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"Emprego e Sustentabilidade Ambiental: os Desafios dos Limites Ambientais ao Crescimento"

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Abstract

This thesis addresses the problem of employment creation and its relation to environmental sustainability. The central question of the analysis is: “how do ecological limits affect the macroeconomics of employment?” The thesis hypothesises that it should be possible to bring the economy back within global ecological limits without leading to reductions in employment. This may, however, require revised or alternative economic models.

The thesis starts with an exploration of the concept of employment and unemployment. It considers issues of measuring employment, both in quantity and quality, as well as other important macroeconomic relationships that affect employment. In particular the thesis highlights the relationship that employment statistics have with GDP growth, population and productivity

The thesis next considers the main themes of ecological economics. It examines the idea of environmental limits to the economy and what this means for GDP and population growth. It also considers proposed methodologies for including these limits within economic statistics.

The thesis continues by evaluating the statistical relationships between environmental, employment and related economic indices. It conducts a literature review and quantitative analyses of cross-sectional data from different countries across the world using a multivariate analysis of the correlation between ecological footprint data and various economic indices related to employment.

The thesis concludes with an exploration of green employment strategies (low environmental impact employment strategies) and environmental policies that affect employment. This includes consideration of environmental Keynesian policies, as well as the theoretical ideas of a steady state economy and degrowth. The need to formulate new economic models, which encompass environmental limits and provide decent employment for present and future generations, is identified as a continuing challenge.

Key words: Growth, Environment, Ecology, Employment, Jobs, Sustainability, Decent work

Resumo

Esta dissertação discute o problema de criação de emprego e sua relação com a sustentabilidade ambiental. A questão central do trabalho é: "como os limites ecológicos afetam a macroeconomia do emprego?" A dissertação parte da hipótese de que é possível definir limites ecológicos ao crescimento econômico sem reduzir o nível de emprego. No entanto, isso pode exigir a revisão dos modelos econômicos atuais ou mesmo a adoção de modelos alternativos.

Inicialmente, a dissertação explora o conceito de emprego e desemprego. Considera questões como a qualidade e a quantidade de empregos, bem como outras importantes relações macroeconômicas que afetam a geração de empregos. Em particular, a dissertação destaca a relação entre emprego, produtividade, crescimento da população e do Produto Interno Bruto (PIB).

Em seguida, a dissertação aborda as principais questões da economia ecológica. Examina a idéia de limites ambientais à economia e seus impactos sobre o crescimento do PIB e da população. Também considera propostas metodológicas para inclusão desses limites às estatísticas econômicas.

A dissertação então avalia as relações estatísticas entre indicadores ambientais, econômicos e aqueles relacionados à quantidade e qualidade dos empregos. Além de revisão da literatura, essas análises baseiam-se em análises quantitativas definidas a partir de dados de corte transversal com informações de diferentes países do mundo.

A dissertação finaliza explorando estratégias de geração de emprego verde (*green employment*, ou estratégias de emprego de baixo impacto ambiental) e políticas ambientais que afetam a geração e a qualidade dos empregos gerados. Isso inclui a consideração de políticas ambientais *keynesianas*, bem como as idéias teóricas de uma economia de estado estacionário e de decrescimento (*degrowth*). A necessidade de formular novos modelos econômicos, que englobam limites ambientais e a garantia de emprego decente para as gerações presentes e futuras, é identificada como um desafio permanente.

Palavras-chave: crescimento econômico, meio ambiente, ecologia, emprego, sustentabilidade, trabalho decente.

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Introduction

There is a growing body of research showing that economic growth is leading human society toward “ecological overshoot,” where we consume more resources than the world can sustain or reproduce. Current models suggest that many states in the world are already consuming more resources than the planet can sustain. It is argued that, given the finite nature of planetary resources, a new model of economics is required that recognises those physical limits to growth. On the other hand prevailing economic theories also assume that the best way to increase employment is through economic growth, with associated increased investment and gains in productivity. If unlimited growth is not possible, how in an ideal world would we provide full and decent employment for everyone who wants and needs it? Does this imply the unpalatable conclusion that there is a global limit on decent employment? If not, is a new model of employment and economics urgently needed?

This thesis is an attempt to consider the issues of ecological sustainability from a perspective that recognises the legitimate issues of job protection in rich countries and job creation in poor countries, while at the same time supporting efforts to tackle climate change and environmental degradation. The author focuses on issues that support the “just transition,” i.e. any ecological transition in the global economy should allow ordinary people, both now and in the future, to enjoy a decent standard of living and improved opportunities for employment. This perspective takes as given the need for resource redistribution and greater equality in future solutions.

At the heart of these issues lies the key question of resource distribution. Ecological economists have made a strong case for the development of economic models that include an understanding of the quantities and limits of the planet’s resources and its capacity to renew them and absorb waste. These ideas not only throw into question current models of economic success, but also resurrect the case for redistribution of resources.

Question

The main question of the thesis is therefore:

How do ecological limits affect the macroeconomics of employment?

Hypothesis

The thesis argues that the dominant theories of macroeconomics fail to deal with the problem of environmental limits to the economy. Dependency on growth in GDP to create employment is not sustainable in the long term.

The main hypothesis of this thesis is, therefore, that it could be possible to engineer a new macroeconomy based on low growth, full employment and improved welfare. This could be possible through strategies of sharing productivity gains more equally, developing alternative measurements for economic success and careful regulation of economic activities such as investment, demographics and consumption. Tackling ecological challenges should not lead to reduced employment as long as the transition is managed effectively. This may however imply a more holistic rethink of the nature of employment and work.

In the context of environmental limits, concepts of redistribution and equality may need to be re-included into macroeconomic policy, if welfare is to be shared. This process also could be an opportunity to redevelop ideas of work and employment to include recognition of job quality and the contribution of “work” that tends to fall outside conventional economic and employment analysis.

Methodology

The thesis encompasses both a literature review and a quantitative analysis. Chapter 1 discusses the factors that affect the level of employment and unemployment in an economy. It starts with a discussion of the evolution of the concept of unemployment and employment. This is followed by a debate about the main statistical measures used to describe the labour market and discusses ideas of job quality and decent work. The chapter then sets out the main macroeconomic debates and theories about unemployment and employment creation. It considers the relationships with various core economic measures proposed by different

economic schools as proxy indicators for labour market conditions. It then draws out the main areas of consensus regarding employment creation.

Chapter 2 considers the relationship that the environment has to economic thinking, highlighting some of the main differences between ecological economics and traditional economics. It explores the main discussions about limited planet economics particularly in relation to theories of growth and steady state economic models.

Chapter 3 examines how economists have attempted to incorporate environmental concerns into economic models. In particular it discusses the ideas of economic valuation, alternatives to GDP for measuring economic success and the development of the ecological footprint measure.

Chapter 4 considers the statistical relationship between ecological footprint and various economic measures related to employment. This chapter further analyses the problem of employment and its relationship to environmental limits to the economy. It presents a brief literature review of some of the major relationships that have already been tested. In particular it looks at the concept of the Environmental Kuznets Curve and the relationship between ecological footprint and inequality. It then tests ecological footprint against several key economic measures relating to employment and decent work. Results presented are based on a cross-sectional analysis of global data.

Chapter 5 considers the implications of the limits to growth discussion for employment and employment creation in practice. It considers the idea of green jobs and some of the policy initiatives proposed regarding the shift to more sustainable economies. It looks at what these might mean for employment and welfare. In particular it examines the ideas of environmental taxes and the double dividend, environmental Keynesianism and green industrial policies. The second part of the chapter considers whether these policies will be sufficient to deal with the problem in the long term. It considers the possibility of new economic models that try to contain the economy within environmental regenerative limits while providing sufficient welfare and decent employment. The analysis addresses ideas

of a steady state economy, economic degrowth and what these might mean to the macroeconomy, business models and work.

The thesis concludes with a list of findings and recommendations for future research.

Introdução

Há um crescente número de pesquisas mostrando que o crescimento econômico recente está levando a sociedade humana rumo à insustentabilidade ecológica, onde consumimos mais recursos que o planeta pode provir. Modelos atuais sugerem que muitas nações já estariam inclusive consumindo mais recursos do que o planeta pode suportar. Argumenta-se que, dada a natureza finita de recursos do planeta, são necessários novos modelos de economia que reconheçam os limites físicos ao crescimento. Por outro lado, a teoria econômica predominante também assume que o crescimento econômico seja a maneira mais eficaz para geração de emprego, associado ao aumento do investimento e ganhos em produtividade. Caso o crescimento ilimitado não seja possível, como seria possível oferecer emprego pleno e decente para todos que querem e precisam em um mundo ideal? Isso implicaria em uma desagradável conclusão de que há um limite global ao emprego decente? Caso contrário, há necessidade de um novo modelo de desenvolvimento econômico e geração de empregos?

Esta dissertação é uma tentativa de considerar a questão da sustentabilidade ecológica, ao mesmo tempo em que reconhece a legitimidade da necessidade de criação de empregos decentes nos países pobres, os esforços no combate à mudança climática, a degradação ambiental e a proteção de trabalho nos países ricos. O autor apoia-se em questões que suportam a *transição justa*, ou seja, que a transição ecológica permita que pessoas comuns, seja agora ou no futuro, possam desfrutar de uma vida digna e de melhores condições de emprego. Esta perspectiva considera a necessidade de redistribuição dos recursos e uma maior igualdade nas futuras decisões.

No centro desses problemas está a questão chave da distribuição de recursos. Economistas ecológicos têm se esforçado no desenvolvimento de modelos econômicos que considerem os limites dos recursos do planeta e sua capacidade de renovação e absorção de resíduos. Essas idéias levam-nos a discutir não somente os modelos de crescimento econômico, como também a questão da redistribuição dos recursos.

Questão

A questão central dessa dissertação de mestrado é: como os limites ecológicos afetam a macroeconomia do emprego?

Hipótese

A dissertação argumenta que as teorias macroeconômicas predominantes falham ao tratarem do problema dos limites ambientais ao crescimento econômico. A dependência do crescimento do PIB para a geração de emprego não é sustentável em longo prazo.

A hipótese principal desta dissertação é, portanto, que seria possível desenvolver uma nova macroeconomia com base no baixo crescimento, pleno emprego e maior bem-estar. Isso seria possível por meio de estratégias de compartilhamento mais igualitário dos ganhos de produtividade, desenvolvimento de medidas alternativas para o progresso econômico e regulamentação mais cuidadosa das atividades econômicas, como investimento, demografia e consumo. O enfrentamento dos desafios ecológicos não deve conduzir à redução do emprego caso a transição seja gerenciada com eficiência. No entanto, isso exigiria uma reformulação mais holística da natureza do emprego e do trabalho.

No contexto dos limites ambientais, conceitos como o da redistribuição e o da igualdade deveriam ser reconsiderados na política macroeconômica. Esse processo poderia ainda ser uma oportunidade para reconstrução das idéias de trabalho e emprego, incluindo o reconhecimento da qualidade do trabalho e sua contribuição para a análise convencional da economia e do emprego.

Método de análise

As análises baseiam-se em revisão de literatura e em resultados empíricos. O Capítulo 1 discute os fatores que afetam o nível de emprego e desemprego de uma economia. Inicia-se com uma discussão sobre a evolução do conceito de desemprego e emprego. Posteriormente, debate as principais medidas estatísticas utilizadas para descrever o mercado de trabalho e idéias de qualidade de emprego e trabalho decente. Em seguida, o capítulo descreve os principais debates macroeconômicos e teorias sobre o desemprego e a criação de emprego. A relação entre diversos indicadores das condições do mercado de trabalho,

propostos por diferentes escolas econômicas, são consideradas. Em seguida, destacam-se as principais áreas de consenso sobre a geração de emprego.

O Capítulo 2 considera a relação entre o ambiente e o pensamento econômico, destacando algumas das principais diferenças entre a economia ecológica e a economia ambiental neoclássica. Esse capítulo explora as principais discussões sobre a economia dos recursos limitados, especialmente em relação às teorias de crescimento e de modelos de estado estacionário da economia.

O capítulo 3 examina as tentativas dos economistas para incorporar preocupações ambientais nos modelos econômicos. Em particular, discute as idéias de valoração econômica, alternativas ao PIB como medida de crescimento econômico e o desenvolvimento indicador ambiental de pegada ecológica.

O capítulo 4 considera a relação estatística entre a pegada ecológica e várias medidas econômicas associadas à geração de emprego. Esse capítulo analisa ainda a relação entre emprego e os limites ambientais ao crescimento econômico. Para cumprir com esses objetivos, apresenta uma breve revisão da literatura de algumas das relações mais importantes já analisadas. Destaque especial é dado ao conceito da Curva de *Kuznets* Ambiental, analisando a relação entre crescimento econômico, desigualdade e impactos ambientais. Para validar a discussão apresentada, o trabalho avalia empiricamente a relação entre a pegada ecológica e vários indicadores econômicos relacionados ao emprego e trabalho decente. Os resultados baseiam-se em uma análise de corte transversal com informações atualizadas das principais nações do planeta.

O capítulo 5 considera as implicações práticas dos limites ao crescimento para a geração de emprego. Considera a idéia de empregos verdes e algumas das iniciativas políticas propostas em relação à mudança para economias mais sustentáveis. O capítulo analisa ainda as implicações para o emprego e o bem-estar das pessoas. Em particular, analisa as idéias de impostos ambientais e o duplo dividendo, o *keynesianismo* ambiental e políticas industriais ecológicas. A segunda parte do capítulo discute se essas políticas seriam suficientes para lidar com o problema em longo prazo. Considera a possibilidade de novos modelos econômicos que tentam restringir o crescimento econômico aos limites ambientais, proporcionando bem-estar suficiente e emprego decente. A análise aborda as

idéias de uma economia de estado estacionário, o decrescimento econômico e quais seriam as implicações para a macroeconomia, finanças e trabalho.

A dissertação finaliza com uma série conclusões e recomendação para pesquisas futuras.

1. Employment and employment creation

This chapter discusses the factors that affect the level of employment and unemployment in an economy. It starts with a discussion of the evolution of the concept of unemployment and employment. This is followed by a debate about the main statistical measures used to describe the labour market. The chapter takes as its starting point the idea that employment has objective value as a social good. There are many arguments about the benefits of employment in reducing poverty, increasing personal empowerment and self-esteem, reducing other social problems like crime and social exclusion, while at the same time increasing consumption and government revenues through increased taxation income. These assertions need to be nuanced by recognition that the quality and conditions of employment also matter to social welfare (Kenway, 2008). To this end the chapter also considers the concepts of job quality and decent work. The second part of the chapter goes on to set out the main macroeconomic debates and theories about unemployment and employment creation. It considers the relationships between various core economic measures, proposed as proxy indicators for labour market conditions by different economic schools. It then delineates the main areas of macroeconomic consensus regarding employment and unemployment.

1.1. The concept of unemployment

Employment creation and the causes of unemployment have long been a major preoccupation of socially minded economists. Current ideas about unemployment, however, have been far from universally accepted throughout the last few centuries. The concept of lacking work and worklessness has undergone various phases in history and it is only with twentieth century capitalism and the impact of the great depression that the concept has solidified. John Garraty illustrated this point in his definitive work, *Unemployment in History*:

> "*Unemployed persons have been treated as criminals who must be isolated from society or driven to hard labor, and as sinners to be regenerated by exhortation and prayer (their own as well as those of their betters). They have been viewed as wayward children who must be taught how to work, as*

lazy incompetents best left to suffer the consequences of their sloth, and as innocent victims of forces beyond their control" (Garraty, 1978).

Many of these ideas pre-dated what we now call the study of economics and were based on pre-capitalist values with different conceptions of the relationship between people, their work and those they worked for. The concept of unemployment continues to be political, value-laden and replete with ambiguities. For example slaves cannot be unemployed even if they can be idle or not working for periods of time. At the same time independent workers such as writers, musicians or artists are never unable to work even if they find it difficult to make a decent living. Similarly, whether rich or poor, small farmers or shopkeepers are owners of businesses and therefore considered capitalists and exempt from unemployment. It is capitalism that defines our modern notions of unemployment. As Garraty highlights:

"*Historically, unemployment has been distinctly associated with free-enterprise capitalism - in a sense it is a disease of capitalism- precisely because under capitalism labor is free (neither employer nor employee is permanently obligated one to the other) and because, on the other hand, the system has increased the dependence of labor by separating workers from the ownership of the means of production. In short, only those who work for wages or a salary, who are at liberty to quit their jobs yet who may also be deprived of them by someone else, can become unemployed*" (Garraty, 1978).

