), while for WM+ capital adjustments increased by 19.4%. Social costs increased by 6% and also the broad ecological costs in WM+ rose by 7%. The latter evolution was caused by increases in the time-varying cost estimate (+40%) and greenhouse gas emissions (+13%), which both made the cost of climate breakdown rise by +58%, which outweighed reductions in all other ecological costs. The increase in broad ecological costs contrasts heavily against the narrow ecological costs in WM- that fell by 52.4%, which further reduced the – already negligible – quantitative importance of this item.

Fig. 11: Positive and negative contributions of per capita welfare categories (2010 prices).



Note: In this figure welfare deductions have been reclassified as negative numbers, even though these categories are deducted as positive numbers in Eq. 1 and 2 to calculate the aggregate welfare level.

Table 3: Annual growth rates of per capita welfare categories during several time periods.

Time period	Unpaid work	Net consumption	Inequality	Government	Social costs	Ecological costs (-)	Ecological costs (+)	Capital adjustments
1995-2007	0,84 (10,1)	1,63 (19,5)	-0,99 (-11,9)	-1,16 (-13,9)	0,87 (10,4)	-2,57 (-30,8)	1,85 (22,2)	1,67 (20,1)
2007-2010	0,21 (0,6)	1,65 (5,0)	2,44 (7,3)	-0,44 (-1,3)	2,44 (7,3)	-3,48 (-10,5)	-1,71 (-5,1)	-9,20 (-27,6)
2010-2014	0,48 (1,9)	0,94 (3,7)	-0,23 (-0,9)	-0,38 (-1,5)	1,13 (4,5)	-4,48 (-17,9)	-2,78 (-11,1)	1,60 (6,4)
2014-2018	-0,08 (-0,3)	0,95 (3,8)	0,71 (2,8)	-2,11 (-8,4)	-3,61 (-14,4)	-1,59 (-6,4)	0,91 (3,7)	7,28 (29,1)
1995-2018	0,55 (12,5)	1,53 (35,1)	-0,16 (-3,7)	-1,02 (-23,4)	0,26 (6,0)	-2,28 (-52,4)	0,30 (6,8)	0,84 (19,4)

Note: The relative changes of each time period is put in parentheses.

5. Discussion

5.1 Toward feminist and ecological economics

Daly and Cobb (2007) created the ISEW in an attempt to debunk GDP as an economic policy guide and thought a conservatively estimated index that was no longer correlated with GDP would be able to do so. They wanted to engage orthodox economists in the welfare discussion and as a consequence they partly played by orthodox economists' rule to be taken serious. Nonetheless, WM also build on heterodox economic thought. One the one hand, one could argue WM address feminist and ecological economic concerns – two streams of heterodox economic thought – by revealing the importance of unpaid care work and the ecosystem. On the other hand, the monetization approach of WM is objectionable to some feminist and ecological economists (Berik, 2018). Martinez-Alier et al. (1998), for instance, have argued that weak comparability of values should be seen as a foundation of ecological economics. Yet, since weak comparability implies incommensurability, i.e. the absence of a common measurement unit, WM will never be incommensurable or have a weakly comparability of values as they are commensurable indicators based on a common, monetary measurement unit. WM seem to be stuck between orthodox and heterodox economics. Spash (2013), for instance, criticized the ISEW as a pragmatic and shallow tool that overrules Daly and Cobb's deep concern for community (see Section 3.1). More than thirty years after Daly and Cobb's pioneering work, it is clear that these pragmatic tools, developed to convince policy-makers and mainstream economists, had little impact on policy-making (Bleys and Whitby, 2015; Corlet Walker and Jackson, 2019). We sought to address this criticism by connecting the construction of WM to feminist and ecological economics' ideas and by making unpaid care work, the environment and community more visible than before. First, unpaid care work was established as the indicator's base and is valued using average wages. Second, shifting ecological costs in time and space is registered as a monetary cost in the broad welfare interpretation.

