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Survey

Green goals and full employment: Are they compatible?

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ABSTRACT

Two empirical correlations are studied: one between economic growth and environmental impacts, and the other between the lack of economic growth and unemployment. It is demonstrated that, at a global level, economic growth is strongly correlated with environmental impacts, and barriers to fast decoupling are large and numerous. On the other hand, low or negative growth is highly correlated with increasing unemployment in most market economies, and strategies to change this lead to difficult questions and tradeoffs. The coexistence of these two correlations – which have rarely been studied together in the literature on "green growth", "degrowth" and "a-growth" – justifies ambivalence about growth. To make key environmental goals compatible with full employment, the decoupling of environmental impacts from economic output has to be accompanied by a reduction of dependence on growth. In particular, strategies to tackle unemployment without the need for growth, several of which are studied in this article, need much more attention in research and policy.

1. Introduction

This article is motivated by the observation of two empirical correlations. One is between economic growth and global environmental impacts; the other is between the lack of economic growth and unemployment. These correlations and our ability to influence them are decisive for environmental sustainability and human well-being.

Due to the importance of both relationships, it is not surprising that they received considerable attention in their respective fields. The relationship between economic growth and environmental impacts has been increasingly investigated in environmental and sustainability science since the 1970s (e.g., Grossman and Krueger, 1991; Meadows et al., 1972; Stern, 2004; UNEP, 2011), while the relationship between (negative) growth and unemployment has been central to economics for even longer (e.g., Ball et al., 2013; Okun, 1962; Prachowny, 1993). What is surprising, though, is that in spite of the importance and relatedness of the two correlations, very few people have studied them together.[1] Mainstream economists have not fully recognized the challenges of decoupling environmental impacts from economic output, whereas scholars of sustainability science have not paid enough attention to the growth–unemployment relationship. This has hindered the emergence of a coherent and realistic vision to reconcile socio-economic and environmental objectives.

The aims of the investigation are threefold: to briefly review the main features of the two correlations at the global/cross-national level, to study prospects of change in both correlations, and to better understand what strategies may help to solve environmental and unemployment issues simultaneously. The analysis has important implications for the feasibility of existing growth strategies such as "green growth" (sustainable economic expansion), "a-growth" (indifference about growth) and "degrowth" (sustainable economic contraction). While acknowledging the good intentions behind and reasonable arguments for all these strategies, weaknesses of each are pointed out. The paper argues for a fourth position which permits ambivalence about economic growth and puts the reduction of dependence on growth in the center of attention. Ultimately, this may result in more coherent policy advice from economic and sustainability science.

The main limitation of the study is due to the global/cross-national level of the analysis. It can be argued that the set of indicators considered is arbitrary and incomplete, that data quality is low and uncertainties are large, and that the observed correlations can be influenced by factors not discussed in the present paper. All of these objections are valid, perhaps even unavoidable at this level of analysis. However, this is not a sufficient reason to restrict investigations to lower levels because global-scale, systemic conclusions cannot be drawn by focusing on individual countries or issues. If, for example, global environmental sustainability conflicts with high (or even positive) growth rates of the world economy, then the unemployment response to low or negative growth has to be studied in many countries to answer the title question. It may turn out that green goals and full employment are incompatible. Without identifying this contradiction, the need for systemic change – e.g., radically new employment strategies that can

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[1] There is no relevant search result in the Web of Knowledge, Scopus and ScienceDirect database for the combination of keywords from the two areas ("Decoupling" and "Okun's law", or "Kuznets" and "Okun").

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solve unemployment in non-growing economies – can remain hidden, which may lead to dismal environmental or social consequences. Therefore, combining the global analysis of the correlation between growth and environmental impacts with the cross-national study of the growth–unemployment relationship is extremely important.

The article is structured as follows. Section 2 gives a brief literature-based overview of the connection between economic growth and environmental impacts, and examines factors that will influence the future of this relationship. Section 3 studies the connection between (negative) growth and unemployment in a similar manner, but in somewhat more detail. Section 4 assesses implications for macro-level strategies. Section 5 concludes.

2. Correlation Between Economic Growth and Environmental Impacts

2.1. The Importance of the Correlation

On a global level, past economic growth has been accompanied by increasingly serious environmental problems including climate change, various types of pollution, and the loss of biodiversity and ecosystems (McNeill, 2000). Leading scientists and institutions repeatedly called for immediate, forceful and persistent action to mitigate these problems (Ehrlich and Wilson, 1991; Foley, 2009; IEA, 2013; IPCC, 2014; MAHB, 2013; Novacek and Cleland, 2001; Rockström et al., 2009). If economic growth continues, these are calls for fast and sustained absolute decoupling[2] between GDP and environmental impacts. Whether sufficiently fast decoupling is feasible is central for sustainability: if not, then output growth[3] is unsustainable, so welfare-decreasing changes in the global socio-ecological system are unavoidable. Since the 1970s, this has been a major concern of environmental and sustainability science, which, however, has been almost completely ignored by mainstream economics and politics (Daly, 2013).

There are two possible reasons for this ignorance. First, one may believe that the feasibility of fast decoupling is irrelevant because environmental sustainability is less important than economic growth. Although this position has few vocal advocates and no reasonable justification, it is likely that many economists and decision makers formally committed to sustainable development have implicitly subscribed to it. This reflects, among other things, the power realities of contemporary societies: those who suffer the most severe consequences of environmental degradation are usually much less influential than those who reap the largest benefits of growth.

Second, one may believe that environmental problems can be meaningfully mitigated in a growing economy because rapid absolute decoupling is possible. Whether this position is tenable will be studied in more detail below. The analysis focuses on three key drivers of environmental problems, namely energy use (and associated CO_2 emissions), materials use and land use. In Section 2.2, past trajectories are presented together with selected key facts. In Section 2.3, current trends are examined to understand how past trajectories may change in the future. Section 2.4 draws conclusions.

2.2. Past Correlations and Trends

Fig. 1 shows historical trends of the gross world product (GWP), energy use and energy related carbon emissions.