1.2. Employment measures

Employment measures in any given country are expressed via several key statistics about the supply and demand and nature of labour in the labour market. The basic statistics used to describe the labour market are the working age population, economically active and inactive populations, the employment rate and the unemployment rate (Hussmanns, 2007). The working age population is usually defined as everyone between the ages of 15 and 64 within a country, although this may vary due to local employment legislation and trends. This working age

population is then divided into two subsections, the active and inactive population. The ILO defines "*the economically active population"* as comprising:

> *"all persons of either sex who furnish the supply of labour for the production of economic goods and services as defined by the United Nations systems of national accounts and balances during a specified time-reference period*" (ILO, 1982).

This includes all those people either in "*paid employment,*" "*self-employment*," or "*unemployed*". The part of the working age population not employed or unemployed is referred to as the "*inactive population*" (ILO, 1982)[1]. The ILO defines employment as those people who:

> *"furnish the supply of labour for the production of goods and services, measured over a short reference period (of one week or one day). It refers to all persons who worked for pay, profit or family gain during that period. It also includes all persons who had a job or enterprise but were absent from that job or enterprise during that period on a temporary basis: persons who during the reference period were sick, on vacation, maternity leave, strike or were temporarily laid off."* (ILO website, 2011)

Unemployment on the other hand is when a person is not working but currently "*available*" for and has been "*seeking work*" for the past four weeks (ILO, 1982). The employment and unemployment rates are measures of the prevalence of employment/unemployment and they are calculated as a percentage by dividing the number of employed/unemployed individuals by all individuals currently in the labour force i.e. the economically active population.

In addition to these basic statistics there are a wide range of other measures that help describe the labour market. These include the break-down and nature of economic activity, employment and unemployment by age, gender, race and region, the skill levels and sectors of the economy where they are taking place, the wage rates across the economy and for different types of jobs and hours worked.

[1] For more detailed definitions see ILO, 1982

1.2.1. Problems of comparability

Employment statistics can be misleading. Counting the unemployed, for example, can often be difficult. The make-up of the unemployed will differ greatly between economies due to different labour markets and regulations. There are also several different kinds of unemployment. These include “structural unemployment” caused by a mismatch between jobs offered by employers and potential workers related to geographical location, skills, and many other factors; “seasonal unemployment” which occurs when an occupation is not in demand at a certain time of year; “cyclical unemployment” that is observed when there is not sufficient aggregate demand or job opportunity in the economy; and even the contentious idea that there may be a natural baseline level of unemployment in every market economy (see section 1.3.4.).

Many economies have different ways of counting the unemployed because of the kinds of surveys they carry out or due to methodological issues, such as the length of time for which a person is defined as unemployed before being redefined (Thomas, 1996). Different statistics agencies treat parts of the unemployed population differently. For example those who have become discouraged over time from actively looking for work and those who are defined as self-employed, such as tradesmen or building contractors, but are currently not working, are not counted as unemployed. Other examples include people who have received involuntary early retirement but would still like to work, people on disability pensions or benefits who still wish to work, and people who could be defined as underemployed or involuntary part-time workers in that they work only limited hours and would ideally like to work more. Other political factors can also distort statistics, for example it can be argued that the large prison population in the USA dampens unemployment statistics compared to many European countries (Katz and Krueger, 1999).

It has been noted that being unemployed in many countries is a privilege; without independent means or some system of benefits, poor people have no choice but to find ways of survival. This is where complex ideas and definitions of informality and the informal economy develop. How this idea of informality can be measured is an extremely controversial problem (Peatie, 1987, Mead and Morrison, 1996,

Bangasser, 2000). For example, some nations' unemployment rates are muted or appear less severe due to the number of “informal” self-employed individuals working in urban areas or small independent farmers working in agriculture. These people may be extremely low-waged or even unwaged, but their unregistered self-employed status by definition takes them out of unemployment. Similarly, some have argued that in highly developed welfare state economies the measures of employment and unemployment may be distorted by the availability of unemployment benefits. These can inflate statistics since they provide an incentive for some individuals to register as unemployed while they work illegally or claim benefits when they are not seeking work.

1.2.2. Hidden work

Under ILO definitions it is possible to be neither employed nor unemployed, i.e. to be outside the "labour force." This includes people who have no job and are not looking for one, such as retired people, school children, prisoners, full-time students, many disabled people and full-time family carers for children, elderly or the disabled. There are many people involved in unpaid labour or voluntary work, such as much of domestic work and particularly work on family farms in agricultural communities (Beneria, 2003). Much of this is not properly captured by the statistics. For example child labour is technically illegal and thus not included in the active population statistics, yet in most countries there are still a significant number of children who work (Anker et al. 2002). The same can be argued for slave labour, forced labour or many irregular migrant workers who are not picked up by surveys (Pinkerton et al. 2004). Employment and labour force statistics usually include only work done for monetary gain. Hence a housewife is neither part of the labour force nor unemployed (Beneria, 2003). This again creates contradictions in the statistics. When a working mother who employs a nanny decides to quit her job to take care of her children, two people lose their jobs but only one is then counted as unemployed (Garraty, 1978).

These issues clearly have many political implications, especially regarding the treatment of vital activities for society, such as child care not being regarded as work. While there have been some attempts to measure this unpaid work or

include it in the statistics, exactly how to achieve this remains contentious and largely outside of mainstream employment statistics (Beneria, 2003). It is thus clear that there are values embodied in the assumptions behind labour statistics.

1.2.3. Job quality

The question of what is of value to society leads to the crucial issue of job quality. Simply counting the numbers of people with a job, as difficult as this can be, does very little to describe the lives or conditions of working people. This requires a much greater understanding of the quality of the job that each person is doing. Defining a “good job” is therefore a major issue, despite being something extremely difficult to measure. There are numerous variables that could define quality in a job. For example factors like salary, job control and responsibility, autonomy, working time, security and type of contract, access to training, collective bargaining, health and safety, social status and aspirations all could play a major part in job quality (Tilly and Tilly, 1998). At the same time, the relative importance of these factors for an individual worker also has multi-variant factors that could affect quality, such as family life, culture, ambitions, social class and so on. These factors not only vary from place to place and between individuals but also have evolved considerably over time (Castree et al, 2004). These are the kinds of questions that lie behind issues of vulnerable employment (TUC, 2007) or labour “precarity” (Rodgers and Rodgers, 1989) and some of the problems with defining work in the informal economy and informal sector (Peattie, 1987, Mead and Morrison, 1996, Bangasser, 2000). They are also the features that help characterise labour segmentation across different sections of the labour market. The term "labour segmentation" serves to define differences between sectors and job types and how these affect different kinds of workers, e.g. women, young people, different ethnicities and social classes (Castree et al, 2004). In the light of these complications, it is necessary to have a definition of what a good or decent job would look like and also a method to measure its prevalence.

1.2.4. Measuring decent work

The ILO first defined decent work in 1999. It argued that decent work was “*productive work under conditions of freedom equity, security and dignity, in which*

rights are protected and adequate remuneration and social coverage are provided" (ILO, 1999). From this the concept has since been refined to include the key characteristics of productive and secure work, respect of labour rights, the provision of adequate income, social protection and social dialogue, union freedom, collective bargaining and participation (ILO, 2001).

Measuring these characteristics is, however, a more complicated matter. The proposals for measuring decent work were outlined in an ILO working paper in 2002 (Anker et al. 2002) which set out 11 broad indicators for decent work. It was not until 2008, however, that the ILO Governing Body finally agreed to test a comprehensive approach to the measurement of decent work. This was tested in 2009, when they compiled detailed indicator definitions and began preparing decent work country profiles for a limited number of pilot countries. It has since been endorsed by the 18th International Conference of Labour Statisticians. Thus measuring decent work per se is a new initiative, even if individual indicators may have been measured for numerous years. The full list of ILO indicators[2] includes statistics on the following:

1. Employment opportunities, including types of employment
2. Adequate earnings and productive work
3. Decent hours
4. Combining work, family and personal life
5. Work that should be abolished – i.e. Child and forced labour
6. Stability and security of work – referring to casual and precarious work
7. Equal opportunity and treatment in employment
8. Safe work environment
9. Social security
10. Social dialogue, workers' and employers' representation
11. Economic and social context for decent work – including statistics on school participation, productivity, rate of HIV in society and wider

[2] More detail can be found here on the ILO website: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---integration/documents/meetingdocument/wcms_115402.pdf

macroeconomic indicators.

Unfortunately there is not yet a large enough or coherent body of statistics to conduct generalised global analysis based on the full definition of decent work. There are, however, several proxy statistics that can be used to imply decent work. These statistics, such as analysis of employment levels, statistics about working hours and working poverty, allow a small glimpse of job quality while the global database is developed. As will be discussed in the concluding chapters of this thesis further analysis of global levels of decent work is an important avenue for future research.

1.3. The macroeconomics of employment and unemployment

While detailed analysis of the nature and quality of employment is clearly a difficult task, there are some other statistical relationships that can help understand the changes in labour force on a macro level. The following sections therefore explore these macroeconomic relationships. Macroeconomic theory has cumulatively developed a broad range of economic relationships that affect employment. These include issues about the structure and organisation of the labour market, population change, wages and profits, productivity, inflation and economic growth.

1.3.1. Demographics, growth, supply and demand in the labour market

As has been noted (section 1.2) employment and unemployment rates are related to the population and demographic statistics of a country. The amount of employment and unemployment in the labour market is related to the supply of labour available (ie. the working age population and the economically active population) and the demand for workers in the economy. The supply side of this equation is therefore affected by wider population changes such as birth rates, average age, as well as percentages of women in the active population and dependency ratios. From the supply side, changes in population are a significant factor in employment and unemployment rates. Hypothetically, if all demand side conditions remain unchanged, an increase in working age population would lead to an increase of unemployment. In reality this is not as simple. Increased population also has impacts on the demand side of the equation as new entrants to the labour

market, like migrants, also stimulate increased economic activity through consumption, innovation and entrepreneurialism. Nevertheless, the relation between growth of economic activity (GDP), regularly referred to simply as growth, and growth in population is a crucial starting point in any employment theory. More population requires more growth in order to provide the additional population with jobs.

This idea of growth and employment can be found in the works of classical economists. Early classical economists, such as Adam Smith (Smith, 1776), David Ricardo (Ricardo, 1817), John Stuart Mill (Mill, 1848) and Arthur Cecil Pigou (Pigou, 1933) did not recognise unemployment per se as a major issue. When they talked about unemployment at all, it was typically discussed as a problem of poverty and in relation to distortions in the labour market. They argued that unemployment was more related to the level of wages. Wages were determined by the relationship between the minimum level of remuneration for which workers are prepared to give up their free time (join the active population) and the level of cost that a firm or entrepreneur can afford in order to make a healthy profit. A job where there are many willing workers (high supply) competing for a job that few require (low demand) will result in a low wage for that job and vice versa. An employer who pays very low wages may find it hard to recruit workers if competitors are offering higher wages. The labour market thus tended towards an equilibrium position where workers were free to choose whether or not to enter the labour market and thus the price of their labour units. As in Say's Law, supply creates its own demand (Say, 1803).

In classical theory unemployment could only be defined either as “frictional”, i.e. due to unforeseen changes in sections of the markets and the break while workers change jobs, or as “voluntary” in that workers are not prepared to work for the wages on offer. As Mill put it:

> “*The capital remains unemployed for a time, during which the labor market is overstocked, and wages fall... These, however, are but temporary fluctuations: the capital now lying idle will next year be in active employment... and wages in these several departments will ebb and flow*

accordingly: but nothing can permanently alter general wages, except an increase or a diminution of capital itself... compared with the quantity of labor offering itself to be hired." (Mill, 1848)

In addition "voluntary" unemployment could refer to unemployment that is caused by people in work creating imperfections in the labour markets that inflate wages i.e. through trade unions and collective action.

In this theory unemployment and employment rates could be altered in several ways. Firstly through the removal of "obstacles" to the free market of labour, like trade unions or labour regulation, which affected wages. These supposedly prevent labour market equilibrium, where changes in wages are in line with labour market conditions. Secondly, as mentioned, there could be demographic changes whereby the increase or decrease of the working population affects the supply of labour available thus affecting the competition for jobs. Finally there could be changes to the demand for labour by increasing the size of the economy[3] (i.e. economic growth).

1.3.2. Employment, productivity and technology

The main exception to this view in classical economics was of course expounded by Karl Marx. Marx introduced the relationship that technology and productivity have with employment trends. For Marx unemployment was an intrinsic feature of capitalism. Capitalism required a "*disposable industrial reserve army*" (Marx, 1863) in order to force wage competition amongst the workers or proletariat. This allows the capitalist system to adapt and evolve while capital accumulation is increased for the employer class or bourgeoisie. As Marx saw it, unemployment was one of the means by which capitalists were able to make profit and compete.

"C*apitalistic accumulation...constantly produces... a relatively redundant population of labourers... The increase in the variable part of capital, and therefore of the numbers of labourers employed by it, is always connected*

[3] It should be recognized that many classical economists had a complicated relationship with growth and for example Smith and Mill both refer to ideas of a stable or steady state economy in their work referred to in 5.3.1.

with violent fluctuations and transitory production of surplus-population" (Marx, 1867).

Marx argued that this constant churn of employment and unemployment was driven by changes in technology and the transformation of productivity. As he described it:

> "[Capital accumulation] *is impossible without disposable human material, without an increase in the number of labourers... This increase is affected by the simple process that constantly "sets free" a part of the labourers by methods which lessen the number of labourers employed in proportion to the increased population*" [i.e. increased productivity]. "*The whole form of the movement of modern industry depends, therefore upon the constant transformation of a part of the labouring population into unemployed or half employed hands*" (Marx, 1867).

Productivity increases are therefore a further factor that influences employment trends. This process of unemployment, driven by increased productivity relative to population trends, allowed capitalism to keep wages low by controlling the supply and demand of labour. Unemployment trends were an intrinsic feature of the capitalist model of accumulation. The solution was therefore the creation of an alternative model of accumulation through revolution.

1.3.3. Employment, investment and the aggregate demand

While for Marx unemployment could only be overcome through the overthrow of capitalism itself, others, like John Maynard Keynes, tried to incorporate Marxist criticisms into a capitalist solution to unemployment (Keynes, 1935). Keynes, like Marx, rejected the idea that unemployment was only ever frictional or voluntary and instead proposed the third more common possibility of "involuntary" unemployment. Keynes argued that wages only had a direct impact on the employment rate in a business if that business was functioning at its full productive capacity. Classical economists were making an unsubstantiated assumption that all the jobs that were possible were being employed. It is employers, not workers, who make decisions about the amount of labour that they can employ and firms rarely

work at maximum capacity. Rather than a function of the supply of labour, these decisions are based on expected returns and profits and the levels of capital that employers intend to invest. Keynes explains that:

> "*In a given situation of technique, resources and factor cost per unit of employment, the amount of employment, both in each individual firm and industry and in the aggregate, depends on the amount of the proceeds which the entrepreneurs expect to receive from the corresponding output. For, entrepreneurs will endeavour to fix the amount of employment at the level which they expect to maximise the excess of the proceeds over the factor cost.*"(Keynes, 1935)

For Keynes, investment and employment could thus be increased through creating macroeconomic conditions that increase employers' profit expectations. This relationship was further described by Mikel Kalecki when he highlighted the relationship between the "mark-up" and profits from production and wages (Kalecki, 1954). Employment and wages were not set on the labour market, although this was still a factor. They were instead dependent on negotiations about the share of a company´s profits based on the level of prices. Kalecki and Keynes thus rejected classical arguments about trade unions and labour regulation being obstacles to employment.

The conclusion drawn from these discussions is that government could stimulate employers to use their full productive capacity and invest in more employment, under the right conditions. Keynes argued that this was possible through the use of policy tools such as the interest rate, fiscal spending and taxes. These tools aimed at expanding the "aggregate demand" of the economy which he defined as the sum of overall consumption, investment, government spending and net exports. Under the right circumstances, the aggregate demand had a positive relationship to the levels of employment and unemployment in the economy. Keynes saw this as a way to kick start a faltering economy, prevent recessions, and as a means to guarantee full employment for workers. With the correct stimuli and stewardship

the labour market could be improved and the economy would continue to grow.

1.3.4. Employment, exchange rates and inflation

For Keynesian policy interventions to be successful they have to be based on a set of key conditions. One of these is the need for a stable exchange rate. As a general rule exchange rate volatility increases the potential risk for employers as it affects the prices of imports and exports. This can limit expectations of employers and thus lead to reduced investment and employment. These concerns were one of the main motivations for the creation of the Bretton Woods system of fixed exchange rates after World War II. Since the 1970s, however, this system no longer exists. Under the floating exchange rates systems that exist today, central banks need to increase the quantity of money in order to buy and sell foreign reserves to stabilise the exchange rate. This process is inflationary and prevents them using their reserves for other economic aims. Monetarist theorists refer to what has become known as the “impossible trinity” - a fixed exchange rate, free capital movement (absence of capital controls) and an independent monetary policy. First proposed by Robert Mundell and Marcus Fleming in the 1960s (Mundell, 1963, Fleming 1962), this implies that in open economies with limited capital controls like those existing in most of the world today, it is impossible to use the policy rate of interest and monetary policy to both stabilise inflation and have a fixed exchange rate. Floating exchange rates have therefore reduced the potential leverage that government has to stimulate the economy and create employment.