The narrow and broad WM compiled in this study reveal different time and boundary views. If one "would only look at current experiences, then this could mistakenly lead to the conclusion that one can happily enjoy experiences in the present while depleting physical capital and plundering the planet" (Van der Slycken and Bleys, 2020). Our results suggest, on the one hand, that negligible narrow ecological costs decreased. On the other hand, substantial broader ecological costs increased, which indicates that Belgium is increasingly shifting ecological costs in time and space. Therefore, we would suggest to use the broad perspective on ecological costs as this is more consistent with an ecological economics view of looking at the costs shifted in time and space, which are overlooked in the narrow perspective. "Fully accounting" for these costs would better inform policy-makers about the adverse effects of economic activities. This position is shared by Clarke (2007), who argued that WM should account for the environmental costs that are outsourced to other regions. Moreover, this way, attention is paid to the "margins", that is to those who are marginalized in the growth economy, as recommended by Hanaček et al. (2020). Yet, since this study only includes domestic social costs, it does not account for the social costs shifted to the margins of the growth economy. Future research could explore how to integrate social costs caused abroad in WM. Furthermore, using the broad WM would also treat physical capital consumption as detrimental to welfare and signal if regions have steady-state economies, in which stocks of physical wealth (artifacts) remain constant (Daly, 1974). Our results give no evidence of physical capital consumption, nor of a steady-state economy (Daly, 1974) as Belgium's physical capital stock is growing because of its positive capital adjustments.

Critics may argue that the broad welfare interpretation is prone to double-counting, since the items climate breakdown and the transition costs of non-renewable energy sources are capturing the same and are both related to climate change goals and the use of fossil fuels. We acknowledge this concern, however, this is an intentional designer's choice as both items are each measuring a separate cost. Climate breakdown is tracing the damage costs related to pollution, while the transition investments are measuring depletion. Both are related to the economy's throughput of fossil fuels. Yet, the former captures the effects at the output side, whereas the latter is concerned about the economy's inputs. Critics may further argue that the marginal social cost of carbon is high. In a similar way, we would argue that it is only an *approximation* of the damage costs related to emissions. Ackerman and Stanton (2012) explained that under reasonable assumptions "the exact value of the social cost of carbon loses importance: the clear policy prescription is to reduce emissions as rapidly as possibly, and cost-effectiveness analysis offers better insights for climate policy than cost-benefit analysis". Yet, this is not what happens in practice. Mainstream neoclassical economists and many integrated assessment models (IAM) do balance costs and benefits of climate policy and take the growth paradigm as given – see for instance Nordhaus's work (2008, 2018a, 2018b) – instead of abandoning growth as an economic policy goal. WM could play a role here in providing empirical arguments to question the growth paradigm and explore other goals, as we will argue in the next section, that are compatible with drastic emission reduction trajectories required to prevent abrupt disruptions caused by climate breakdown.

5.2 Toward a disaggregated dashboard approach

The results over the entire period provide no evidence of the threshold hypothesis, nor of a decoupling between welfare and growth. Nonetheless, the findings provide clear evidence to de-emphasize GDP and its growth because there is a growing divergence between GDP and WM during periods of economic growth and a decreasing divergence during a period of economic downturn and stagnation. Yet, it is crucial to look at the detailed welfare categories since the outcome and trends of WM ultimately depend on the design, weights and sometimes "market prices" of the different welfare categories. The positive aggregate welfare trends did result in a higher social and ecological burden (if a broad ecological view is adopted). These undesirable trends do not impact the monetary aggregate that much since the quantitative importance of net consumption (even after inequality correction) and unpaid work outpaced rising social and ecological costs.

A closer inspection of WM+'s welfare categories, shows one desirable and four undesirable trends, while it can be questioned whether the evolutions of two categories are desirable. The only category that clearly showed a desirable evolution are the welfare losses from inequality, which reduced because the sharp decline in inequality more than compensated rising consumption expenditures. The fact that social and ecological costs increased and the government cut its non-defensive expenditures are undesirable welfare trends. Another undesirable trend is a reduction in the time dedicated to household work – the value of unpaid work increased over time, but this trend was driven by rising average wages which compensated a slight decline in the time devoted to unpaid work between the two datapoints available. Although more research is needed to provide frequent time use data, we can safely label the decline in the amount of unpaid work between 2005 and 2013 as an adverse time use trend. Net consumption expenditures increased, however, from a well-being perspective it is questionable whether this consumption growth is beneficial to welfare and well-being as well-being studies indicate that more consumption even reduces well-being (Easterlin, 2003; Frank, 2000; Kasser, 2002; Jackson and Marks, 1999). Finally, it is also questionable whether the increase in capital adjustments is a desirable evolution. Daly (1974), for instance, reasoned that non-growing steady state economies would not have an increasing, but a constant stock of physical wealth (artifacts) – together with a low throughput of materials and energy. From this viewpoint, zero net capital stocks would be desirable. Since WM have dashboard-like features that allow us to trace changes in contributing items (Berik 2020), we recommend to adopt a disaggregated dashboard approach by looking at the welfare categories (and items) separately and targeting to reduce social costs, ecological costs and inequality measured by the adjusted Atkinson Index.