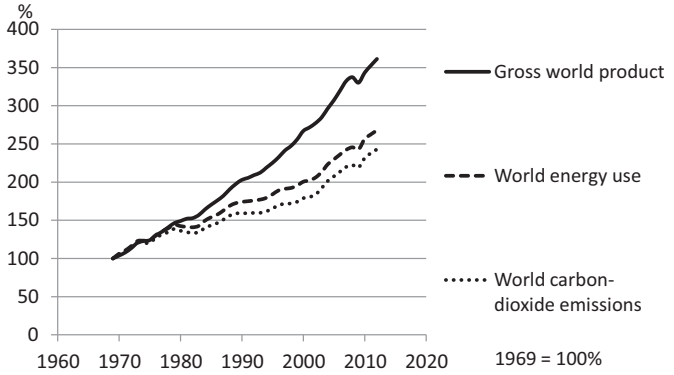

Fig. 1. GWP, world primary energy use and world carbon-dioxide emissions (through the consumption of oil gas and coal) from 1969 to 2012.
Source: BP (2013).

Key facts: 1) The annual growth of GWP is a major determinant of the annual increase of atmospheric CO_2 concentration (Tapia Granados et al., 2012). 2) There is no country-level evidence for fast and sustained absolute decoupling for energy use (Luzzati and Orsini, 2009) or CO_2 emissions (Bassetti et al., 2013; Cavlovic et al., 2000; Huang et al., 2008; Itkonen, 2012). 3) Approximately 3% annual reduction of CO_2 emissions would be necessary according to UNEP (2013a) and 6% according to Hansen et al. (2013).

Fig. 2 shows the historical trends of GWP and global materials consumption.

Key facts: 1) Global materials use – just like energy consumption – reacted sensitively to recessions and economic slowdowns, with concomitant negative changes (Krausmann et al., 2009). 2) Demand increases sharply in emerging economies and stabilized at very high per capita levels in several industrialized countries (UNEP, 2011). 3) Current modes of development, both for emerging and already industrialized economies, are fundamentally unsustainable (Steinberger et al., 2013).

Fig. 3 shows global patterns of agricultural land use.

Key facts: 1) Quantifying global land use change is difficult due to the limited availability of high quality time-series data (Choumert et al., 2013; Gibbs et al., 2010; Phalan et al., 2013). 2) The growing demand for agricultural products had very large negative impacts on ecosystems (Foley et al., 2011, 2005; Ramankutty et al., 2008), especially in tropical countries (Gibbs et al., 2010; Phalan et al., 2013). 3) In a debate organized by *The Economist*, 77% of voters disagreed with the statement that economic growth is good for biodiversity (The Economist, 2013).

Unsurprisingly, aggregate environmental indicators for the world never show absolute decoupling (Aşıcı, 2013; Bradshaw et al., 2010; Caviglia-Harris et al., 2009; Dietz et al., 2007; Spangenberg, 2001). Indeed, studies generally find a monotone relationship between GDP and such indicators already at the country level (Aşıcı, 2013; Caviglia-Harris et al., 2009), especially if the leakage of environmental effects between countries is accounted for (Ghertner and Fripp, 2007; Suri and Chapman, 1998; Wiedmann et al., 2013). Globally, increasing GDP may well be the most important driver of environmental impact (Bradshaw et al., 2010; Dietz et al., 2007).

2.3. Prospects of Change

If quick and sustained absolute decoupling has not happened until now, the question is whether prospects for the future are better. It is clear that environmental efficiency can be improved in every major field and that policies to stimulate such improvements have been very weak until now. However, there are several reasons to be very skeptical about quick absolute improvements.

[2] Absolute decoupling means that the absolute level of environmental impact is reduced in a growing economy. The reduction of environmental impact per unit of GDP is called (relative) decoupling. Any decoupling can happen due to the reduction of resource use per unit of GDP or the reduction of the environmental impact per unit of resource use (UNEP, 2011).

[3] "Output growth", "GDP growth", "economic growth" and (in some cases) "growth" are used interchangeably.

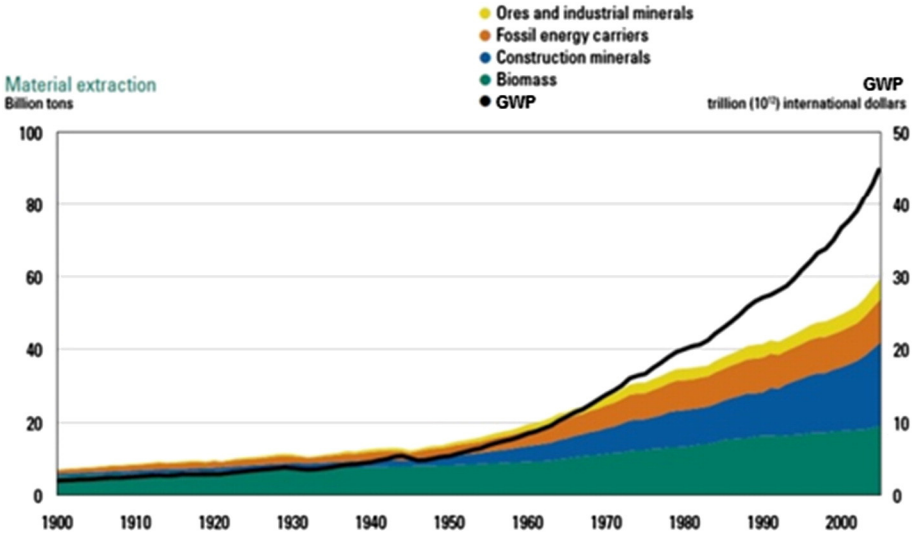

Fig. 2. GWP and global materials use.
Source: UNEP (2011).