This relationship between exchange rates, aggregate demand and inflation is one of the arguments used by Milton Friedman (Friedman, 1968) and other economists in the monetarist school against government intervention to stimulate employment. In Friedman's view inflation and employment were linked. Interventions, as prescribed by Keynesians, would not be sustainable as they would in general lead to price inflation. Friedman drew from the findings of the Phillips Curve that plotted unemployment against inflation in the UK (Phillips, 1958). Phillips’ paper appeared to show that there was a rate of unemployment that could not be reduced without pushing up inflation. Friedman referred to this rate as the “natural rate of

unemployment" i.e. the level of unemployment that is part of the structure of the market.

Friedman's conclusion was to return to the classical ideas of the labour market. He argued that the economy, if left unimpeded, would tend towards an equilibrium position which would be the level of functional full employment without inflation. The key policy for Friedman was to create economic growth by providing a stable economic environment for investment and trying to improve the productivity and innovation in the economy. State intervention, as Keynes had suggested, would distort the market, leading to inflation and eventually to a corrective recession to align the levels of production with real market conditions. The state's role was thus to stabilise prices. Friedman prescribed a policy of monetarism whereby the central bank uses the supply of money to stabilise the inflation rate, so that it is in line with the real income of the economy.

It should be noted that the relationship between inflation and employment continues to be controversial and monetarist policy is far from universally accepted. For example some critics have challenged the model, calling for flexibility with inflation and capital controls (Epstein, 2007). Similarly there continues to be a major debate about the existence of the natural rate of unemployment, now more often referred to as the non-accelerating inflation rate of unemployment (NAIRU). Some economists who have revisited the statistics now reject the existence of the relationship (Kitov, 2009), while many of those who accept its existence argue that it varies among economies and can change over the long term (Stiglitz, 1997).

1.3.5. Employment and growth

It is clear then that the factor most universally linked to employment creation is economic growth. While there are different theories about how economic growth is achieved, the aim is still fundamentally the same for most economic theories. As Milton Friedman put it:

> "*There is wide agreement about the major goals of economic policy: high employment, stable prices and rapid growth. There is less agreement that these goals are mutually compatible or, among those who regard them as*

incompatible, about the terms at which they can and should be substituted for one another" (Friedman, 1968).

Since the 1930s economic activity, often referred to as the national accounts, has been measured by either Gross National Product (GNP) or Gross Domestic Product (GDP). GDP measures a country's overall economic output, i.e. the market value of all final goods and services produced within the borders of a country in a year. GNP is similar but measures production by enterprises *owned* by a country's citizens. Thus in a global context, world GDP and world GNP are equivalent terms. For many years it has been widely assumed that economic growth on aggregate, while not perfect, is a good approximation to increased welfare in a society (Nordhaus and Tobin, 1972). Even most apologists for large scale inequality in society justify it based on a belief that growth is the best way to improve the lot of those at the bottom, i.e. through an interpretation of Rawls' difference principle (Rawls, 1971). The concept of economic growth has long been heralded as the panacea for all economic ills (Daly, 2005). Growth is prescribed as the route to increased employment and reduced inequality (Sala-i-Martin, 2007), growth will affect fertility rates and lifestyles to stabilise population growth (UN, 2004), growth will raise the overall standard of living and reduce poverty (Lopez, 2008) and growth will be the route to investment and development (Sen, 1999). As Alvater explains:

"*The ideology of triumphant growth is the idea that economic growth increases employment, incomes and taxes, and in this way provides resources for the alleviation of social conflicts, the expansion of development assistance, the eradication of poverty, the implementation of environmental standards, and so on. Steady growth was indeed the backbone of the corporatist "Keynesian class compromise" associated with the "Fordist" mode of regulation that characterised developed capitalism during the post-war period; and it is also assumed to offer a remedy for backwardness in the less-developed world... the argument of "modernisation" theory*" (Alvater, 2001).

1.3.6. Empirical relationships between growth, productivity and employment

The main empirical theory linking employment and growth is known as Okun's law. First described by Arthur Okun (Okun, 1962), the theory is based on an empirically observed relationship relating unemployment to losses in a country's production measured in GDP. Put simply, Okun's law says that a decrease in GDP will lead to a rise in unemployment, although not necessarily in reverse. Negative growth will lead to unemployment, but while positive growth creates employment it does not automatically follow that unemployment will decline. New job opportunities may be taken by new workers entering the labour market such as through population growth, migration and the entrance of the formerly economically inactive.

A recent IMF paper (IMF, 2010) reassessed the Okun relationship by looking at the impact of the 2007/8 recession on many of the largest economies in the world. The paper showed that the relationship, while partially useful, was affected by several other variables and thus cannot be generalised. In particular, the paper showed how labour market policies that allowed heightened "*job flexibility*" (or precariousness, depending on your political perspective) had increased the "*responsiveness of unemployment to output... over the past 20 years in many countries*". In other words countries with more flexible labour markets are more likely to have higher Okun coefficients. The paper concluded that the financial crises, collapse of house prices, and other sectoral shocks raise unemployment beyond the levels predicted by Okun's law. These same problems continue to constrain employment creation and create uncertainty that slows employment growth. It concluded that, while in some countries such as Spain and the US Okun's law could be useful, policies such as short-time working programs (Germany, Italy, Japan, Netherlands) show that the relationship is far from deterministic.

These findings reinforce those of previous papers. For example Imad A. Moosa found wide variability among different G7 economies and their Okun coefficients, concluding that the Canadian and the US employment rates were more responsive to economic growth than rates in Europe or Japan (Moosa, 1997). Similarly after comparing OECD countries Jim Lee concluded that "[w]*hile Okun's law is*

statistically valid for most countries, the quantitative as opposed to qualitative estimates are far from uniform" (Lee, 2000). More recently Edward Knotek tested the various versions of Okun's law against the same statistics and found that the relationship had varied considerably over time and over the business cycle. He highlighted many exceptions where growth slowdowns have not coincided with rising unemployment both in the long and short term. Knotek concluded though, that by factoring in the variability of the relationship and "*allowing for a dynamic relationship between unemployment and output growth*". Okun's law could be used as a useful forecasting tool even if it is *"a rule of thumb* [rather than] *...a structural feature of the economy*" (Knotek, 2007).

The conclusions of these studies are that growth is not a sufficient condition to guarantee employment creation, but it is a substantial ingredient. Ewald Walterskirchen highlights that there have been many cases of growth without employment and there are a variety of potential causes (Walterskirchen, 1999). While there is a strong and positive relation between GDP-growth and employment, the latter will only rise if economic growth rates are outstripping productivity gains. Studies by Verdoorn and Kaldor on the effect of output growth on both productivity and employment highlight that these three factors are intimately linked (quoted in Walterskirchen, 1999). Productivity gains can be derived from both labour and resources. Gains in labour productivity, however, can negatively impact on employment much more than the gains in resource productivity. Similarly, the kind of growth activity has an effect on the level of employment. For example "*a rise in labour-intensive domestic demand will affect employment much more than an increase in capital-intensive exports*" (Walterskirchen, 1999). Employment is therefore part of a complicated interplay among various political factors affecting the labour market, changes to the participation and population rates and the relative increase in GDP and productivity. Employment and unemployment rates are affected by economic participation changes that can exert pressure on labour productivity. New entrants to the labour market, such as migrants and young people, can lead to increase in employment without diminishing unemployment (although as discussed in 1.3.1 their entry also can create employment). The reverse is also true, as the

employment effects of growth can have a time lag due to political factors like additional early retirement or active labour market policies such as short-time working programmes. Similarly changes to working hours, such as a growth in part-time work can reduce unemployment rates.

1.3.7. Growth without employment

Elmar Altvater has highlighted that in today´s economy this relationship between productivity, employment and growth has not been easy to balance. Altvater argues that this is due to the nature of the current system of capitalist accumulation. Given that "*surplus profits can be generated by both advanced productivity and low labour costs, the same profit rate may result from very different constellations of productivity, wages, and capital-labour relations"* (Altvater, 2001).This makes the social implications of 'growth' hard to determine. Altvater cites evidence from Angus Maddison (Maddison, 1995, cited in Altvater, 2001) showing that labour productivity has a positive relationship with economic growth and that labour productivity rose much faster than GDP per capita during the period that Maddison studied (1820-1992). This, Altvater argues, has led to a rapid growth in what he calls "unproductive labour" which serves to diminish productivity increases. Altvater claims that the consequence has been the dismissal of workers and the emergence of an "employment gap". In other words:

> "*Growth tends to become "jobless growth" - a development that can only be counteracted by a reduction of working time or the creation of jobs in the public and non-manufacturing private sector… There are no easy solutions for the employment gap in dynamic capitalist societies. That is, structural unemployment must be considered an inevitable consequence of a strongly performing economy. It is not, however, a state of affairs that people happily and voluntarily resign themselves to, although economists are prompt to justify it with the NAIRU-formula"* (Altvater, 2001)

Altvater highlights that over the last century economists concerned with this issue have sought non-market alternative policies for achieving full employment, such as Keynesian stimuli. The space for this kind of action, however, has sharply diminished due to the international nature of the economy. Consequently the only

remaining choice is for people to "exit" from the system of paid employment, either through acceptance of unemployment or, where that is not a possible survival strategy, to rely on precarious work in the growing informal economy. As Altvater puts it:

> *"The consequence of "successful" adjustment to the challenges of globalisation is thus the creation of a dual economy: a formal part, competitive and highly productive, and an informal part that serves to absorb dismissed workers precisely because it is in general less productive than the formal one. The rise of the informal economy obviously provides a "solution" for the problem of growing unemployment. Its detrimental effects on labour conditions, wages, social security, health conditions and so on become virtues in the era of globalisation and under an accumulation regime or growth model which excludes growing parts of the global labour force from the formal employment system"* (Altvater, 2001).

Thus Altvater concludes that growth is no longer sufficient to provide jobs and welfare. Under the current system of capitalist accumulation, where accumulation in the financial sector is not matched by growth in the real economy, unemployment is part of the system.

1.4. Conclusions

This chapter has discussed the foundations of the concepts of employment and unemployment in capitalist economics. It has highlighted the main approaches to measuring employment and the difficulties involved, particularly in international comparisons and measuring job quality. It has also discussed the main theories of employment creation and the proxy measures that help describe the macroeconomics of employment.

From these discussions it can be concluded that the macroeconomic problem of unemployment has not been solved. In many cases the macroeconomic aim to provide full employment has been jettisoned in favour of economic policies that accept unemployment, or at least precarious employment, as part of the system.

Employment and unemployment have complicated relationships with growth, productivity, demographics and population, price inflation and political conditions that affect the labour market. At the same time the different elements of the aggregate demand, i.e. consumption, investment, financial regulations, government spending, imports and exports, all play a major part in defining the nature of employment and the parts of the economy that are most affected. Wages and labour market conditions can influence employment but this is not a straightforward relationship and has much more to do with the division of profits and price setting. Despite all this, it is clear that, in certain circumstances, growth in GDP can act as a proxy for growth in employment, especially when GDP growth is faster than population and productivity. There is wide agreement that, even if growth without employment is possible, growth is a necessary if not sufficient condition for employment creation.

2. Environment and the growth dilemma

This chapter considers the relationship between the environment and macroeconomics. In chapter 1 it was concluded that growth in economic activity is a necessary condition for providing employment, when population and productivity are also growing. Concerns about the environmental limits to economic growth have therefore led to some major dilemmas for macroeconomic theory. This chapter looks at some of these dilemmas by examining the role of the environment in economic thinking and highlighting some of the main differences between ecological economics and traditional economics. It then considers the issue of environmental limits to economic growth and resource use.

2.1 Employment and resource use

As discussed in the previous chapter, employment is related to several key factors in macroeconomic theory. Central to this theoretical perspective is the relationship between growth, labour productivity and population change. These three factors have a particular relationship with resources and environmental services. In most cases, population increases and increased economic activity lead to increased consumption of resources. Similarly increases in labour productivity lead to more resource use per unit of labour. The relationship is of course far more complicated. Resource consumption, for example, can be tempered by other factors such as increases in resource productivity, i.e. the extraction of more value from each unit of resource, or the absorption of labour productivity gains by reductions in working hours. Population increase also brings with it more knowledge and technology that can stimulate these changes. Consumption trends are hard to predict. Does, for example, more free time for workers mean more time relaxing in the park or more time consuming resources in recreational activities like travel? Resource consumption choices are therefore complicated and contingent on various factors. For many years, however, natural resources and environmental services were a neglected and underdeveloped part of economic thinking. This has begun to change in the last few decades as the economics of resources and environmental services have begun to be more widely debated.

2.2 Ecological Economics and Environmental Economics

Broadly there are two economic schools that attempt to factor the environment into their models. These are commonly referred to as Ecological Economics (EE) and the more traditional Environmental and Resource Economics (ERE). ERE is best understood as a branch of neo-classical economics which has attempted to factor the environment and resource problems into its wider economic models. Figures such as Julian Simon, William Nordhaus, Robert Solow and Martin Weitzman have tried, amongst other things, to develop methods of attributing monetary values to environmental services, cost-benefit analysis to evaluate environmental policy and to develop theories of capital replacement and technological innovation (Cropper and Oates, 1992). Ecological Economics (EE) on the other hand is influenced by economists such as Kenneth Boulding, Nicholas Georgescu-Roegen and Herman Daly, as well as ecologists like Crawford Holling and Howard Odum. It sees itself as a broad multidisciplinary school of economics that attempts to bring together economics and ecology through a pluralistic approach developed in response to traditional environmental and resource economics.

Although there are clearly some areas of over-lap, these two schools have some fundamentally different assumptions underlying their positions (Costanza, 1994, van den Bergh, 2001, Söderbaum, 2004a, 2004b, Illge and Schwarze, 2006). The central difference is in the intellectual framework of analysis used, particularly concerning economic actors and their relationships. As Jeroen van den Bergh explains

> "*[t]he core of ERE is the theory of (negative) externalities or external costs. This considers environmental degradation and use of un-priced natural resources as a negative effect outside the market by one economic agent on another, without any form of compensation taking place. This implies that the environmental problem is cast in terms of an interaction between people (economic agents), that is, nature and environment are only implicitly described"* (van den Bergh, 2001).

EE in contrast attempts to model the relationship between ecological and economic concerns by fully integrating people and the environment into the model and trying

to map the cause and effect relationships. For ecological economists the environment itself is part of the model and intrinsic to economic activity.

2.2.1 Conceptions of sustainability

At the core of this debate is the relationship between resources and ideas of sustainability. The argument largely revolves around the question of ability to substitute different kinds of capital and resources for one another. The ERE perspective contends that there are two kinds of capital; *economic capital* that comprises machines, land, labour and knowledge and *natural capital* [which] covers resources, environment and nature. From this perspective these different types of capital are interchangeable and can substitute for one another. What matters is total capital, ie. the sum of both economic and natural capital, and hence environmental capital can be sacrificed in the pursuit of growth (Solow 1974, 1986; Hartwick 1977 sited in van den Bergh, 2001). The essential argument here is that technology and innovation are the factors that define resources and there is therefore a substitute for any and all scarce materials. This is sometimes referred to as technological optimism (Illge and Schwarze, 2006).

The EE vision of sustainability in contrast rejects the idea that natural capital is substitutable for human-made capital. Ecological economists argue that natural capital is an intrinsic part of the ecosystem and economy and of value in itself. They argue that natural capital is not ours to consume, as nature and other living organisms also have rights to it. Similarly future generations have as much right to have access to the resources of the world, or at least to decide whether they want access to them, as those of us living today. Konrad Ott powerfully sought to justify this position through John Rawls' veil of ignorance thought experiment, i.e. a lack of knowledge of your own position in the distribution (Ott, 1995). If the veil of ignorance is used to imagine what the best distribution of resources would be, both on an intra-generational and inter-generational basis, the conclusion would be for a distribution that did not disadvantage generations in the future. Ott concluded that:

> "*In general, both kinds of capital are complementary. Those who claim that a natural entity is substitutable bear the burden of proof...* [therefore] *modern*

environmental policy must be an actively precautionary policy that conserves and invests in natural capital" (Ott, 1995).