Future research could explore how to overcome the methodological and empirical shortcoming that continuous increases in consumption are beneficial to welfare. One approach could be to decommodify the indicator, for instance, by valuing personal care work, leisure or by introducing a consumption cap. This could be a research project in which feminist and ecological economists could collaborate in the future – Berik (2018) already articulated the desirability of such a collaboration in moving toward a sustainable future, while Gerber and Gerber (2017) argued decommodification may be the best option toward a post-growth future and thus should be a foundation for ecological economics. Yet, failing to address the commodification bias could mean that WM fail to capture certain desirable welfare trends. While Berik (2020) argued the GPI "uniquely suited to evaluate the impact of policy proposals", future research may be needed to investigate how WM would respond to a policy of reducing working hours, which may be good for reducing unemployment and environmental pressure, while boosting people's well-being (Coote and Franklin, 2013; Kallis et al., 2013).

To better inform policy-making, Berik (2018) proposed to complement WM with a narrative approach. We would argue that a degrowth narrative of living well with less consumption would help to explore paths toward a desirable, just and life-sustaining future. Policy-makers need to measure economic performance differently and have other economic targets because GDP is missing important welfare elements. If one looks at the disaggregated welfare categories and the non-monetary data behind these categories, then WM have a crucial role to track policy-makers' success in going beyond growth and prioritizing goals such as well-being, justice and ecological sustainability.

6. Conclusion: toward a 2.0 methodology

This paper attempts to standardize the methodology of welfare measures (WM), such as the ISEW and GPI by addressing the cross-time and cross-boundary issues involved and the discussion on Fisherian versus Hicksian income as theoretical underpinnings. Two WM with distinct time and boundary views to deal ecosystem costs and physical capital changes are compiled for Belgium from 1995 to 2018: the narrow WM- only looks and the present and within domestic borders and the broad WM+ also looks at the impacts of present activities that are shifted in time and space. The results indicate that there are substantial and increasing ecological costs that are shifted in time and space in WM+, while the present ecological costs within domestic borders in WM- are negligible and decreasing.

This study does not provide evidence in favor of the threshold hypothesis as all WM also improved, alongside GDP. Nonetheless, we observed that our suggested measure, i.e. WM+, diverged from GDP during periods of economic growth, whereas the gap converged during the economic recession and stagnation after the financial crisis in 2008. Furthermore, the positive aggregate welfare evolutions came at an increasing social and overall ecological burden. This clearly shows that GDP should be dethroned as economic policy goal as it is missing important welfare trends. Since important information is lost during the aggregation procedure, we advise to look at WM's disaggregated welfare categories to successfully evaluate economic performance.

Future studies should carefully consider the time and boundary views to allow consistent estimates. We argued to use WM+ as it accounts for the ecological costs shifted in time and space, which is more compatible with an ecological economic position and accounts for the consumption of physical capital. Therefore, we believe it to be more informative for policy-making. The narrow WM- is less useful for 'full' accountability or policy-making as it only includes present ecological costs that happen within borders and regard physical capital consumption as beneficial to welfare.

Furthermore, we argued to make WM not only more compatible with ecological economics but also with feminist economics. To do so, we revalued unpaid work by de-emphasizing consumption as the indicator's base and discounted a part of consumption to account for the impacts of relative income on social comparisons and individual's well-being. Nevertheless, consumption remains an important welfare category. Other methodological novelties are that this study is the first to adopt a consumption footprint view for the emissions embodied in trade and air pollution, to register the climate impacts of aviation and shipping and to include an approximation for the shadow economy. Such a beyond border viewpoint would better inform policy-making about the impacts abroad and importance not only to reduce domestic emissions but also to devise policies like a carbon border adjustment tax to reduce the emissions embodied in trade (Van der Slycken and Bleys, 2020).

Finally, practitioners should be cautious not to design a pragmatic tool meant to break GDP's dominance, but that fails to see cost-shifting as an important part of economic activities or that overestimates the importance of consumption in achieving well-being. Future research could investigate how these type of indicators could go beyond consumption and commodification. Designing welfare indicators that better reflect the contributions of the environment and society to economic welfare, besides the mere economic contributions, would further increase their existing debunking, policy-guiding and transformative potential. Calls made to question the growth paradigm, materialism and consumption would then be defended by the results of more thorough WM, as they offer building blocks and compelling empirical arguments for a social-ecological transformation of well-being economies that are socially and ecologically healthy.

Acknowledgements

We gratefully acknowledge that this research is supported by a doctoral fellowship from the Special Research Fund (BOF) of Ghent University and we would like to thank our colleague Bart Defloor for sharing his thoughts and comments that helped to improve an earlier draft of this article.

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