2.3.1. Geopolitical Reasons

More than half of the growing world population lives in countries where relatively fast GDP growth goes along with a transition toward a resource intensive lifestyle. Therefore, global energy demand is set to grow by 25% in the next decade alone, and the world is not at all on track to reduce the carbon intensity of the energy sector to compensate this (IEA, 2013). Similarly, materials consumption in emerging economies is expected to increase quickly even in the most ambitious – already politically unfeasible – future scenarios. Industrialized countries would have to reduce their consumption by a factor of 3–5 by 2050 to just stop the growth of global demand for raw materials (UNEP, 2013b, 2011). Furthermore, GDP growth in developing countries is a main determinant of rising demand for animal products which have large ecological impacts through land use (Speedy, 2003; York and Gossard, 2004). As more than 3 billion people are moving up the food chain (Bonhommeau et al., 2013; Brown, 2012), negative environmental effects will continue unless radical action is taken, for instance, to sharply reduce the consumption of animal products in rich countries (Lal, 2008; McMichael et al., 2007; Neset and Cordell, 2012; Popp et al., 2010; Powles, 2009). In addition to rising absolute demand, environmental impacts can be expected to grow due to the increasing share of more resource intensive, less environmentally regulated regions in production (Bruckner et al., 2012; Feng et al., 2013; Peters, 2008; Steinberger et al., 2012). Reducing the material intensity of emerging economies is particularly difficult because the role of circular material flows is limited when the total stock of materials in use grows (e.g., Müller et al., 2011).

The required major change of resource consumption trajectories looks politically impossible for several reasons. Vested interest groups do not seem to lose power (MapLight, 2013), myopia, selfishness and barriers to environmental concern persist (Takács-Sánta, 2007), and problem solving is increasingly difficult due to the growing complexity of socio-technological systems (Antal and Hukkinen, 2010; Homer-Dixon, 2000). In sum, geopolitical factors increase environmental impacts very quickly but the conditions of problem solving do not seem to radically improve.

2.3.2. Economic Reasons

Another group of difficulties is the result of simple economic logic, namely that cheaper options are used first to achieve any given goal through an economic activity. For this reason, most easily available energy sources and materials have already been used up. The extraction of remaining stocks is an increasingly pollutive and energy intensive process and in most cases technological improvement cannot offset this (Davidson and Andrews, 2013; Davidson et al., 2014). For oil, energy-return-on-investment declined significantly in the first years

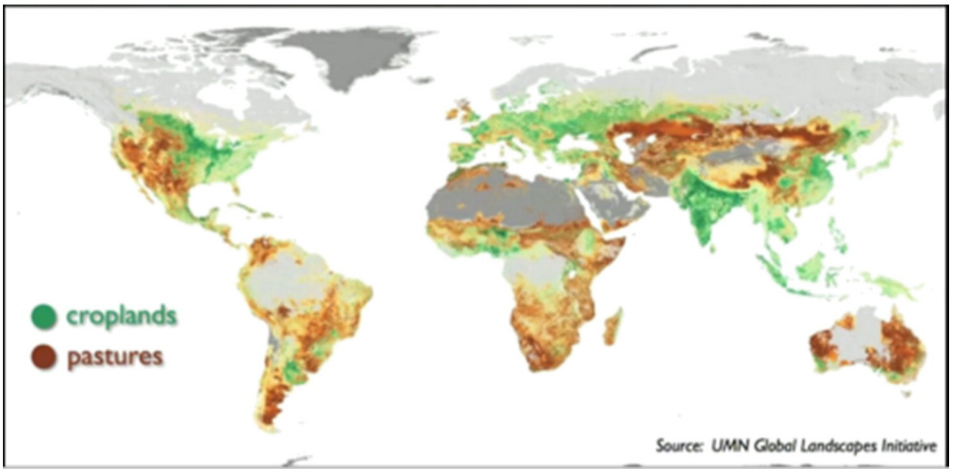

Fig. 3. Global patterns of agricultural land use in 2010.
Source: Foley (2010).

Table 1
Is quick absolute decoupling possible? Focus on energy (E), materials (M), and land (L) use.

	Global resource use (biophysical terms)	Impact per unit of resource
Factors that increase environmental pressure	– More than 3 billion people (and growing) in emerging economies: –> Rapid growth of resource use (E, M, L) –> Increasing weight of more energy and material intensive economies (E, M)	– Shift of extraction/production to countries with weaker environmental regulation, more pristine nature (E, M, L) – Less available fossil fuels, falling ore grades (E, M, L) – Circular material flows limited in emerging economies (M)
Factors that prevent fast decoupling	– Socio-technological lock-in (E, M) – Theoretical limits of efficiency not too far in certain cases (E, L) – Gradually more difficult to improve environmental efficiency (E, M, L) – Increasing complexity of systems to be regulated (E, M, L) – Vested interests, myopia, selfishness, non-compliance (E, M, L)	– Substitution of harmful materials limited by physical and chemical properties (M)
Factors that offset improvements	– Rebound (E, M, L) – Shifting of environmental problems (E, M, L)	

of the 21st century (Dale et al., 2011; Gagnon et al., 2009; Murphy, 2014). As production moves to off-shore sites, arctic waters and unconventional sources, this trend can be expected to continue. Moreover, drilling now threatens invaluable conservation areas such as the Yasuní National Park in Ecuador. For minerals and metals, ore grades are rapidly falling worldwide (Bardi, 2014; Prior et al., 2012). As a result, environmental burdens per unit of resource use are rising. There is no easy solution because opportunities for the substitution of materials are limited by physical and chemical properties (UNEP, 2011).

Besides aggravating environmental problems, the 'easy-options-first' logic complicates solutions: after easy measures to improve efficiency are exhausted, further improvement requires more technologically challenging or socially controversial actions (Næss and Høyer, 2009). Therefore, progress in environmental problem solving can slow down — especially in areas where efficiencies are already approaching their absolute physical or biological limits. Grain yields, for example, have started to plateau in agriculturally advanced countries, which increases pressure on uncultivated land (Brown, 2012; Ray et al., 2012). The importance of such concerns will grow quickly if efforts to address environmental problems are substantially increased.

2.3.3. Systemic Reasons

A third group of problems with quick decoupling has systemic origins. Through direct and indirect mechanisms, efforts to improve environmental efficiency can have unintended consequences. In energy conservation, for example, several types of rebound effects may partly, fully or more-than-fully offset environmental gains. Although these effects can rarely be quantified with much confidence (Sorrell, 2007; Turner, 2013), most estimates range from non-negligible (≈10%) to very high (>50% or even >100%) values. Certain rebound effects are becoming increasingly important due to the rapid growth of highly resource intensive economies (Antal and van den Bergh, 2014).