2.2.2 The planet as a limited resource

The idea of substitutability of capital is at the core of discussions about planetary limits to resources. Neo-classical and ERE economists see no natural limits to economic growth, as innovation and technology will create new resources and new ways to improve economic activity. This reflects a 19th and 20th century optimistic vision of technological progress and the continuous expansion of human civilisation (Victor, 2008). This optimistic view has led to predictions of mining other planets for resources that have run out on Earth (Lewis, 1997). Such ideas were famously characterised by Kenneth Boulding in his famous metaphor about cowboy and spaceship economies (Boulding, 1966). A cowboy economy does not see past its local worries and problems and thus sees expansion and consumption of new resources, frontiers and territories as their solution. In contrast a spaceship economy sees the world as a whole, where humans take a holistic view of managing large but limited material and food supplies. The image of a limited planetary economy is the model advocated by ecological economics.

This idea of limited planetary resources was powerfully developed by Nicholas Georgescu-Roegen (Georgescu-Roegen, 1971) widely regarded as the father of ecological economics. Georgescu-Roegen pointed out, that despite claims that economics is a scientific discipline, it has failed to keep pace with developments in physics and other sciences. In particular Georgescu-Roegen noted that economists have singularly failed to grasp the implications of the Laws of Thermodynamics. The Second Law of Thermodynamics deals with the concept of entropy and the transition of energy from a free or available state to a bound or unavailable state. This happens when materials change form and also through the transfer of energy to other materials in their environment. It is the idea that energy while always conserved tends to be dispersed as a material's state changes, such as during industrial processes. The law states that this is eventually an irreversible process. As Georgescu-Roegen describes it:

> "*The common fact that heat always flows by itself from the hotter to the colder body, never to reverse, came to be generalized by the Entropy Law, which is the Second Law of Thermodynamics... Its complete enunciation is incredibly simple. All it says is that the entropy of the universe (or of an isolated structure) increases constantly and, I should like to add irrevocably. We may say instead that in the universe there is a continuous and irrevocable qualitative degradation of free into bound energy. Nowadays, however, one is more likely to come across a modern interpretation of this degradation as a continuous turning of order into disorder*" (Georgescu-Roegen, 1971).

The implications of this are clear; entropy places an eventual limit on all resources. Humankind is currently the most significant contributor to entropic degradation through the process of increasing rates of extraction of natural resources and proliferation of wastes into the environment. At a very simplistic level energy enters the earth system from the sun and the ability of this process to replace energy lost from consumption is in the long term the natural limit to our economy[4]. If we are able to consume at a rate faster than this now, it is only because we are consuming what could be termed the energy and resources saved-up from the billions of years before human activity. The conclusion is that we need to factor these limits into our economic models and consumption patterns. As Georgescu-Roegen puts it:

> "*Perhaps the earth can support even forty-five billion people, but certainly not ad infinitum. We should therefore ask "how long can the earth maintain a population of forty-five billion people?" And if the answer is, say, one thousand years, we still have to ask "what will happen thereafter!"*" (Georgescu-Roegen, 1971).

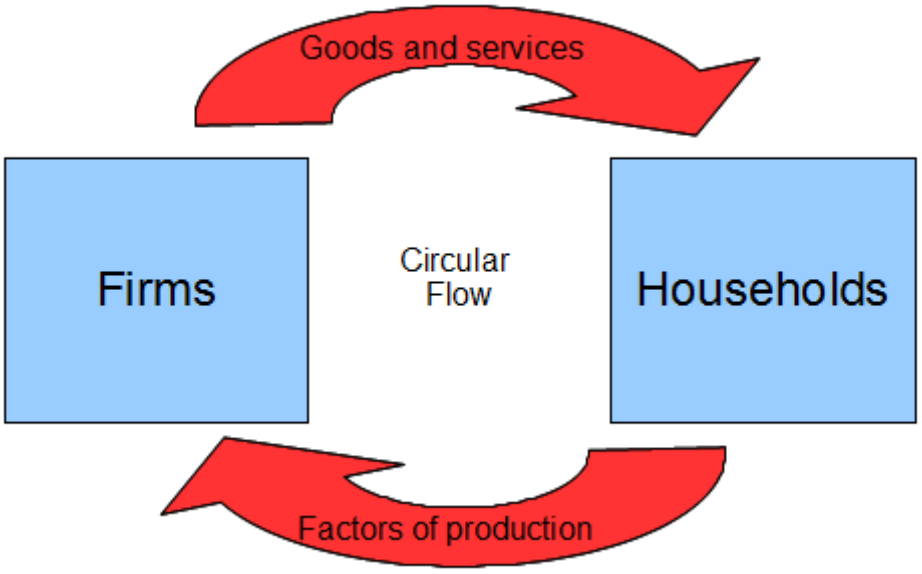
2.3 Ecological limits and Growth

The implications of Georgescu-Roegen's model led economists, such as Herman Daly, to question the prescription of growth as the answer to every economic

[4] This idea was also developed by ecologist Howard Odum (quoted in van den Bergh 2001) and has since been expanded into the idea of EMERGY tracing all environmental products and services back to solar energy.

problem (Daly, 1996). Drawing from his experience and frustrations of working in the World Bank, Daly argued that traditional macroeconomic models largely fail to take account of resources and the eco-system. Mainstream economics views the economic system as a separate and self-contained system of exchange. It is not a sub-system of anything and can therefore expand without limits. The economy is viewed as a cyclical system whereby consumers or households interact with companies through a simplistic relationship of labour and consumption (see figure 1).

Figure 1: The economy as an isolated system



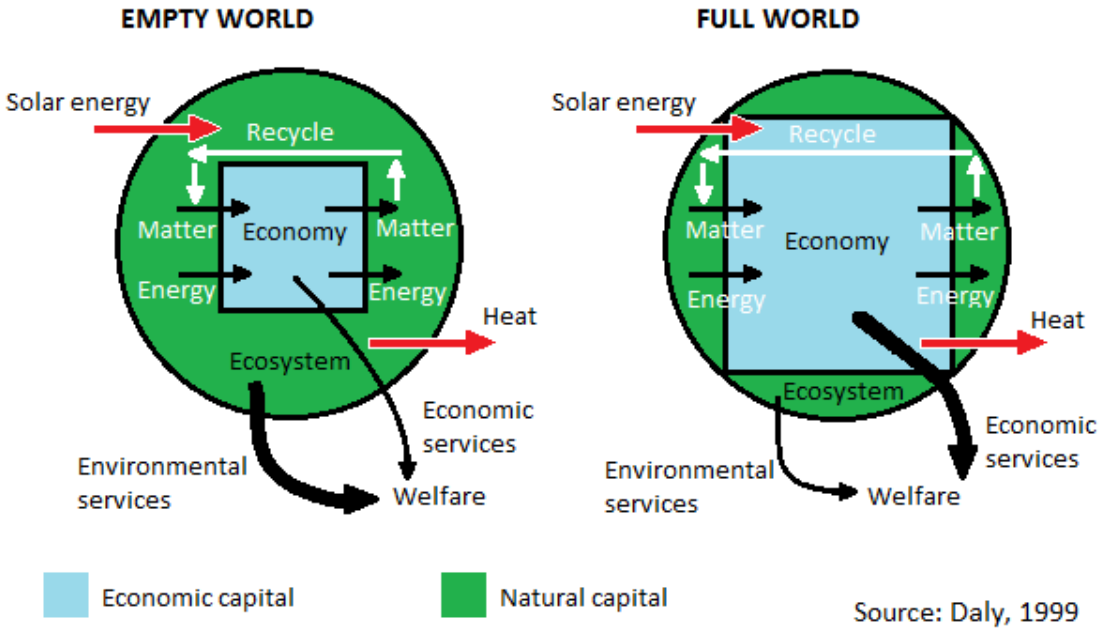
Source: Daly 1996

In this system there is no value given to resources or understanding of exchange of matter or energy from the environment. It is just a system of exchange value between firms and households or consumption and production. Daly argued that this model misses the crucial "*physical dimensions of the goods and factors that are being exchanged*" (Daly, 1996). For this model accurately to reflect the economy/ecology, it has to be considered more like a digestive system than a cyclical system, with resources entering and waste leaving (see figure 2).

These problems do not exist in microeconomics. A firm's balance sheet always looks at the costs of all inputs, including resources and labour, as well as the costs of outputs such as waste disposal. Microeconomic units are always seen to be acting in a wider system - the macroeconomy. In this way microeconomics presents no problem in understanding the concept of "optimum scale" beyond which growth becomes uneconomic. As Daly says:

> "*In microeconomics every enterprise has an optimal scale beyond which it should not grow. But when we aggregate all microeconomic units into the macroeconomy, the notion of optimal scale, beyond which further growth becomes antieconomic, disappears completely!*"(Daly, 1996).

Figure 2: A Macro view of the Macroeconomy



2.3.1 Economic and uneconomic growth

Figure 2 illustrates Daly´s model of the economy. The economy is modelled as a sub-system of the wider but limited ecosystem, with the empty and full world diagrams illustrating the issue of economic resources replacing natural resources. The diagram also illustrates the entropy relationship that the economy has with the ecosystem as energy and matter are consumed. Daly refers to this as resource "through-put". Daly describes resource use as similar to sand flowing through an

hourglass that cannot be flipped over (Daly, 2005). There is an infinite supply of energy coming into the system from the sun but we have no control over the rate of that input. If we use above the rate of supply we are simply borrowing from the energy that has already been introduced. The optimum for Daly is to stabilise throughput so the rate of resource use equals the rate of energy entering the system.

From this model Daly developed his idea of economic and uneconomic growth (Daly, 1999). Daly argued that there are some activities that consume more resources and energy than the environment can sustain. By increasing this consumption above the natural limits of the eco-system to produce more economic services, the growth actually has negative effects on the overall welfare levels as environmental services are lost. In other words, there comes a point where the costs of resource consumption outweigh the benefits from the activity. Daly would term this uneconomic growth, because the activity makes no economic sense if it keeps expanding. This does not mean that economic growth is not possible, but Daly questions whether all growth is by default economic. For developing countries especially, there may be a need for and possibility of economic growth. Firstly, however, the growth needs to be measured against the impacts it will inevitably have on the environment and secondly against the fact that for most of the rich countries the limit to economic growth has already been reached (Daly, 2005).

2.4 Technological solutions to environmental limits

This idea of a physical limit to the economy is not a new one. The first major figure to raise the issue was Thomas Malthus in 1798. Malthus made wide-ranging predictions about approaching famines and misery in Europe due to uncontrollable population increase that could not be matched by agricultural production (Malthus, 1798). Malthus' major point, that the planet should not be considered an infinitely consumable resource, is one that has since resurfaced many times (Krautkraemer, 2005, Masjuan and Martinez-Alier, 2004). Some notable examples of theories of unsustainable population growth and resource usage were *Scarcity and Growth* (Barnett and Morse's 1963)*, the Population Bomb* (Ehrlich, 1968) and *The Limits to Growth (*Meadows et al. 1972). Another feature these theories have in common

with Malthus, however, is that they have been largely proven wrong (Aligica, 2009). All had misunderstood the crucial role of technology in mitigating pending disaster, particularly in food production.

The leading critic of growth limit theories was Julian Simon. Simon was a strong proponent of technology-led solutions to resource shortage problems. In essence Simon argued that, in the face of increases of population and decreasing resources, humans have in general been able to innovate and survive. In fact in most cases they are now better off. Simon argued that "*the increase in the world's population represents our victory against death...*"(Simon 1998). We should be celebrating our scientific achievements and see them as an opportunity for the future. Population growth was a good thing as it led to greater thought, innovation, efficiency and knowledge. In his words "*minds matter economically as much as, or more than, hands or mouths*" (Simon 1998). His idea has a similarity to Schumpeter's ideas of creative destruction (Schumpeter, 1942) whereby the greater competition for resources leads to improvements in efficiency, innovations and new solutions that replace the old products and resources. As Simon puts it:

> "*Greater consumption due to increase in population and growth of income heightens scarcity and induces price run-ups. A higher price represents an opportunity that leads inventors and business people to seek new ways to satisfy the shortages. Some fail, at cost to themselves. A few succeed, and the final result is that we end up better off than if the original shortage problems had never arisen. That is, we need our problems, though this does not imply that we should purposely create additional problems for ourselves*"(Simon, 1998).

2.4.1 Criticisms of Simon

This optimistic view about human endeavour is appealing, given the kinds of doom and gloom predictions made by many commentators on environmental science. Technology's contribution to human development cannot be denied, but Simon's message is reflecting a different set of values to ecological economists (See section 2.2). As with other neo-classical economists the underlying subtext of Simon's work is that humans are the most important part of the ecosystem. The

logical conclusion of Simon's work is that the world is ours to exploit and that the use of resources has only limited or irrelevant impact on other organisms, future generations or the planet. This is a short-term, human-centric view of nature, which sees humanity as separate and superior to the environment it inhabits. The logical outcome of such a view is that things only have worth if they are of value to humans. There is, therefore, no major concern if one species is made extinct by human action, especially in a specific locality.

Simon's work views technology and markets as politically neutral, implying only inevitable progress. This runs contrary to experience and many economists reject the idea of political neutrality (Illge and Schwarze, 2006). Technology and markets should be seen through the prism of power and social relationships that shape them. This understanding is not new, as Marx put it:

> "*social relations are closely bound up with productive forces. In acquiring new productive forces men change their mode of production; and in changing their mode of production, in changing the way of earning their living, they change all their social relations. The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist*" (*Marx, 1846-7).*

From this view all technologies are the embodiment of a power relationship that created them and at the same time all technology has implications for power relationships within society. Examples include nuclear power, bio- and nano-technology that require a strong state to fund and protect them, the steam engine that revolutionised work and society during the industrial revolution and computer technology which enabled the decentralisation of control of information through the internet and social media.

2.4.2 The future is difficult to predict

In Simon's work, history appears to be inevitable and one-directional. We have always found solutions to our problems so we can assume that we always will. The solution is to leave progress to the market and human ingenuity will save the day. This is the assumption of many people who resist climate change legislation for

example. In fairness to Simon, his criticisms of various predictions have proved correct on several occasions, notably in his famous wager against Ehrlich (Regis, 1997) and this has given weight to his position. Predicting the future, however, is a difficult task and one of questionable value. This is as true for technological optimists like Simon as for those predicting neo-Malthusian crises. As Costanza put it:

> "*The technological optimists say yes and the technological pessimists say no. Ultimately, no one knows. Both sides argue as if they were certain, but the most insidious form of ignorance is misplaced certainty*" (Costanza, 1989).

Present day ecological economists, like Constanza, instead propose a precautionary approach to problems. Rather than assuming the best case scenario, the rational choice is for economists and governments to plan and mitigate against possible negative outcomes. An unintended aspect of Simon's work is that it can be interpreted in exactly this way, i.e. that it is the knowledge of the problem that is allowing us to be innovative in our economic ideas. This awareness allows for the design of more effective models of development to manage resource use for generations to come. Predicting the future can only be based on probabilities and incomplete information. It is therefore more useful to highlight potential problems using scientific process and to base our decisions on caution rather than reckless gambling. It is better to mitigate against a disaster that might not happen than to not mitigate and let it take place.

2.5 Conclusions

It seems hard to argue against the premise that there are ultimately ecological limits to the size of the economy. Whether those limits are met now or in the future, at a theoretical level those limits must at some point be reached. The major divisions amongst economists about this issue seem to largely boil down to ideological differences about the value of certain resources over others. While it is appealing to think that there will always be a new technological solution to all our resource problems, current scientific understandings tend to point in the opposite direction. Resource issues such as over-fishing, deforestation or climate change

serve to reinforce this position.

Given the conclusions of chapter 1, these limits to growth and resource consumption pose a serious challenge to traditional approaches to job creation and the provision of decent employment. Perhaps the next technological innovation in the face of these shortages will not only be through the creation of new processes and productivity gains but also a new framework for economic success that takes natural limits into account.

3. Factoring the environment into economic measures

The discussions about growth and environmental limits to the economy have made it imperative that scientists and economists find a way to assess those limits and factor them into their models. This chapter considers some of the methods that have been proposed so far. It first looks at the process of economic valuation of the environment. It then considers alternative measures to GDP for measuring economic progress. Lastly the chapter looks at the most recognised environmental indices, ecological footprint and biocapacity measures.

3.1 Economic valuation in theory

Economic valuation theory has been developed in order to try to incorporate the cost of environmental services, damage and mitigation into economic models. In other words, it is an attempt to put a monetary value on the environment. The lead theorist of this approach is probably David Pearce. Pearce is a strong advocate for using economic modelling to try to place a financial value on the services and resources provided by the environment. He argues that this is part of integrating economic decision-making with ecology by creating a "*level playing field between environment and economic development*" (Pearce, 1993). He argues that:

> "*until the economic value of environmental quality is an everyday feature of the way we compute progress and, more importantly, the way we make economic decisions, then this imbalance will not be corrected and the environment will not be given a fair chance. That is why economic valuation is important*" (Pearce, 1993).

The aim is to create a system that measures the costs of environmental damage and loss of resources both in the short term and also potentially in the long term. As Pearce puts it:

> *"given that resources are scarce in relation to human demands upon them, choices or 'trade-offs' have to be made".* [It is therefore] "*fundamentally important to know what is being traded-off against what. And we cannot*

know that unless we have some idea of the economic value of environmental assets" (Pearce, 1993).

This valuation will help to make better-informed choices. By understanding external costs and integrating them into mainstream economic decision-making, misallocation of resources can be avoided. Economic valuation should therefore be a central part of all levels of public choice, including appraisal of projects and programmes and evaluating the impacts of choices already made.

3.1.1 Deciding what is of value

Economic valuation is a complicated process. Some issues such as costs of cleaning up environmental damage are fairly easy to factor into prices, while other issues are less so, such as the cost to an indigenous community of being displaced from their lands. It is nearly impossible to place a value on some of these factors, as they involve making value judgements based on conceptions of justice which may not be shared. It is also crucial to develop a way to factor in both inter- and intra-generational questions of justice. Not only do values need to be placed on current trade-offs and choices where there will be winners and losers, but there need to be methods to incorporate the potential choices and values of future generations, including the yet unborn. This process is called discounting and is the source of much debate amongst those engaging in economic valuation. Pearce highlights two key elements to the process of economic valuation, the importance of firstly demonstrating and measuring the economic value of environmental assets, some of which may never before have been considered, and secondly of finding ways to capture the value of those assets and services (Pearce, 1993).

3.1.2 Creating commodities and resources

One of the most difficult problems is to predict what will or will not be a commodity in the future. A natural resource is not a given thing just waiting to be discovered; rather it is something that is created through the development of technologies. In this way "*the term natural resource is to an important extent an oxymoron, that something in the natural world only becomes useful to humans in the context of a*

particular socio-technical framework that can make use of it." (Buck, 2007) As Marx described it in Capital:

> "*technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of production of the social relations of his life, and of the mental conceptions that flow from those relations*" (Marx, 1867).

Technology is one of the key ways to change natural materials into commodities, by giving those materials use-value and making them desirable for humans in the production of other commodities (Coe et al. 2007). The other transferral of value is that of scarcity which make the commodities valuable in exchange for other commodities. This can be due to a range of issues such as shortages or increased competition and demand for certain resources. Resources also have many environmental and political constraints. For example resource extraction industries need to be located in places where resources are found and issues such as transportation, investment and logistical support often mean that there are many governmental and other political actors involved in the creation and valuation of resources (Coe et al. 2007). The future values of such resources, is therefore extremely difficult to predict. All of this involves many imperfections, but as Pearce puts it "*valuation may be imperfect but, invariably, some valuation is better than none*" (Pearce, 1993).

3.1.3 An assessment of economic valuation

Economic valuation of the environment is a fairly recent concept and one that is being steadily developed. There have been several examples of economic valuations over the last few years, for example the work of both William Cline (Cline, 1992) and William Nordhaus (Nordhaus, 1993), as well as the attempt by Robert Costanza to put a value on the global ecosystem (Costanza et al, 1998). The process is also increasingly used in public policy, for example to evaluate the impacts of the US Clean Air Act (Lutter and Beltzer, 2000) and the economic costs of climate change (Stern, 2006, Garnaut, 2008).

Despite criticisms, most economists accept the contribution of environmental valuation analysis, such as that of the EPA or Stern review, to the discussion about environmental costing, policy development and modelling. Most criticisms focus on improvements, time frames, costs and assumptions in models. Seeking to place a financial cost on the problems of environmental degradation has the major benefit of speaking to economists and business leaders in a language that they understand, i.e. money and risk. In the final analysis, economic valuation of the environment is as much about persuading these actors to take the environment seriously, as successfully making economic predictions about such complicated problems. This approach does, however, raise a major question about the whole theoretical approach of economists. As Söderbaum put it:

> "*in neoclassical theory, for instance Cost-Benefit Analysis (CBA), it is assumed that there is agreement in society about 'efficiency'. But any idea of efficiency is necessarily based on specific values and is ideological*" (Söderbaum, 2004a).

It therefore begs a number of questions. Does the environment really have a monetary value? Do humans have ownership over the environment such that they have the right to make a cost-benefit analysis about its destruction? Do the planet itself and the other organisms on it have rights too? It is these concerns that have motivated others to call for a more holistic rethink of economic policy (WPCCCRME, 2010).

3.2 Creating an alternative measure to GDP

The second approach to the growth conundrum has been to try to build an alternative measure for economic success to replace Gross Domestic Product (GDP) and Gross National Product (GNP). As discussed earlier (section 1.3.5), GDP has largely been regarded as a proxy measure for welfare in a society, since first defined by Simon Kuznets in 1934 and developed by, amongst others, John Maynard Keynes. This, however, was never the intention behind the measures, as Kuznets himself stated in his report to the USA Congress, "*the welfare of a nation can... scarcely be inferred from a measure of national income*" (Kuznets, 1934).

Measures of GDP and GNP were developed in order to build a set of national accounts of economic activity to help government and policy-makers better understand the workings of the economy, i.e. where activity was taking place. This was particularly useful following the post depression and Second World War Keynesian consensus, when government used state investment to stimulate parts of the economy in order to guarantee full employment. GDP allowed them to better understand which sectors of the economy needed interventions (Cobb, Halstead and Rowe, 1995). As a result of this and related improvements to standards of living during the post war period, it is widely assumed that GDP, while not perfect, is a good approximation to welfare in a society.

This was notably tested by William Nordhaus and James Tobin in 1972. They developed a more complete measure of welfare called the Measured Economic Welfare index (MEW) and compared it to GNP growth in the USA over the period 1929 -1965 (Nordhaus and Tobin, 1972). Their study found that GNP and MEW increases were roughly equivalent and for many years this idea was accepted. It was not tested again until 1989 when Herman Daly and John Cobb revisited the Nordhaus and Tobin study. They further developed the MEW into what they called the Index of Sustainable Economic Welfare (ISEW), breaking the period down into greater increments and extending it by a further twenty years. Daly and Cobb's study found that the correlation between welfare (ISEW) and GNP was not as straightforward as previously described, showing a substantial divergence from the 1970s followed by a decline (Cobb and Daly, 1989).

More recently the UK based New Economics Foundation have looked at GDP growth as a concept and tried to look for alternative models of development. They have highlighted questions about the success of consumption-led growth to improve the lives of humanity, either on crudely defined economic measures of development or in terms of the long-term maintenance of the Earth's ecosystem. For example NEF point to the fact that:

> "*between 1990 and 2001, for every $100 worth of growth in the world's income per person, just $0.60, down from $2.20 the previous decade, found its target and contributed to reducing poverty below the $1-a-day line. A*

single dollar of poverty reduction took $166 of additional global production and consumption, with all its associated environmental impacts. It created the paradox that ever smaller amounts of poverty reduction amongst the poorest people of the world required ever larger amounts of conspicuous consumption by the rich." (Woodward and Simms, 2006)

In a further report they highlight that:

"*Given current, highly unequal patterns of the distribution of benefits from growth, to get everyone in the world onto an income of at least $3 per day – the level around which income stops having an extreme effect on life expectancy – implies, bizarrely, the need for 15 planets' worth of resources to sustain the requisite growth. Even then, environmental costs would fall disproportionately, and counter-productively, on the poorest – the very people the growth is meant to benefit*" (Woodward and Simms, 2010).

In addition, NEF point out that there are now a growing number of studies which show that above a certain level of material prosperity, humanity stops getting happier[5]. Herman Daly and Peter Victor have also raised this issue (Daly, 2005, and Victor, 2008) As Professor Richard Layard, London School of Economics said:

"*Economic growth is indeed triumphant, but to no point. For material prosperity does not make humans happier: the 'triumph of economic growth' is not a triumph of humanity over material wants; rather it is the triumph of material wants over humanity.*"(Layard, 2005)

3.2.1 The problem with using GNP/GDP to measures welfare

Looking again at the concepts of GNP and GDP, the reasons for this become obvious. By looking only at financial transaction activity, GDP obscures many important factors in welfare. This problem is powerfully described in Cobb, Halstead and Rowe's 1995 'If the GDP is Up, Why is America Down?' They show for example that, "*because no money changes hands*" GDP almost completely ignores *"the contribution of the social realm - that is, the economic role of*

[5] Some research on this can be found here: http://www.neweconomics.org/programmes/well-being

households and communities." This is *"where much of the nation's most important work gets done, from caring for children and older people to volunteer work in its many forms*" (Cobb, Halstead and Rowe, 1995). GDP totally ignores issues such as the distribution of income, leisure time and time with the family. It also disregards the environment, ignoring the role, value and services that the environment provides.

Worse still, GDP includes many social and ecological ills on the wrong side of the balance sheet. "*In the apt language of the nineteenth-century writer John Ruskin, an economy produces "illth" as well as wealth; yet the conventional measures of well being lump the two together*" (Cobb, Halstead and Rowe, 1995). If we first pollute and then pay to clean up the mess, both activities add to GDP. Environmental degradation frequently looks good for the economy. *"When the need for a second job cuts the time available for family or community, the GDP records this loss as an economic gain"* (Cobb, Halstead and Rowe, 1995). Matters like divorce, crime, natural disasters and pollution appear as gains in GDP as they lead to increased economic activity, such as legal fees, house buying, the security industry, rebuilding work, media, medical bills, clean-up operations and increased policing. Kuznets, himself, emphasised this point by saying that "*distinctions must be kept in mind between quantity and quality of* [GDP] *growth, between costs and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what*" (Kuznets, 1962).

3.2.2 Alternative progress indicators

It is precisely this problem that has provided the motivation for creating new models to measure economic success by trying to take account of resource use, social conditions and planetary limits in economic measures. There have been numerous attempts to create a measure that captures environmental sustainability as part of a wider index of economic success, particularly to replace GDP. These include the Measure of Economic Welfare (Nordhaus and Tobin, 1972) and the Index of Sustainable Economic Welfare (Cobb and Daly, 1989), both of which led to the development of the Genuine Progress Index (Cobb, Halstead and Rowe, 1995 and Anielski, 1999, Anielski and Rowe,1999). Others have included

measures such as the Human Development Index (UNDP, 2000), WWF's Living Planet index (WWF, 2001), the Happy Planet Index (NEF, 2006 and 2009) and the Chinese Government's experiments with Green Domestic Product (SEPA and NBS, 2006). What is clear, however, is that:

> "*no comprehensive or unified analytical framework that integrates the complex interplay of human, ecological, and economic health has emerged. Indeed, the social cohesion factors of well-being have yet to emerge*" (Anielski and Soskolne, 2002).

Figure 3: Genuine Progress Indicators of Sustainable Wellbeing

GPI Economic Well-Being Indicators	GPI Social-Human Well-Being Indicators	GPI Environmental Well-Being Indicators
• Economic growth • Economic diversity • Trade • Disposable income • Weekly wage rate • Personal expenditures • Transportation expenditures • Taxes • Savings rate • Household debt • Public infrastructure • Household infrastructure	• Poverty • Income distribution • Unemployment • Underemployment • Paid work time • Household work • Parenting and eldercare • Free time • Volunteerism • Commuting time • Life expectancy • Premature mortality • Infant mortality • Obesity • Suicide • Drug use • Auto crashes • Divorce • Crime • Problem gambling • Voter participation • Educational attainment	• Oil and gas reserve life • Oilsands reserve life • Energy use intensity • Agriculture sustainability • Timber sustainability • Forest fragmentation (ecological integrity) • Fish and wildlife • Parks and wilderness • Wetland • Peatland • Water quality • Air quality related emissions • Greenhouse gas emissions • Carbon budget deficit • Hazardous waste • Landfill waste • Ecological footprint

Source: Anielski and Soskolne, 2002

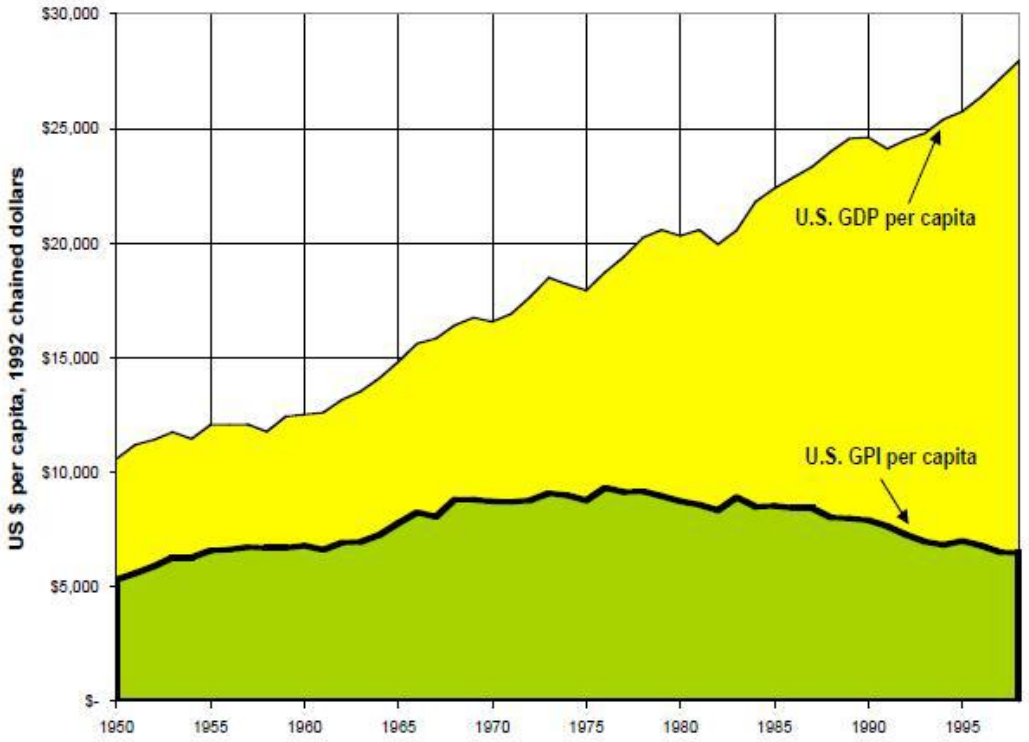
3.2.3 Genuine Progress Index

The Genuine Progress Index, for example, attempts to include a range of social and environmental outcomes in the system of GDP accounting. Factors such as the value of housework are included as "*the approximate rate a family would have to pay someone else to do it,*" while loss of leisure through for example having to

do two jobs to make a living is "*included in it at an average wage rate*" (Anielski and Soskolne, 2002). In this way a full structure of the GPI has been developed to include environmental damage, crime, emissions, unpaid work and wider social indicators like life expectancy. As first produced by Cobb, Halstead and Rowe (1995) for the USA and then updated by Anielski and Rowe (1999) and Anielski and Soskolne (2002), Figure 3 illustrates the factors taken into account.

GPI models confirm Daly and Cobb's original ISEW results. Using GPI as a measure of welfare and comparing results with GDP show that growth in welfare does not necessarily correlate with GDP growth. Studies of GPI, for both Alberta in Canada (Anielski, 2000) and the USA (Anielski and Rowe, 1999), show that, in recent years, welfare has begun to decline against GDP growth. This graph produced by Anielski helps to illustrate this trend (Anielski and Soskolne 2002):

Figure 4: USA GDP growth (per capita) versus GPI (per capita), 1950 to 1999



Source: Data derived from spreasheets from the U.S. Genuine Progress Indicator (GPI) for 1999. Redefining Progress, Oakland, CA

3.2.4 Evaluating the Genuine Progress Index

Despite this, the GPI is far from being accepted as an alternative measure to GDP or developed to its full potential. It has faced criticisms for example over the political decisions it makes about weighting and assumptions. The authors accept that:

> "*there will never be a way to assign an exact dollar value to our family and community life, our oceans and open spaces. This doesn't mean they don't have value. It means only that we don't have a way to register their value in a form comparable to market prices.*"

They, however, retort that:

> "*the current GDP is far from value-free. To leave social and environmental costs out of the economic reckoning does not avoid value judgements. On the contrary, it makes the enormous value judgement that such things as family breakdown and crime, the destruction of farmland and entire species, underemployment and the loss of free time, count for nothing in the economic balance. The fact is, the GDP already does put an arbitrary value on such factors - a big zero*" (Cobb, Halstead and Rowe, 1995).