Furthermore, efforts to solve one environmental problem often create or aggravate other problems. Renewable energies that reduce carbon emissions can exacerbate land use or water conflicts (Havlík et al., 2011; Scheidel and Sorman, 2012; Yang et al., 2012) and significantly increase metal demands (Kleijn et al., 2011; Vidal et al., 2013). Minimizing environmental effects during and after mineral resource extraction often requires large amounts of energy (Johnson and Hallberg, 2005). The land sparing strategy of agricultural intensification increases energy input and environmental burdens (Diaz and Rosenberg, 2008; Matson et al., 1997). The list could be continued indefinitely.

A last systemic reason that slows down decoupling is socio-technological lock-in. One important cause for this is investment in long-lived infrastructure that is environmentally unsustainable (World Bank, 2012). For climate change, all carbon emissions permitted in the 2 °C scenario will be locked-in by 2017 (IEA, 2012). In addition, several economic, political, social, institutional and behavioral factors contribute to lock-in, including economies of scale, sunk investments in competencies, and the power of incumbent actors to block transitions (Unruh, 2000). Further causes are shared beliefs and discourses, standards and regulations that inhibit radical innovation, habits and routines, and the adjustment of consumer lifestyles to existing technological systems (Geels, 2011).

Path dependence can be particularly strong if long-term decisions enabled by technology put environmentally appropriate behavior and basic human desires at odds with each other. For example, mobility enabled by cheap air travel may create a tradeoff between greenhouse gas emissions and seeing one's family. More generally, whenever pollutive technology increases speed, the dilemma is between saving time and reducing pollution. Whenever it increases productivity, the tradeoff is between success and pollution. It seems unlikely that all such mechanisms and pathways can be changed very quickly.

2.4. Summary

There are many reasons to believe that neither resource use per unit of output, nor environmental impact per unit of resource will decline fast enough to overcompensate global economic growth by a sufficiently wide margin to meaningfully reduce a number of crucial environmental problems simultaneously.[4] Table 1 summarizes factors that increase environmental impacts, work against rapid decoupling, and offset improvements.

3. Correlation Between Lack of Economic Growth and Unemployment

3.1. The Importance of the Correlation

GDP growth is valued for several reasons (Antal and van den Bergh, 2013). Perhaps the most important reason is that unemployment tends to rise when growth is not sufficiently fast. How strong is this negative correlation and what changes can be expected in the future?

The answer largely determines the importance of economic growth for the well-being of people. Unemployment plays such a central role because it can affect many people and it reduces the well-being of those affected very much (Murphy and Athanasou, 1999; Winkelmann and Winkelmann, 1998). Therefore, if economic growth is very important to avoid mass unemployment, then it can be expected to be very high on the agenda of decision makers. A weaker correlation would not, in itself, justify the quest for growth.

[4] Today, even open-minded economists recognize this. In a survey of leading Dutch economists the majority believed that economic growth is bad for the environment (van Dalen and Koedijk, 2013).

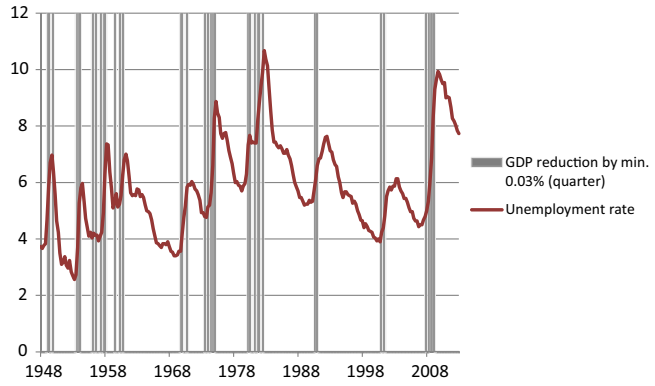

Fig. 4. Recessions and unemployment in the United States since 1948. Data from the U.S. Bureau of Labor Statistics.

3.2. Past Correlations and Trends

To begin with an example where the growth–unemployment correlation is unmistakable, Fig. 4 shows the unemployment rate in the United States from 1948 to 2012. Shaded areas are quarters when real GDP was less than 99.97% of the previous quarter. It is clear that even a minimal contraction of the economy goes along with increased unemployment. The correlation between the two variables is strong: a few consecutive quarters of GDP reduction is usually accompanied by a significant rise in unemployment. Furthermore, every time when unemployment increases significantly, economic contraction appears to be one of the contributing factors.

The empirically observed relationship between changes in unemployment and changes of real GDP is called "Okun's Law"[5] (Okun, 1962). Its textbook version for the USA says that every 2% deviation of economic growth from its average value (approximately 3%) corresponds to −1% change in the rate of unemployment (Mankiw, 2010). Mathematically: $\Delta u = 1/2 \cdot (3 - Growth\ \ rate)$ where Δu is the percentage change in unemployment from one year to the next and *Growth rate* is the percentage change of real GDP.

While the growth–unemployment relationship is not always as clear-cut as in the USA, the existence of a similar relationship has been confirmed for individual states of the USA (Blackley, 1991), all studied OECD countries (Freeman, 2001; Kaufman, 1988; Lee, 2000; Moosa, 1997; Paldam, 1987; Perman and Tavera, 2005), several other market economies (Hanusch, 2012; Izyumov and Vahaly, 2002; Noor et al., 2007) and various panels of countries and states (Huang and Yeh, 2013). The general conclusion of these studies is that a significant negative correlation exists between economic growth and unemployment in capitalist economies, but differences between countries are large. If the relationship is written in its simplest form as

$$\Delta u = 1/c \cdot (k - Growth\ \ rate) \quad (1)$$

then c and k differ across countries.

The heuristic reason for the negative correlation is simple: if labor force (L) or labor productivity (P) grows,[6] then normally an economic growth rate of $k = \Delta L/L + \Delta P/P$ is needed just to hold the unemployment rate steady, while reducing it requires even faster growth (Bernanke, 2012). Country differences in c may arise from differences between labor market rigidities: unemployment tends to react more sensitively to changes of GDP if the labor market is more flexible (Cazes et al., 2011; IMF, 2010; Lee, 2000; Moosa, 1997; Sögner and Stiassny, 2002). The concrete form of the equation used and numerical results vary due to specifications such as assuming a contemporaneous or lagged relationship, considering or not considering other variables (like labor force participation, working hours and capacity utilization), the method of extracting the cyclical components of unemployment and output, the sample period and other factors (Moosa, 1999).