This recognised, it does not mean that all these factors must be lumped into one single index. Aggregating so much data necessarily relies on a huge number of assumptions and can also mean hiding a huge diversity of results as factors change at different rates, some improving while other deteriorate. As Shmelev and Rodriguez-Labajos put it:

> "*going beyond GDP accounting... should mean something different from "greening the GDP" or that, at the other extreme, genuflecting before one single environmental index... It should mean to go into a multi-criteria assessment of the economy, working with eight, ten, twelve indicators of social, cultural, economic and environmental performance*" (Shmelev and Rodriguez-Labajos, 2009).

They illustrate this point with reference to the economic crisis of 2008-09 in Spain pointing out that this led to:

> "*a very substantial decrease in emissions of carbon dioxide, less accidents at the work place, less would-be immigrants drowning at sea, and a sudden slowing down in the rate of soil sealing, while it also means much increased unemployment and perhaps an increase in some forms of crime. Are we better off now than in 2007? Or rather, previous to this, could we agree on a methodology for macroeconomic participatory multi-criteria evaluation with a set of socially agreed indicators?*" (Shmelev and Rodriguez-Labajos, 2009).

3.3 Ecological Footprint and Biocapacity

In line with Shmelev and Rodriguez-Labajos´ suggestion, there is a less ambitious measure than the GPI that focuses on environmental sustainability. The ecological footprint (EF) and biocapacity (BC) indices of sustainability have been much more widely developed and discussed. When used in conjunction with other economic measures, these can be used to factor in the environmental costs of economic activity.

The ecological footprint (EF) was first proposed by William Rees and developed along with Mathis Wackernagel in the early 1990's. (Rees, 1992; Wackernagel, 1994; Rees, 1996; Rees and Wackernagel, 1996). Rees proposed a methodology for constructing a matrix of consumption and land use by seeking to calculate the necessary land area for the production and maintenance of goods and services consumed by a defined community.

Since 2003 the most widely used ecological footprint measure has been the footprint account calculated by the Global Footprint Network[6], an NGO set up to promote sustainable living (Global Footprint Network website, 2010). Global Footprint Network and its more than 75 partner organisations have built reference accounts covering more than 150 nations dating back to 1961. There is an ongoing process of improving the quality and accuracy of these accounts by linking up with other researchers across the globe (Global Footprint Network, 2010).

[6] http://www.footprintnetwork.org/en/index.php/GFN/

3.3.1 EF methodology

EF accounting assumes that it is possible to quantify and track the majority of the resources people consume and the wastes they generate. It is designed to represent human consumption of natural resources and generation of wastes by defining the appropriated ecosystem area, measured in global hectares (gha), required to sustain it. This in turn can be compared to the biosphere's productive capacity in a given year, otherwise referred to as biocapacity (BC). These measures can be used to assess the total consumption by a given population, state, city or even by the whole planet (Kitzes et al 2009). Estimates for environment overshoot can be calculated by comparing the EF and BC for a given area. In other words, area demanded can exceed area supplied if demand on an ecosystem exceeds that ecosystem´s regenerative capacity. Those resource and waste flows that cannot be measured are excluded from the assessment and therefore the EF measure should always be recognised as a systematic underestimate of humanity's true ecological footprint (Ewing et al. 2010).

The Footprint Network calculate ecological footprint and biocapacity using six land use types: cropland, grazing land, fishing ground, forest land, built-up land and the uptake land to accommodate the carbon footprint. For each land use type, the demand for ecological products and services is divided by the respective yield to arrive at the footprint of each land use type. Ecological footprint and biocapacity are scaled with yield factors and equivalence factors to convert this physical land demanded to world average biologically productive land, expressed in global hectares (gha) (Ewing et al. 2010a). This allows for comparisons between various land use types with differing productivities.

3.3.2 Criticisms of EF

There continues to be considerable debate about the statistical accuracy of the EF and BC measures. This debate has been comprehensively detailed in various papers, most notably by Kitzes et al. 2009 who sought to produce a meta-analysis and definitive discussion of the various concerns that other papers had raised. Their paper highlights twenty-six separate criticisms that have been raised about the ecological footprint measure. Some of these include issues over the reliability

and quality of source data for footprint accounts, as the accounts are based on a variety of international and national data sources. There are concerns about the key constants and also weighting of various factors used in the analysis. This has led to suggestions that EF has a high error and no major systematic analyses have yet been published to examine and test confidence levels of source data in the National Footprint Accounts. Questions have been raised over the use of global hectare accounting, particularly questions about how it is calculated and also how it hides crucial issues about the ways in which land is used. There are issues about the supposed inbuilt bias against foreign trade and the allocations associated with it, as well as the way it measures energy production, nuclear power and other major ecosystem impacts, such as water problems. The accounting of consumer and producer relationships, in particular the valuation of tourism, is also criticised. On a political level, there are questions about understanding of the index for application and policy use (Kitzes et al. 2009).

These criticisms have mostly taken the form of suggestions and improvements to the measure. It is therefore likely that this index will continue to be compiled and improved. Despite criticism, this detailed development and ongoing research into improving the measure probably make the EF and BC the most complete and reliable indicators yet on environmental sustainability.

As Kitzes et al. say it should be recognised:

> *"that the Ecological Footprint does not exist "in a vacuum," but is instead one of a suite of indicators and assessment tools that address different components of the sustainability challenge. Any single indicator can only address a single question, and an integrated approach with multiple criteria can better cover the entire range of concerns relevant for decision making"* (Kitzes et al. 2009).

3.4 Conclusion

In this chapter we have considered the various approaches so far used to factor environmental impacts and services into economics. It is clear that all approaches have their value. Economic valuation has opened a space to discuss the economic

costs of environmental destruction and has also allowed policy makers to predict the economic impacts of environmental decisions. This is especially important when evaluating the effects of environmental policy on employment, a theme that will be dealt with in more detail in chapters 4 and 5. It is also clear that the use of GDP needs to be rethought. Either GDP needs to be replaced with a more effective measure or at the very least its use as a measure of economic success and welfare needs to be downgraded. For want of an accepted alternative, GDP should be used in combination with a basket of other measures that highlight the contradictions hardwired within it. The best environmental measures available to include in that basket are the Ecological Footprint and Biocapacity accounts. These can be used to help develop effective environmental policy that can dovetail with other economic concerns such as employment and welfare creation.

4. Statistical analysis: testing the relationship between Ecological Footprint and Employment

This chapter extends analysis of the statistical relationship between ecological footprint and economic measurements relating to employment. Using ecological footprint data from the Global Footprints Network as well as data from international organisations (IMF, World Bank, United Nations and ILO), it analyses the problem of employment and its relationship to environmental limits on the economy. Firstly it presents a literature review of some of the major relationships that have already been tested. Particularly it considers the concept of the Environmental Kuznets Curve (EKC) and the relationship between ecological footprint and inequality. It then tests ecological footprint data against several key economic measurements that relate to employment, employment creation and decent work.

4.1 Literature review

As discussed in chapter 3 ecological footprint is the most widely recognised statistical measure of environmental consumption. While the EF measure faces some criticisms, it still represents the best evidence of resource consumption and sustainability relativities to-date. As a dataset the EF has been used to illustrate the environmental trends in various states and regions. This data has been used to highlight where environmental improvements can be made. For the purposes of this study there are two general strands of analysis that need to be considered – the relationship between EF and GDP growth and the relationship between EF, resource distribution and equality.

4.1.1 Kuznets curve theory – Ecological Footprint´s relationship with Growth

One of the primary debates concerning ecological footprint has been over the existence of a Kuznets relationship between environmental damage and growth in GDP, used as a proxy for wealth. The Kuznets relationship is based on a paper written by Simon Kuznets in 1955. Kuznets proposed that inequality had a quadratic relationship with GDP. Using available statistics he predicted that

inequality increases initially with wealth creation and then, at a certain level of GDP, decreases again in a bell shaped curve relationship (Kuznets 1955). Kuznets' hypothesis is:

> *"that the distribution of income would deteriorate over the initial stages of development as an economy transforms from rural to urban and from agricultural to industrial. Subsequently, inequality would decrease as the labor force in the industrial sector expands and that of the agricultural sector falls"* (Lopez, 2008).

Putting aside questions about the validity of Kuznets' original hypothesis (recent UK income distribution trends being an example against[7]), this theoretical model has more recently been proposed for environmental measures. There has been a raft of studies trying to test the relationship between environmental indices and GDP.

The broad argument is that, as a country's GDP increases, there is likely to be a dramatic increase in pollution and environmental degradation largely due to increased manufacturing production, energy use, the mechanisation of agriculture and growth of cities. This pollution is tolerated by most people as they are poor and in need of money and work to improve their lives. There comes a point, however, when the trade-off between financial well-being and environmental well-being ceases to be weighted towards finances, both because the level of income is significantly above a survival level for many people and because the negative effects of pollution are far more noticeable. At this point public pressure and technological innovation lead to a decoupling of pollution and GDP, with GDP steadily declining along with growth. This coincides with the growth of service sector activity in the economy.

Before we consider the evidence for this relationship, it is important to consider the implications of the environmental Kuznets curve (EKC) idea. Firstly this relationship can be used to justify inaction or a business as usual free market model of

[7] From the 1980s onward the UK has seen a strong increase in inequality despite long periods of economic grow. http://www.poverty.org.uk/

development. This kind of argument promotes the idea that the laws of economics are deterministic and require very little agency or political will to bring them about. It is equally possible to argue that it was policy makers, as well as activities by those who did not accept this deterministic relationship, which led to the changes, through implementing regulations and innovations to deal with the problem. Thus the Kuznets curve, instead of being predetermined and predictable, can be regarded as a best case scenario for those parts of the world already producing unsustainable levels of pollution and as something to avoid for countries yet to start on a high pollution developmental process, for example through pollutant-avoiding technology transfers from already developed states.

There have been several articles seeking to test this theory (Dinda, 2004, Raymond, 2004, Galeotti, Lanza and Pauli, 2006 and Bagliani, Bravo, Dalmazzone, 2008). The general conclusion is that these relationships are not as simple as the Kuznets theory suggests. There is some evidence that a Kuznets relationship could exist for pollutants that have an immediate or short term impact on the quality of life of people (Raymond 2004). These include issues like air quality, chemical dumping and waste disposal. However, it is far from clear that this relationship exists for longer term pollutants, such as carbon emissions or other greenhouse gasses that take many years to produce an effect (Raymond, 2004 and Galeotti, Lanza and Pauli, 2006). Evidence for these emissions suggests that they have usually tended to continue to rise with GDP. This could either imply that we have not yet reached the automatic turning point for such emissions or that more realistically there is no automatic Kuznets relationship.

It is possible to conclude that the absence of EKC relationship derives from the fact that EF takes into account the displacement of environmental damage away from high income countries, i.e. the pressures supposedly behind EKC relations are leading to a change in location of supply rather than decline in resource use (Bagliani, Bravo, Dalmazzone, 2008). When wealthy countries with high resource and labour productivity reduce resource use in production and move towards greater levels of service sector activity, the trend appears to be for that production to move to countries that have worse productivity and lower labour costs. The end

result of this is that while in wealthy countries levels of resources used in production tend to decrease, consumption footprint measured by the EF tends to rise. This further emphasises the need for better pricing of resource use (as described in chapter 3). Finally even where an EKC is empirically observed, there is still no agreement in the literature on the income level at which environmental degradation starts declining (Dinda, 2004).

4.1.2 Global inequality of consumption

The other major relationship that has been tested relates to the distribution of ecological footprint consumption. Global inequality is widely recognised and this has a large influence on global ecological impacts. For example the UNDP HDI report 2007/08 strongly emphasised the inequality of contribution to the global climate change crisis which is primarily caused by the wealthy. It also highlights that suffering from the global climate change crisis will be most felt by the poorest (UNDP, 2007). This theme has been developed by the Footprint Network's Ecological Footprint Atlas 2010 (Erwing et al, 2010b). The report highlights the paucity of countries living within the dual global aims of a high level of development with HDI score of 0.8 or higher and living within the planetary resource regeneration limits of 1.8 global hectares per person or lower. Using World Bank classifications of countries by income groups, the report concluded that within the three income groups there were differing trends in the time period since the 1960s. High-income countries were characterised by a consistent increase in the average per person ecological footprint, from 3.8 global hectares to 6.1 global hectares, but with a relatively small increase in population. This illustrates the economic growth and improvements in quality of life experienced in these countries and how population and affluence are major contributors to a country's total ecological footprint. Low-income countries in contrast had seen small increases in consumption and ecological footprint per person, but larger population growth. The report pointed out that much of the increase in ecological footprint for high-income countries had come from increases in the emissions of carbon dioxide, which had more than compensated for a decrease in the share of cropland footprint.

In order to understand the distribution better, Thomas J. White tested the spread of ecological footprint across the globe (White, 2007). White calculated the Gini coefficient and Atkinson index for total ecological footprint to show how inequality in the ecological footprint is related to the inequality of income and environmental intensity (White, 2007). White concluded that there was a large overall inequality in ecological footprint across the globe, but that different parts of the ecological footprint are more unequally distributed than others. For example energy use is far more unequal compared to food consumption. He also concluded that inequality of income was greater than inequality of environmental intensity. This suggests that while the latter may be easier to reduce it is unlikely to be effective in reducing EF without also reducing global income inequality.

White's conclusions are mirrored by two studies of embedded carbon footprints in the UK (Papathanasopoulou and Jackson, 2008 and Druckman and Jackson, 2009). Both studies highlight that the carbon footprint of different segments of the UK population shows wide variation: the segment with the highest carbon footprint emitted 64% more CO_2 than the segment with the lowest in 2004 (Druckman and Jackson, 2009). Between 1968 and 2000 the Gini coefficient for total fossil resource consumption grew by 24%. By comparison the Gini coefficient for overall household expenditure rose by only 13%. The analysis also showed that the Gini coefficient for "direct" fossil resources (such as fuel, lighting and car use) was lower and rose less steeply than the Gini coefficient for fossil resources embodied in other goods and services with indirect fossil resource requirements (Papathanasopoulou and Jackson, 2008). This again highlights the issue of outsourcing of ecological impacts to other parts of the world. Both papers suggest that policies should be targeted towards segments of society responsible for the highest carbon footprints rather than universally across all sections of society. It should also be added that the inequality within UK consumption patterns shown in these studies is likely to be much higher in countries such as Brazil and India where inequality is much higher.

4.2 Statistical analysis

The second half of this chapter attempts to extend these discussions by looking at the relationships that EF and its component parts have with employment statistics discussed in Chapter 1. It looks at the issues of correlation, inequality and distribution, regression and causality, as well as geographical trends and patterns between various countries. In the concluding section it relates these relationships to environmental and employment problems.

4.2.1 Material and Methods

Overall, 22 environmental and economic variables were included in the analysis. In addition to the EF and biocapacity measurements, the macroeconomic measurements of GDP, the balance of trade and both labour and resource productivity are considered. Employment indicators such as unemployment and employment by broad economic sector are also considered. Data was collected from the World Data Bank (WDB)[8], the International Labour Organization´s Key Indicators of the Labour Market database (KILM)[9] and from the Global Footprint Network (GFN)[10]. As discussed in section 1.2.4, a full list of statistics relating to decent work indicators is not yet available, but our analysis attempts to touch on this issue through reference to working poverty and working time. Variables were transformed using alternative formats in order to strengthen linear relations and mitigate against problems of using different units of measure. The primary indicators analysed are therefore as follows:

Variable	Description	Year	Unit	Alternative functional forms	Source
EF	Total and per capita (pc) ecological footprint	2007	gha (pc)	ln (EF)	GFN
Cropland	Area required to grow all crop products, including livestock feeds, fish meals, oil crops and rubber	2007	% of EF pc		GFN

[8] Available at http://data.worldbank.org/. Access on April, 2011.

[9] Available at http://kilm.ilo.org/KILMnetBeta/default2.asp. Access on April 2011.

[10] Available at http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_for_nations/. Access on April 2011.

Grazing	Area of grassland used in addition to crop feeds to support livestock	2007	% of EF pc		GFN
Fishing	Annual primary production required to sustain a harvested aquatic specie	2007	% of EF pc		GFN
Forest	Annual harvests of wood fuel and timber to supply forest products	2007	% of EF pc		GFN
Built land	Area of land covered by human infrastructure: transportation, housing, industrial structures and reservoirs for hydroelectric power generation	2007	% of EF pc		GFN
Carbon	The uptake land to accommodate the carbon Footprint	2007	% of EF pc		GFN
BC	Total and per capita (pc) biocapacity	2007	gha (pc)	ln (BC)	GNP
Population	Total population	2007	persons	ln (Population)	WDB
GDP	Total and per capita (pc) Gross Domestic Product	2007	constant 2000 US$	ln (GDP)	WDB
Import	Imports of goods, services and income	2007	Current US$	ln (Import)	WDB
Export	Exports of goods, services and income	2007	Current US$	ln (Export)	WDB
Balance	(Export - Import) / GDP $\times$ 100	2007	%		WDB
NR Prod	Natural resource productivity measured by GDP per unit of energy use	2007	Constant 2005 PPP $ per kg of oil equivalent	ln (NR Prod)	WDB
L Prod	Labor productivity measured by GDP per person employed	2007	Constant 1990 US$	ln (L Prod)	WDB
Unemployment	Unemployment to Economically Active Population ratio	LA	%		KILM
Employment	Employment to total population ratio, 15 years or older	2007	%		KILM
Workd hours	Average weekly working hours	LA	Hrs per week		KILM

Primary	Employment in the agricultural, forestry, fishing, mining and quarrying to total working population	LA	%	KILM
Secondary	Employment in the manufacturing industry to total working population	LA	%	KILM
Tertiary	Employment in the service sector to total working population	LA	%	KILM
W Poor	Employed population with wage lower than 2 dollars per day to total working population	LA	%	KILM

[1] LA is Last Available year before 2007

This analysis was based on the following relationships and statistical methodologies:

i. Pearson correlation coefficients:

The use of Pearson correlation coefficients analysis allows us to understand the level of linear association between environmental and economic variables. Although it does not allow for cause and effect analysis, the Pearson correlation is useful to understand statistical trends. For example it helps to illustrate whether those countries consuming higher levels of EF per capita are also those with the best socio-economic indicators.

ii. Fifths of EF per capita:

Countries were divided into five groups of equal number (fifths) based on their EF per capita. Analysing countries by dividing them in this way allows us to compare the level of inequality between environmental and economic indicators. Countries in the first fifth represent the 20 percent of countries with the lowest EF per capita and countries in the last fifth represent the 20 percent countries with the highest EF per capita. Thirty-five countries had no information for EF and were classified in a separated group (*null*).

iii. Determinants of total EF:

Based on previous analysis (Bagliani, Bravo, Dalmazzone, 2008), a multiple regression analysis was used to fit a function of selected economic variables (matrix ***x***) to the natural logarithmic of the total EF (vector **ln y**). In other words:

$$\mathbf{lny} = \mathbf{x}\boldsymbol{\beta} + \mathbf{e} \quad (1)$$

The aim of this analysis is to understand how the EF varies given a unit variation in one of the variables of interest (β coefficients), while other independent variables remain constant. The main determinants tested in this analysis were: ln(GDP); % Balance / GDP; ln (Nat. Res. Prod.); ln (Labour Prod.); ln (Employment); % Agriculture; % Industry; % Service (reference of analysis). Due to high multicollinearity, i.e. several variables in the model were highly correlated; many of these variables were excluded in the final analysis.

iv. Clusters of EF:

Countries were aggregated into relatively homogenous groups (clusters) according to their share of each component of the EF: cropland, grazing land, fishing ground, forest land, built-up land, and the uptake land to accommodate the carbon footprint. This helps to identify different patterns of demand for natural resources and to suggest different strategies for reducing environmental impacts. Analysis was based on the Ward´s method of multivariate cluster analysis. Ward´s method is based on the analysis of variance within and between groups. The aim of this analysis is to obtain hierarchical groups in such a way that variances are minimum within groups and maximum between groups (Crivisqui, 1999).

4.2.2 Results

By applying these analyses and methodologies, the following results were achieved:

a) World distribution of ecological footprint

Firstly correlation coefficients show strong bivariate relationships between the EF and other economic measures tested (Table 1). Results highlight, for instance, a strong and positive relationship between EF and GDP per capita, balance of trade, labour productivity, industry and service sector participation. This means that countries with higher EF per capita tend to be those with features prevalent in developed countries: higher GDP per capita, balance of trade, labour productivity and higher share of economic activity in the industry and service sectors. Unsurprisingly the poorest countries, which have a higher share of agricultural workers and working poverty, tend to have a lower EF per capita.

These results allow for other important analyses. For instance, the employment rate tends to be higher in countries with a higher share of agricultural workers and working poor. As discussed in chapter 1 this could be due to the statistical measures and definitions used, for example in relation to welfare systems or the inclusion of subsistence farming and informal sector jobs under employment rates. Natural resource productivity, which plays an important role in environmental sustainability, tends to be correlated with higher labour productivity and GDP per capita, although not strongly. Similarly there is a correlation between lower working hours and employment in the service sector, with the highest working hours linked to agricultural work and working poverty.

Table 1: Pearson correlation coefficients

Variable	ln (GDP pc)	Balance Payment	ln (Nat. Res. Prod.)	ln (Labour Prod.)	% Unemp.	% Particip.	Work Hours	% Agricult.	% Industry	% Service	% Working Poor
ln(EF)	0.834	0.336	0.242	0.801	*-0.018*	-0.263	-0.506	-0.730	0.570	0.704	-0.776
ln(GDP pc)		0.424	0.475	0.894	*-0.064*	-0.335	-0.525	-0.829	0.526	0.816	-0.851
Balance Payment			*0.083*	*0.361*	*-0.210*	*-0.065*	-0.230	*-0.296*	*0.100*	*0.346*	-0.316
ln (Nat. Res. Prod.)				0.422	*0.108*	-0.215	*-0.181*	-0.344	0.224	0.313	-0.435
ln (Labour Prod.)					*0.086*	-0.405	-0.521	-0.858	0.556	0.821	-0.859
% Unemp.						-0.424	*-0.155*	*-0.012*	*-0.033*	*0.020*	*0.021*
% Particip.							*0.190*	0.474	-0.375	-0.436	0.413
Work Hours								0.436	*0.057*	-0.488	0.386
% Agricult.									-0.672	-0.946	0.858
% Industry										0.390	-0.734
% Service											-0.800

Table elaborated by the author using data from WDB, KILM and GFN

Values in *italics* are not significant at 5%.

Table 2 reinforces previous analysis, with the average and cumulated distribution of economic measurements according to fifths of EF per capita. Firstly, results highlight a huge concentration of the demand for natural resources in specific groups of countries. Those 30 countries with the highest EF per capita were responsible for 30.9 percent of the total demand for global resources. At the same time they share just 10.8 percent of the global population while accounting for 55.2 percent of the world's GDP. This group represents mainly European, North American and wealthy oil producing countries such as Qatar. The one notable exception is Mongolia which has an extremely high dependence on grazing footprint due to the fact that around 50 percent of its population live nomadic lifestyles. It also has 68.6% of its population in working poverty. The Mongolian example illustrates one of the drawbacks of using the EF aggregate figure, as environmental impact of Mongolian grazing is arguably not equivalent to the excessive carbon footprint of many wealthy countries. The vast majority of countries in fifths 4 and 5 are also those with the highest carbon footprints. This implies that Mongolia should be treated as an anomalous result due to its distinctive development model.

In contrast the bottom three fifths of countries represent 73.5% of the total world population. At the same time they represent just 16% of global GDP and 46.2% of global EF. Dissecting these results shows that the 31 countries in the third fifth represent the closest to a fair distribution of resource consumption. They account for 26.5 percent of global demand for resources (EF) and 27.5 percent of global population.

Table 2: Economic measures according to fifths of EF per capita

Indicator	Fifth of EF per capita						
	1	2	3	4	5	Null	Total
Countries (N)							
Number	30	30	31	30	30	52	203
Population (%)	32,6	12,1	28,8	14,6	11,4	0,4	100,0
Ecological Footprint							
Per capita (gha)	0,9	1,5	2,2	3,8	6,3		2,9
Total (%)	12,5	7,2	26,5	22,9	30,9		100,0
Biocapacity							
Per capita (gha)	1,6	2,5	2,7	2,9	4,7		2,9
Total (%)	14,1	8,0	22,7	30,2	24,9		100,0
GDP							
Per capita (1000 US$)	0,5	1,0	2,5	8,1	21,8	12,7	8,0
Total (%)	3,5	1,9	10,6	27,9	55,2	0,9	100,0
Balance of Trade							
Percent of GDP	-15,1	-19,4	-10,8	-3,2	2,5	-19,1	-10,4
Imports (%)	3,1	2,2	9,7	23,9	56,8	4,3	100,0
Exports (%)	2,7	2,0	10,6	24,5	55,7	4,5	100,0
Nat. Res. Productivity (US$ / kg oil)	4,5	5,9	6,8	6,1	7,1	6,5	6,2
Labor Productivity (1000 US$ / worker)	4,7	9,1	13,0	28,0	40,5	34,1	21,8
Unemployment (% of EAP)	7,7	8,1	10,7	7,6	7,4	11,2	9,1
Employment (% of EAP)	65,7	60,2	55,8	55,3	56,8	57,5	58,5
Working hour (h/week)	40,3	38,6	36,7	35,9	32,0	36,4	35,0
Employment (%)							
Agriculture	59	46	33	16	6	11	24
Industry	13	16	20	26	26	21	21
Services	28	38	48	59	68	68	55
Working Poor (%)	80,0	63,6	34,1	13,9	3,0	43,4	39,3

Table elaborated by the author using data from WDB, KILM and GFN

These statistics are misleading, however, as they also account for just 10.6 percent of world GDP and represent many countries that have some of the worst Gini coefficients of inequality in the world (e.g. Namibia, Botswana, Colombia, South Africa and Bolivia). The figures are also misleading as this group includes China that represents 6.2 percent of global GDP, 19.9 percent of global population and 18.2 percent of total global EF, despite only having an EF per capita of 2.2. If China is excluded, this fifth represents only 8.3 percent of global EF, 4.4 percent of global GDP and 7.6 percent of global population. India, which accounts for 1.9 percent of global GDP, 17.1 percent of global population and 6.5 percent of global EF, has a similarly distorting effect on the first fifth. If India and China are removed, the figures for the bottom three fifths become 7.9 percent of GDP, 21.5 percent of EF and 36.4 percent of population.

It is therefore clear that while EF per capita increases along with GDP per capita, GDP per capita grows faster. This raises questions about whether these two factors could be decoupled (see chapter 5).

Countries with the highest EF per capita have higher average natural resources productivity which is beneficial for sustainability, but their average labour productivity is also substantially higher than in other countries. This would cancel out any employment benefits of resource productivity and helps explain the need for high GDP rates in these countries in order to keep unemployment low. These same countries tend to show lower unemployment and working poverty rates, substantial dependence on service sector activity and concentration of nearly 60 percent of global trade. They also have on average the shortest working hours.

Despite such a large asymmetry of global demand for natural resources, it is important to highlight that the 42 percent of countries with available data had an EF per capita within the planetary resource regeneration limits of 1.8 global hectares per person or lower. At the same time 60 percent of countries had a biocapacity per capita higher than their EF per capita. These countries, which tend to exhibit the worst socio-economic indicators, could still use their natural resources in order to

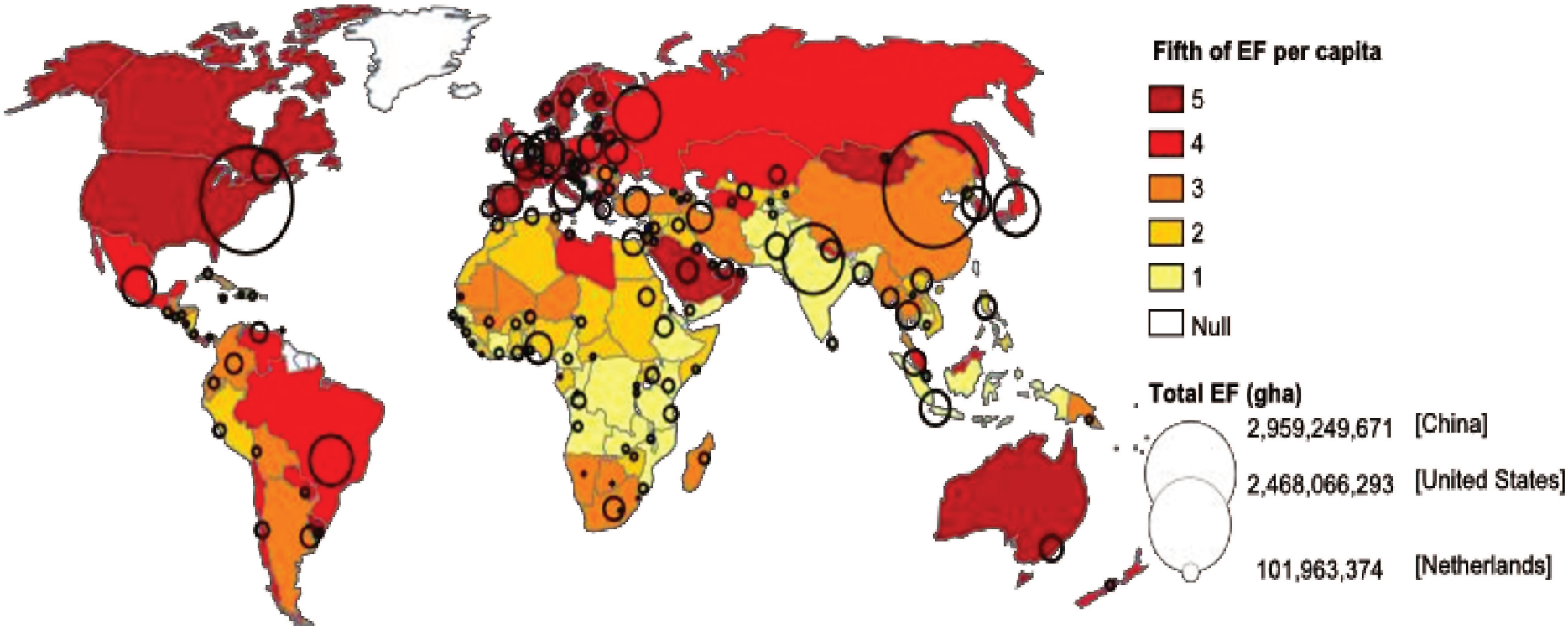
improve their level of economic development. Due to the level of demand from the more developed countries this possibility is globally unsustainable, emphasising a need for redistribution. The problem is that, as it currently stands, those people living in rich countries are consuming far more than their equal global share of EF. Worse still, redistribution systems such as trade and migration are being regulated in order to protect that privilege. The implication is that if poor countries seek to improve their standard of living, wealthy countries will have to reduce their resource consumption in order for the economy to stay within environmental limits.

It is important to stress that a truly fair distribution of resources would not be based on artificial political borders but on population, a factor that is obscured by a single country analysis. The issue of historical justice should also figure in this discussion. Poorer countries clearly should be allowed to grow their economies in order to create jobs and improve the living conditions of their populations. This should, however, be justified as part of the "just transition" and redress of historical injustice, rather than due to accidental possession of more natural resources.

One recommendation for further study would therefore be for an evaluation of how many people are living within the planetary resource regeneration limits. This would highlight the considerable inequality within countries as well as between them and would avoid some of the statistical anomalies encountered due to highly populated countries like India and China.

The spatial distribution of the most polluting countries in the world is well known (Figure 5). Higher EF per capita is observed in the world's richest countries such as the USA, Japan, Qatar and countries in Europe. As already discussed, although China represents the highest total EF, its EF per capita is relatively low in comparison with the other countries (3rd fifth). This is predominantly due to the lower standard of living of many Chinese people, high population and the fact that its economy is still predominantly geared towards agriculture and industrial exports.

Figure 5: World distribution of countries according to fifths of EF per capita (colours) and total EF (circles)



Map elaborated by the author using data from WDB, KILM and GFN.

Cartographic source: Philcarto

Socioeconomic variables were tested as determinants of the total EF using equation (1) (see 4.2.1. iii) and the most significant final results are presented in Table 3. Unfortunately it was not possible to consider many countries in this analysis, due to lack of statistics for various independent variables. Overall, 82 countries were considered in the final analysis and results show that the five selected independent variables fitted well on the natural logarithmic function of the EF, explaining more than 95 percent of its total variability.

First of all, results highlight the important role of natural resource productivity in reducing EF. For every 1% percent variation in natural resource productivity, total EF reduces by 0.2% percent. On the other hand, conventional economic growth, which is closely followed by increases in employment and labour productivity, tends to increase EF substantially. There is a 1.3 percent increase in EF for every simultaneous percent variation in employment and labour productivity. These results suggest that natural resource productivity must grow almost 7 times faster than labour productivity and employment growth in order to stabilise the environmental impacts of growth.

Table 3: OLS estimates for socio-economic determinants of EF per capita

Variable	β	S_β	t	P
Intercept	1.909	0.512	3.726	***
ln (Employment)	0.973	0.025	39.285	***
ln (Nat. Res. Prod.)	-0.222	0.079	-2.816	0.006
ln (Lab. Prod.)	0.361	0.070	5.149	***
% Agriculture	-0.013	0.003	-4.020	***
% Industry	-0.001	0.006	-0.112	0.911
	n=82	R^2=0.954	F=317.6***	

Table elaborated by the author using data from WDB, KILM and GFN.