Accordingly, there is a range of estimates for the sensitivity of the growth—unemployment relationship. If a simple linear equation such as Eq. (1) is used, values for c usually vary between approximately 1.5 and 6. Countries with a very rigid labor market, like Japan, can have a c value above 10 (Hamada and Kurosaka, 1984; Moosa, 1997). These numbers have to be interpreted with precaution because it is questionable whether the relationship is linear (Virén, 2001), symmetrical (Cuaresma, 2003; Harris and Silverstone, 2001; Holmes and Silverstone, 2006; Silvapulle et al., 2004) or stable in time (Huang and Lin, 2008; Knotek, 2007; Sögner and Stiassny, 2002; Weber, 1995).

Nevertheless, only the particular form of the equation is debated by the overwhelming majority of relevant studies, not the existence of the negative correlation itself. While it is probably impossible to identify a single "precise" form of the relationship due to the numerous alternative methods of measurement, there are strong reasons to believe that the simple original equation is still reasonably accurate (Ball et al., 2013). After several decades of application and repeated assessments, Okun's law has been argued to be one of the most enduring stylistic facts in macroeconomics (Freeman, 2001), one of the very few almost universally accepted core beliefs (Blinder, 1997). It is widely used by macroeconomists (Friedman and Wachter, 1974; Sögner and Stiassny, 2002) and professional economic forecasters around the world (Mitchell and Pearce, 2009; Pierdzioch et al., 2012; Rülke, 2012).

What does the existence of this durable statistical relationship mean from the perspective of this study? The qualitative message is that in the absence of growth unemployment can generally be expected to increase in market economies. The negative correlation between growth and unemployment is typically strong enough to make growth an important political priority, at least in the sense that longer periods of low or negative growth are socially damaging. In most countries the statistical average of the annual rise of unemployment is in the 0.2%—1.5% range for zero growth, and in the 0.4%—3% range for a few percent (1–3%) negative growth.

Higher values of the unemployment response – usually corresponding to countries with flexible labor markets – show a strong and direct dependence of well-being on economic growth. In the longer term, countries with a moderately sensitive relationship are equally growth dependent: if, for any reason, the unemployment rate is high, then in most cases rapid or sustained economic growth is needed in these countries to reduce it. As only an extremely insensitive growth–unemployment relationship can prevent the rise of unemployment during longer periods of low or negative GDP growth, such periods reveal the growth dependence of almost all capitalist economies.

The conclusion that growth is currently necessary to avoid mass unemployment in market economies does not depend on the particular form or the long-term stability of the equation that connects the two variables. In fact, continuous labor productivity growth itself makes output growth necessary to prevent the rise of unemployment, unless labor input is reduced. But increasing labor productivity provides competitive advantage for employers. The result is the so-called "productivity trap" of capitalist economies (Jackson and Victor, 2011). The present analysis shows that this theoretical prediction about the necessity of growth to avoid unemployment can be empirically observed, namely in the form of Okun's law. Furthermore, empirical data suggest that country-specific institutions and regulations can significantly alter the unemployment response to reduced growth. Hence, the key question is what strategies could help to keep unemployment low without the need for growth.

[5] Or "Okun's rule of thumb" because it is not a theoretically derived deterministic "law".

[6] Labor productivity means economic output per worker per hour. Market competition forces firms to increase profits, which often happens through increasing labor productivity.

3.3. Prospects of Change

Possible changes of the growth–unemployment relationship can fall into two major categories. First, it is possible that Okun's law remains statistically valid, but its parameters change significantly. Second, the law may become statistically weaker or lose its relevance entirely. Both options are discussed below.

3.3.1. Changing Parameters in Okun's Law

If Okun's law remains valid, then the question is how parameters of the equation that describes the relationship will change. Thinking in terms of the simplest model (Eq. (1)), the question is how the values of c and k will change. While uncertainties are large, recent trends may provide some indication.

There seems to be a consensus view that the sensitivity of unemployment to changes in GDP ($1/c$) has increased over time (Cazes et al., 2011; Gordon, 2010a; Kaufman, 1988; Moosa, 1997; Sögner and Stiassny, 2002). One likely reason for this is labor market liberalization. Another contributing factor can be the reduced bargaining power of workers versus firms due to stronger international competition, increased mobility of labor, increased inequality and weaker unions. A third possible explanation is that employers are now more willing to lay off workers because turnover costs are reduced (e.g., because hiring is easier via the internet) or because they fear that recessions would be more severe than previous downturns. None of these factors are very likely to change quickly and radically on a global scale so as to reverse the trend. Even more unlikely is a global shift toward c values that are high enough to meaningfully reduce dependence on growth. Moreover, a rigid but statistically valid relationship between growth and unemployment would not be a solution in many countries where unemployment is currently high.

On the other hand, changes of the trend growth (k) may, to some extent, help reduce dependence on growth. This is because global population growth is slowing down and labor productivity growth may decelerate in several rich countries as well. According to Gordon (2013), two important headwinds for productivity growth in the United States are the decreasing importance of inventions (e.g., running hot water vs. the internet vs. Facebook) and the fact that the new generation is not better educated than the previous one. These headwinds may soon affect other rich countries.[7] Natural resource scarcities or stringent environmental policies may further reduce productivity growth. As a result, low growth may become more tolerable from an unemployment perspective. However, productivity growth is not likely to turn negative soon, so k values will probably not decline enough to enable GDP reductions without increases in unemployment. In addition, less affluent countries still have much room to increase labor productivity, so the (hypothetical) global trend growth may even increase.

Although reducing dependence on growth looks difficult if Okun's law remains valid, the case of Japan is worth mentioning here. Japan managed to keep unemployment low (and well-being high) during two decades of low growth. Between 1992 and 2011, average GDP growth in Japan was 0.77%, while unemployment increased from 2.2% to only 4.5% (Statistics Bureau of Japan, 2014; World Bank, 2014a, 2014b). Factors that probably helped to prevent a larger increase are very low job separation rates, a roughly 20% share of informal lifetime employment contracts (Ono, 2010), a decline in the length of the workweek,[8] and low productivity growth (Hayashi and Prescott, 2002). This trajectory may look attractive for those concerned about the environment, but its economic sustainability is questionable. Government debt, for instance, ballooned from 49% of the GDP in 1992 to 190% in 2011, which is a great concern even if 95% of this debt is held domestically. Moreover, it is not even sure that economic growth was really so low. It has been convincingly argued that official growth figures have been distorted downwards to help Japan's trade (Fingleton, 2011). This would not only explain low unemployment but also the extraordinary increase of trade surplus and the appreciation of the yen during the "lost decades". In light of these complexities it is difficult to tell whether the case of Japan gives any guidance on how to run an economy without growth.

3.3.2. Weakening Okun's Law

There is a diverse set of economic and political strategies that may reduce the validity of Okun's law. Some of these would merely adjust existing taxes or policies while others represent a radical departure from solutions currently applied in capitalist countries. Pros and cons of a few potential strategies – in which businesses, states and communities are relied upon to various degrees to address unemployment – are briefly discussed below.

A first group of strategies would invalidate Okun's law by systematically decreasing the cost of labor. One opportunity for that, which can also help achieve green goals, is an environmental tax reform. This means increasing environmental taxes and using the revenues to reduce labor taxes. Likely consequences of such tax reforms have been modeled by hundreds of simulation studies. Meta-analyses conclude that it is realistic to expect a significant reduction of environmental impacts and a slight increase of employment (i.e., a double dividend), while effects on GDP are very small (Bosquet, 2000; Patuelli et al., 2005).[9] This looks promising to decouple both environmental impacts and employment from economic growth. However, employment gains are likely to be minor; somewhere around 0.5% for a 10% reduction of pollution (Patuelli et al., 2005). So an environmental tax reform cannot, in itself, effectively address high unemployment during longer periods of low or negative growth. It can be a useful part of a larger policy package, though.

More generally, selective employment subsidy policies may help to "repeal" Okun's law in the short run (Bishop and Haveman, 1979). By reducing the price of labor at the margin, employment is encouraged, unemployment reduced and the composition of employment shifted toward target-group workers. Driven by these objectives, hiring subsidies and subsidized short-time work programs that affect firing margins have been applied in several countries during the 2008–09 recession (Hijzen and Venn, 2011; Neumark, 2012). Effects of a new employment subsidy on Okun's law are, however, temporary and diminish as the labor market moves toward a new equilibrium. After the adjustment, dependence on growth is reduced only if subsidies went to sectors where labor productivity or labor productivity growth is low, so that the trend growth (k) is reduced (Jackson and Victor, 2011). Moreover, employment subsidies may contribute to economic growth by delivering large fiscal multipliers (Faia et al., 2013), so the systemic consequences of this strategy need careful attention if the goal is job creation without growth.

A further strategy to change marginal costs of labor and reduce employment effects of recessions is making wages more flexible, for instance by paying a base wage plus either profit-related cash bonuses or shares of the company (Weitzman, 1984). Then lower profits during an economic downturn may be translated into lower wages instead of layoffs. Due to the income risk introduced, however, the solution is less appropriate at lower salaries, especially during longer periods of low or negative growth. Moreover, as firms do not frequently offer such compensation schemes, governments would need to provide incentives or regulate and police the system. In addition, research results about the effectiveness of this strategy are, at best, inconclusive

[7] Most economists consider the slowdown of productivity growth as a major problem, not least because increasing productivity may reduce unemployment through economic growth (Pissarides and Vallanti, 2007). However, the present analysis looks at strategies that do not require growth to reduce unemployment.

[8] Kawaguchi et al. (2008) showed that monthly wages hardly changed during the reduction of legal working hours, so effective hourly wages increased. As a result, output decreased and employment did not increase.

[9] From an employment perspective, the case for an environmental tax reform is further strengthened if informal employment is considered (Markandya et al., 2013).

(Bellmann and Möller, 2010; Blanchflower and Oswald, 1987; Freeman and Weitzman, 1987; John, 1991; Nordhaus, 1988).[10] Current experiences in countries where wages are more flexible than elsewhere (such as Japan) do not give sufficient guidance. In the absence of large-scale real-world examples, the potential of this strategy to reduce dependence on growth will remain difficult to assess.

A second group of strategies is changing policies automatically when GDP decreases. The main question is whether governments have any feasible policy options to address unemployment without stimulating economic growth. Apart from employment subsidies and less powerful tools such as adult training and placement services, a further option is to increase public employment. Although generally not supported by growth-oriented macroeconomists, this is a direct way to reduce unemployment, invalidate Okun's law and serve socially useful purposes. On the other hand, it is not always a convenient solution for workers and it is not cheap for the country. Recent experiences in Hungary are informative. In 2012, public work programs involved approximately 5% of the workforce (>200,000 people). For workers, most of whom have been permanently unemployed in previous years, public work meant short-term employment for a monthly net wage of 165€. This was 20% below the net minimum wage but 70% above the allowance most participants would have received otherwise. At the country level, public work programs increased employment by 2.2% and costs made up approximately 0.85% of the national budget (447 million €) (Ministry of Human Resources, 2012). Clearly, reducing cyclical rather than structural unemployment would cost at least twice as much per employee unless large welfare losses are accepted. In addition, public work does not address the cause of cyclical unemployment, so it is not a long-term solution in market economies.

A more comprehensive, but in many ways more problematic, governmental strategy would be a job guarantee for people who are able and ready to work. This means that the state would act as an employer of last resort (Alcott, 2013). While this strategy would surely undo Okun's law and eliminate involuntary unemployment (Mitchell and Wray, 2005), there are many open questions (Sawyer, 2005). How much would a job guarantee program cost? Is it possible to offer meaningful work at the right time, right place and right level of skill for the unemployed? How would a job guarantee program influence the labor market (e.g., wages of similar private sector jobs) and productivity? In the absence of large-scale experiments, there are no definitive answers to these questions. However, costs of public work programs indicate that a job guarantee would require substantial tax increases. With a shrinking tax base during an extended period of low or negative growth and a continuous inflow of employees into the system of guaranteed jobs (which is likely because causes of unemployment in the private sector are not addressed), the likely result is much increased state influence.

If markets and states cannot provide work opportunities without large side-effects, a further option would be to rely on traditional modes of production aimed at self-sufficiency or 'sustainable community living' when unemployment increases in the capitalist system. Small scale agriculture and fisheries are shown to play such a buffering role in several countries (Béné et al., 2010; Hanusch, 2012). More self-sufficient people need less money, which makes underemployment, unemployment and exit from the labor force more tolerable. In rich countries a shift away from market solutions is seen as desirable by an increasing number of people concerned about quality differences between market and household production, and between capitalist and self-sufficient/communitarian lifestyles. Barriers to non-wage employment include the limited access to resources (such as land), the lack of skills, low economic productivity, and the attraction of an easier life through wage labor. In addition, income is still needed for social security contributions, transport, communication, and other goods and services that people want but cannot produce locally. Nevertheless, assisting unemployed or partly employed people in achieving a higher level of self-sufficiency could somewhat reduce the pressure to maintain economic growth.

If market-, state- and community-based solutions cannot create enough jobs under low or negative growth, then the total amount of work has to be reduced to invalidate Okun's law. This requires translating productivity growth into fewer working hours instead of more production and higher income. Experience shows that this is not entirely unrealistic: for instance, annual hours per employed person have been reduced by approximately 30% in several European countries since 1960 (Alesina et al., 2005). However, we are still far from a 15-hour workweek predicted by Keynes (1930) for our generation. To assess the prospects of work time reduction, the following two paragraphs highlight facilitating conditions and likely consequences of this strategy.

Studies on Europe after 1960 (Alesina et al., 2005; Gordon, 2010b) and the United States in the 1930s (Taylor, 2011) identify several factors that encourage work time reductions. First, labor taxes can discourage long hours directly by reducing net wages and indirectly as a source of welfare coverage.[11] Note that the elasticity of labor supply depends on age, gender and income. Second, incentives for firms – such as tax breaks for shorter hours and a government-endorsed 'work sharing logo' for participating companies – can help reduce working hours. Since companies may want to receive such benefits without reducing working hours, monitoring of compliance and enforcement issues are important here. Third, unions and the labor market regulations they advocate can increase leisure time. These effects can be long-lasting due to political inertia, as illustrated by the resistance against labor market reforms in several European countries. Fourth, culture is important. It influences not only macroeconomic policies and their effectiveness, but also decisions at the microlevel: if employees prefer to work more, they can find second jobs; if they prefer to work less, demand for certain goods and services can decrease.

If, for any reason, paid working hours of employed workers decline in a country, the next question is what macroeconomic and welfare consequences can be expected? The answer depends on how the decline happens. As a shift between paid and unpaid work has been discussed earlier, the focus here is on the case when leisure time increases. A crucial determinant of welfare impacts then is the distribution of work between people and within the life of each individual. Although the subjective utility of leisure is fundamentally influenced by culture and individual psychology, it is usually higher at a (very) young and (very) old age; increases with daily, weekly and annual working hours above society-specific threshold levels; and increases with others' leisure time due to lower competitive pressure and higher enjoyment of social activities. Family status, income, job type and sectoral differences can further influence perceived utilities. On the other hand, costs of work time reduction depend on its effects on labor force participation rates, unemployment and economic output. A critical issue is whether people working shorter hours get increased hourly wages: the higher the compensation, the smaller the employment gain and the larger the output reduction will be (Hunt, 1999). As in several rich countries uncompensated (or partially compensated) work time reductions can be realistic for large segments of the society, research on work sharing may reveal opportunities to reduce unemployment without growth while improving the well-being of people.

3.4. Summary

There is no silver bullet solution to unemployment in longer periods of low or negative growth. Only a context-specific combination of several strategies can be effective. Fig. 5 shows how these strategies can

[10] If job creation happens through growth, somewhat higher wage flexibility can be counterproductive in recessions caused by a liquidity trap (Krugman, 2011).

[11] As discussed earlier, labor taxes hamper other strategies to address unemployment without growth.

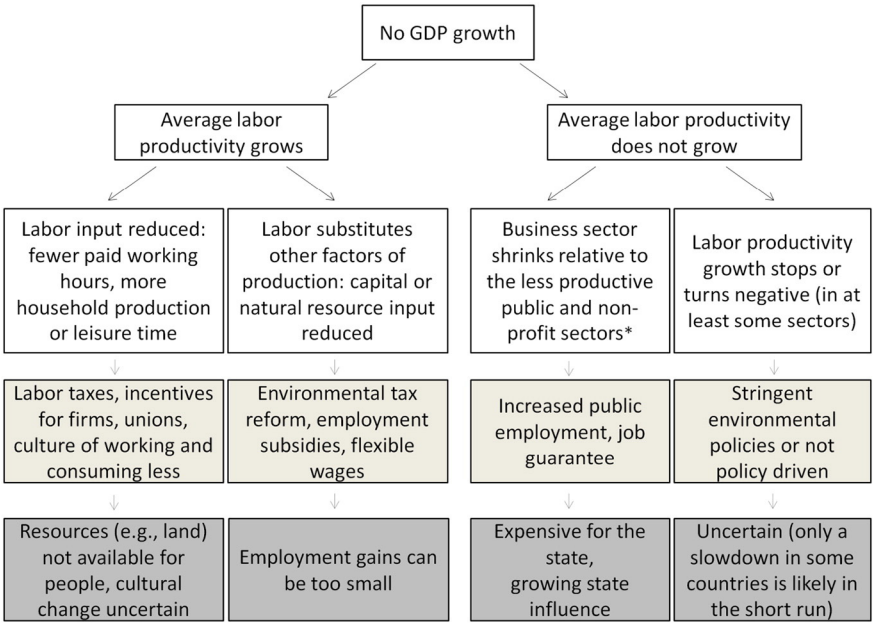

Fig. 5. Low unemployment without growth? Alternatives (white), policies (light gray) and problems (dark gray). *Difficulties of measuring productivity in the public and non-profit sectors are acknowledged. Productivity does not measure social usefulness.

reconcile labor productivity growth with zero output growth (by decreasing at least one input of production) or, alternatively, how they stop labor productivity growth — thereby eliminating the necessity of output growth to keep unemployment low. As options in Fig. 5 are complementary, finding further alternatives that are not combinations of the strategies listed here is probably difficult.

4. Consequences for Macrolevel Strategies

On a global scale, economic growth is strongly correlated with environmental degradation while the lack of economic growth significantly increases unemployment in most market economies. The immediate relevance of these correlations differs very much between countries and social groups, and the depth of people's knowledge about the two issues differs substantially. Therefore, it is not surprising that contradictory macrolevel strategies are called for.

Various groups of experts and decision makers who are more immediately interested in avoiding the problems associated with low or negative growth, and are also more familiar with these problems, call for green growth (OECD, 2011; World Bank, 2012). This is partly understandable because it would be very desirable to combine the benefits of growth with environmental sustainability. However, on a global scale green growth is almost surely an oxymoron. The correlation between GWP and environmental impacts shows the failure of capitalism and its currently existing large-scale alternatives to internalize environmental concerns into their decision making processes. When green growth as a strategy fails, growth can be expected to be higher on the economic and political agenda than its green nature. Denying the need to transcend the growth paradigm is almost certainly equal to sacrificing crucial environmental goals.

A small group of researchers very much aware of the difficulties of absolute decoupling call for degrowth, which entails GDP reduction (e.g., Kallis et al., 2012). This is understandable because a reduction of economic activity seems inevitable for environmental sustainability. However, GDP degrowth is socially unsustainable today. A main reason for this is that the lack of global economic growth would significantly increase unemployment in at least some major countries. Theoretically, zero global growth could result from universally low growth rates (with some countries having slightly positive and others slightly negative rates), or the combination of relatively high growth in less affluent countries and significant economic contraction in rich countries. While the first option is unacceptable for poor countries and emerging economies, the second one is rejected by rich countries. Unemployment is one of the main reasons for the rejection, especially in the case of the more equitable second scenario. Hoping for a radical change of employment strategies that would suddenly eliminate the correlation between growth and unemployment may be just as unrealistic as hoping for green growth. Considering that unemployment is just one of several important problems associated with GDP reduction, degrowth as a goal is only realistic at a very local level today.

In view of the many positive and negative sides of economic growth, a third recommendation is neutrality or indifference about growth (van den Bergh, 2011). This is understandable because GDP is not an appropriate progress indicator, so it seems rational to concentrate only on a set of more immediately relevant social and environmental indicators. However, we cannot ignore growth – or if we do, it will not change real world strategies too much – because changes of GDP are tightly correlated with changes of these other indicators. Until such correlations are substantially weakened, we will have multiple reasons to be concerned about growth. In other words, the economic system has to change to make GDP less important.[12] Until then, "a-growth" as a strategy will only be meaningful inasmuch as economic behavior – e.g., laying off people during recessions – is driven by the cognitive effects of focusing too much on GDP. In the case of layoff decisions, such effects are negligible compared to effects in the real economy (like shrinking demand); otherwise changes of unemployment would not be radically different between sectors during periods of GDP decline. More generally, relaxing about growth cannot be expected to fundamentally affect the growth dependence of our economies. For that, changes in the mechanisms of the real economy are needed (like the ones discussed in Section 3.3), which will probably result in a paradigm shift away from capitalism as we know it.

Instead of a positive, negative or neutral position on economic growth, a more realistic and fruitful attitude may be ambivalence about growth. This can be a common ground for economists and scholars of sustainability science that may facilitate discussions about economic and environmental objectives. Such cooperation is absolutely

[12] Simultaneously, focusing on other indicators can help to change the system. Thus, the system and its indicators have to change together.

necessary because today both economic growth and its alternative, economic contraction, reduce well-being in several ways. There is no other way out than simultaneously decoupling environmental impacts *and* unemployment from GDP growth. Insights from the literature on green growth and degrowth can be very useful to understand the opportunities for, and difficulties of, both types of decoupling. Nevertheless, due to the contradiction of environmental and economic goals that is unavoidable in the short/medium term, any strategy that takes a stand concerning the ideal behavior of GDP constrains democratic decision making by implicitly choosing what to sacrifice. Instead of specifying how GDP should change, a more constructive approach may be to frame solution efforts around the reduction of the contradiction identified above. In a greener, less growth dependent economic system a neutral position on growth will be more tenable than it is today.

5. Conclusions

Two correlations have been studied in this article: one between economic growth and environmental impacts, and the other between economic growth and unemployment. While both relationships are complex, their analysis at the global level leads to a simple conclusion. Without systemic changes, green goals and full employment are incompatible. If there *is* economic growth, several key environmental problems including climate change, pollution associated with materials use, and damage to ecosystems due to land use changes are unlikely to be mitigated quickly enough to stave off very severe consequences. If there is *no* economic growth (or it is negative), unemployment can be expected to rise significantly in most market economies with large and immediate negative impacts on well-being.

There are two main options to address this contradiction: accelerating the decoupling of environmental impacts from GDP and tackling unemployment without growth to make low or negative growth more socially sustainable. Both are very difficult. Considering the magnitude of the challenges only the two together have a reasonable chance to reconcile environmental and socio-economic objectives.

Current efforts to accelerate decoupling are insufficient – hence the frequent calls for greener practices, technologies and lifestyles. Tackling unemployment without growth, on the other hand, is not even seriously discussed today – partly because the most powerful economic and political actors advocate growth even if environmental sustainability or the well-being of people directly affected by the negative impacts of growth strategies has to be sacrificed. Therefore, very significant efforts are needed to put questions of non-growing economies on the public agenda. In particular, employment strategies such as a systematic reduction of the cost of labor (e.g., through an environmental tax reform), increasing wage flexibility at high income levels, public employment, non-wage employment aimed at self-sufficiency, and the reduction of working hours deserve much more attention in research and policy. More generally, a major increase of research efforts about reducing dependence on growth is necessary to address the many problems of growth-constrained economies.

Easy solutions cannot be expected: besides providing benefits, reducing dependence on growth can incur various social, political or economic costs as it has been demonstrated for strategies to tackle unemployment without the need for growth. Comparing such benefits and costs with the benefits and costs of further economic growth will lead to difficult questions and tradeoffs. Nevertheless, these dilemmas are unavoidable and will only get more difficult because environmental costs of growth are rising. To attain the most prosperous scenario, we have to start thinking about all available options now.

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