*** Significant at 5 percent level

Results show that countries with a higher participation of workers in primary activities tend to consume lower quantities of natural resources. Statistics suggest that increased employment in these sectors could reduce the EF, after controlling

for other economic variables. In contrast with Kuznets curve theories, this result suggests that a higher share of service workers actually tends to increase EF, which could be related to the increasing demands for other forms of natural resources (transport, consumption, among others). Most countries with high levels of agricultural and extraction industries tend to have high levels of poverty. In these cases they tend to be either producing for subsistence or exports. This is illustrated by a comparison between the world's largest food exporters, Brazil and USA. Brazil has many more people working in agriculture, but this is due to the dual economy of subsistence and small farming that exists in tandem with a highly productive export sector. In most countries the move away from employment in agriculture and other extraction industries has been driven by productivity gains, particularly as a result of the use of petrochemicals to power machinery or as agricultural pesticides and fertilisers. There are questions as to whether these productivity gains are sustainable long term and whether there are other less resource intensive ways to increase productivity. For such a transition to be just, it would need to avoid a return to the dangerous and low paid work that preceded current technology. This is one of the issues for consideration in reducing emissions in Brazilian live stock industries and also wider agriculture (Lima, Barioni, and Martha, 2006, de Gouvello, 2010).

Other economies illustrate similar trends. For example, China with its high level of manufacturing industry is mostly producing for exports. This again accounts for its low EF per capita. At the same time the inequalities in Chinese development are clear as it continues to have 56.6% of its population working in agriculture and a large amount of working poverty (42.3 percent). There are several examples of countries that have a large service sector but not a high EF or standard of living. Most of these economies are in Latin America, the Middle East and Africa. These include countries such as Argentina, Ecuador, Venezuela, Panama, Iraq, Jordan and South Africa. Argentina, for example, has over 75 percent of its population working in the service sector but an EF per capita of only 2.6. These countries are all marked by lower GDP per capita than other countries with a similar sectoral division of employment. They also have a large inequality between richest and

poorest (Gini coefficients of between 45 and 55) and are the only countries with high service sectors to have working poverty. This suggests that many of those employed in the service sector are working in informal economy jobs or personal services, for example cleaners or maids.

These figures illustrate some important issues. It is not employment per se that is driving ecological footprint, but consumption and standard of living. This is an uncomfortable conclusion in that it implies that reducing consumption and income is the only way to reduce EF. However, a comparison of GDP per capita with EF, shows that this is not a straight forward relationship as there are marked differences in consumption patterns. For example Norway and Japan both have higher GDPs per capita than the USA but considerably lower EF figures. This is primarily due to the USA´s high carbon footprint. Qatar, Denmark, Canada and the United Arab Emirates all have considerably worse EF figures than countries with similar GDP per capita such as the UK, France and Germany. Even though all of these countries have an EF much higher than predicted limits allow, this difference may hold some clues to how changes to consumption trends could be made.

One recommendation for further research would be to perform more analysis of the relative contribution of sectors to different parts of the EF. Similarly a much more sophisticated survey of types of activities and further disaggregation of sectors and jobs would be useful. For example it would be useful to consider the EF for different activities in various sectors such as the financial sector, different types of agriculture, health sector, education, manufacturing, heavy industry, transport or construction. Comparisons could then be made between countries to see whether they are more or less efficient. Another question would be to consider whether consumption taking place is as individuals or collectively such as through public services. This may shed some light on different patterns of consumption.

b) World distribution of components of Ecological Footprint

These statistics highlight that countries exhibit different patterns of economic development, primarily represented by the differing distribution of working population in each economic activity. In addition countries witness different patterns of demand for natural resources. In order to facilitate such analysis, countries were clustered according to their share of the component parts of their EF. Five groups were selected through the cluster analysis. Differences between groups represented 60 percent of the total variability on average, based on the shares of components of the EF (Table 4). The spatial distribution of the countries according to their cluster can be seen further on, in Figure 6.

Clusters 1 and 2 represent mostly developing countries from Africa, the Middle East and South East Asia. In such countries, EF is especially characterised by a high share of cropland (cluster 1) and forests (cluster 2), which is related to the high prevalence of primary activities and, consequently, a large percentage of agricultural workers in the total labour force. Most have low EF and GDP per capita, and high levels of poverty. Most are also in the first and second fifths of EF (see 4.2.2 a). Together these clusters represent almost 35 percent of the world´s population, although this is largely due to the presence of India and to a lesser extent Pakistan, Bangladesh and Nigeria in cluster 1.

Cluster 3 represents mostly African and Latin American countries as well as Australia. While these countries tend to have a large contribution of forestry and cropland, they also have a large percentage of grazing activity and to a lesser extent carbon consumption which is contributing to their EF. They represent only 9.7 per cent of global population but they account for nearly 30 percent of global biocapacity. This is mainly because of countries like Brazil, Australia, and Argentina.

Table 4: Clusters of countries according to components of EF

Indicator	Clusters of EF						
	1	2	3	4	5	Null	Total
Countries (N)							
Number	21	15	33	12	70	51	203
Population (%)	30,0	4,4	9,7	6,9	48,6	0,4	100,0
Ecological Footprint							
Per capita (gha)	1,2	1,5	2,2	2,8	4,1		2,9
Total (%)	12,5	2,1	9,1	4,5	71,8		100,0
Components of EF (column %)							
Cropland	46,7	28,7	23,8	23,2	23,6		27,3
Grazing	8,3	8,5	34,1	4,1	5,6		12,4
Fishing	4,0	6,6	2,4	30,3	4,2		6,1
Forest	14,3	44,8	18,0	9,6	9,8		15,7
Built land	6,8	3,9	3,3	3,3	2,3		3,4
Carbon	19,9	7,5	18,4	29,6	54,4		35,1
Biocapacity							
Per capita (gha)	1,1	4,5	4,7	2,0	2,3		2,9
Total (%)	10,9	4,5	29,5	5,0	50,1		100,0
GDP							
Per capita (1000 US$)	0,8	1,0	2,7	6,2	12,0	12,7	8,0
Total (%)	3,3	0,2	5,9	2,4	87,3	0,9	100,0
Balance of Trade							
Percent of GDP	-14,3	-33,4	-8,5	-5,0	-2,8	-19,1	-10,4
Imports (%)	3,1	0,3	4,1	3,8	84,4	4,3	100,0
Exports (%)	2,6	0,2	3,7	3,9	85,2	4,5	100,0
Nat. Res. Productivity (US$ / kg oil)	4,7	4,2	7,2	7,4	6,1	6,5	6,2
Labor Productivity (1000 US$ / worker)	6,5	5,8	13,7	18,6	29,1	34,1	21,8
Unemployment (% of EAP)	5,4	7,8	9,5	6,5	9,2	11,2	9,1
Employment (% of EAP)	62,5	71,0	60,5	61,0	53,7	57,5	58,5
Working hour (h/week)	38,5		35,2	36,1	34,2	36,4	35,0
Employment (column %)							
Agriculture	53	63	35	31	16	11	24
Industry	15	10	18	21	25	21	21
Services	32	27	47	49	60	68	55
Working Poor (%)	72,4	78,1	52,4	39,1	12,7	43,4	39,3

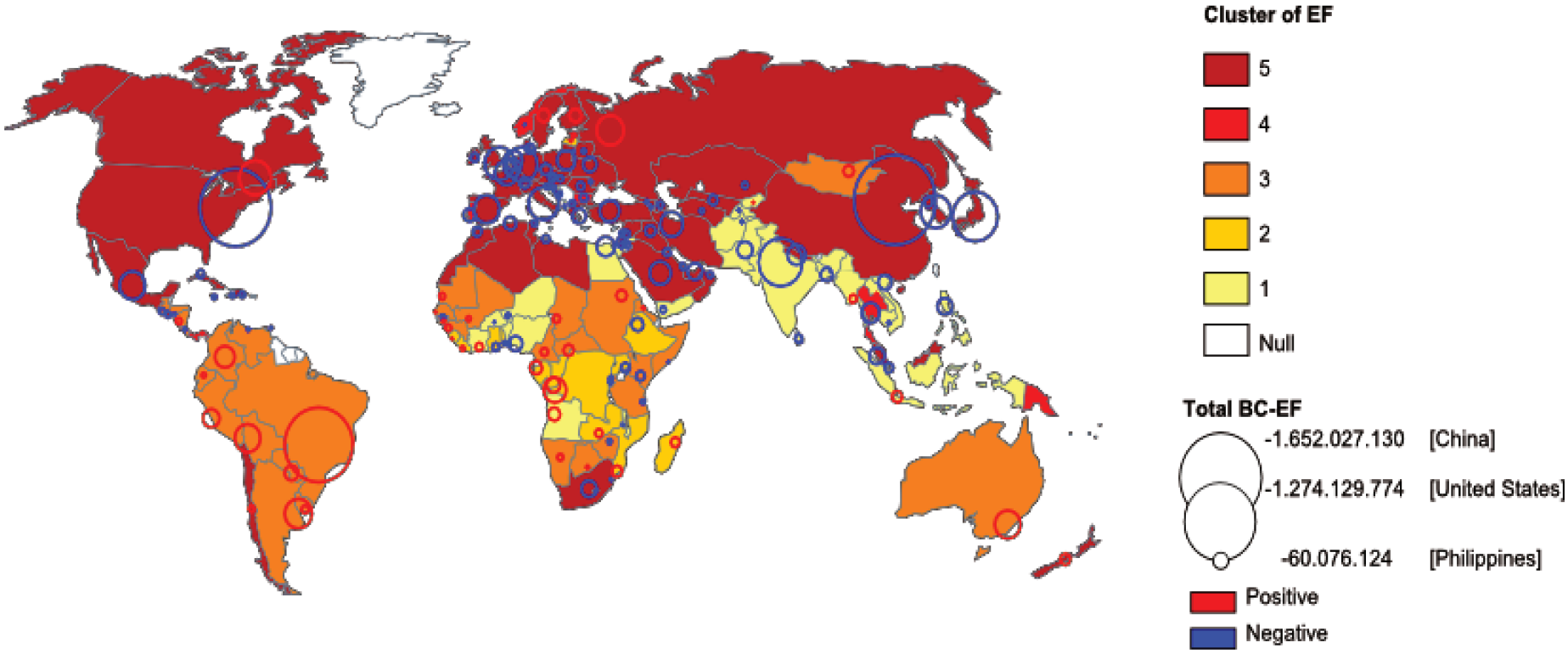
Table elaborated by the author using data from WDB, KILM and GFN.

Clusters 4 and 5 represent countries whose EF is most dependent on carbon consumption. Cluster 4, which consumes less carbon, also has a high dependency on the fishing industry. These countries mostly represent North American, European, East Asian and wealthy Middle Eastern countries. Together they represent 84 percent of total world population, with approximately one quarter of this due to the inclusion of China in cluster 5. They also account for 76.4 percent of total EF, 71.8 percent of which is due to Cluster 5. Cluster 5 represents 87.3 percent of total world GDP and around 85 per cent of global trade. It includes countries with by far the highest labour productivity, lowest number of people in working poverty and the shortest working hours. These countries also have by far the highest percentage of employees in the service sector and lowest percentage in agriculture. For example the UK has an EF of 4.89, but 59% of this is due to carbon consumption. This group represents most of the countries with the highest EF per capita such as United Arab Emirates, Qatar, Denmark, Belgium, the United States and Canada. This highlights just how important reducing carbon consumption is for reducing global EF. This is especially true for the United States because not only does it have one of the largest per capita footprints but it also has one of the world´s largest populations. The rapid economic growth of other highly populated countries will pose a significant challenge for global sustainability if they follow US consumption patterns.

From the above analysis it is possible to draw several key conclusions. Firstly, different countries contribute to the ecological footprint in different ways. Different industries and economic structures have different impacts on the environment and by grouping similar countries, it should be possible to work towards solutions for different kinds of resource problems. Countries in Cluster 3 may be able to improve the efficiency of their live stock industries while those in Cluster 4 could develop strategies to better manage fish stocks. By far the most significant of these factors appears to be carbon consumption at around 55 percent of global EF. This means that in order to bring the economy down within global ecological limits, the main focus should be on reducing carbon footprint.

What this implies for employment is not entirely clear. As it has been stressed most of the countries with high service sector activity tend to have a higher GDP per capita, higher labour productivity, lower working hours and less poverty. These also tend to be countries with high EF per capita and high carbon consumption. This tends to imply that better quality employment, i.e. higher paid with lower hours, has a relationship with increased carbon consumption. This relationship should be explored in more detail in order to find ways to move towards a more sustainable economy without declining employment. In particular a greater understanding of the relationship carbon consumption has with different kinds of employment activity, as well as a more sophisticated methodology to measure decent work and welfare, would help improve our understanding of the issue.

Figure 6: World distribution of countries according to clusters of EF (colours) and total deficit of gha (circles)



Map elaborated by the author using data from WDB, KILM and GFN.

Cartographic source: Philcarto

4.3 Conclusions

The chapter has highlighted the statistical relationships between ecological footprint, growth in GDP, global inequality and employment. Several conclusions can be drawn from this. First of all, ecological footprint data illustrates how environmental sustainability has to be viewed from a global perspective. Growth in GDP and growth in consumption, while caused at a local level, are highly dependent on behaviours in other countries. At the same time evidence does not support the existence of an environmental Kuznets curves when considering resource consumption on a global scale. This implies that the economic benefit of moving production to countries with lower labour costs needs to be balanced with the environmental costs of that production. Incorporating environmental costs into prices could help, as would technology transfers from wealthy countries to help improve the productivity of workers and production in less developed economies.

Another conclusion of this chapter is that global resource is highly unequally distributed, both amongst countries and within them. While this is not unexpected, it does further highlight the need for redistribution in any transition. Resource use is not based on natural assets found in any particular country. Consumption trends tend to illustrate the opposite, with resource rich countries often suffering some of the worst social, economic and employment conditions. The world's resources should in an ideal world be distributed equally by population, so that people in highly populated countries with low biocapacities per capita also have access to resources. This means that in the absence of a more even distribution of population, international trade and migration are crucial elements of global resource justice. The problem is, however, that those people living in developed countries are consuming much more than their equal global share of EF. This means that if poor countries are to improve their standard of living, wealthy countries will have to reduce their resource consumption in order for the global economy to stay within environmental limits. Poorer countries clearly should be allowed to grow their economies in order to create jobs and improve the living conditions of their populations. This is justified both on grounds of current levels of poverty and to redress historical injustice.

With regard to employment, the findings in this chapter show several broad trends. There is currently a clear link between employment in agriculture, poverty, GDP and thus EF. All of the indicators of decent work, such as working time, levels of poverty and productivity imply that this work is strongly associated with high ecological footprint. The more people employed in agriculture, the lower the GDP and ecological footprint, and the higher the levels of poverty. Of course not everyone who is employed in agriculture is poor, but data used in this study does not allow for differentiating between consumption trends for different categories of people involved with agricultural activities. There is a similar problem with service sector activity, although in this case it is reversed. Most countries with high service sector activity tend to have lower levels of poverty and thus higher EF per capita. There are, however, many exceptions to this trend, such as those countries with high levels of inequality and urban poverty found particularly in Latin America. These economies are characterised by high levels of low paid service sector jobs such as those of domestic workers and street vendors.

What is more clearly illustrated is that the countries with the best indicators for decent work and GDP per capita tend to have higher EFs per capita. The majority contributor to EF for these countries is their carbon footprint. Countries, where EF is mostly derived from carbon footprint, account for 72 percent of total global footprint. This suggests that finding ways to reduce carbon footprint in particular should be an urgent priority. One positive implication of the statistics is that, while no country is meeting the joint aspirations of high welfare and sustainable ecological footprint, there is substantial variation in ecological footprint amongst countries with similar standards of living and economies. This suggests that there are opportunities to explore alternative more sustainable patterns of consumption in the future.

5. Environmental approach to job creation and employment

This final chapter considers the implications of the limits to growth discussion for employment and employment creation. It considers the idea of green jobs and some of the policy initiatives proposed regarding the shift to more sustainable economies. It looks at what these might mean for employment and welfare. In particular it examines the ideas of environmental taxes and the double dividend, environmental Keynesianism and green industrial policies. The second part of the chapter assesses whether these policies will in the long term be sufficient to deal with the problem. It considers the possibility of new economic models that try to contain the economy within environmental regenerative limits while providing sufficient welfare and decent employment. It therefore considers ideas of a steady state economy, economic degrowth and what these might mean for the macroeconomy, business models and work.

5.1 Delinking employment from environmental degradation

Previous chapters have demonstrated that the level of employment in an economy has an intimate relationship with many of the drivers of environmental degradation and resource consumption. In particular, employment is linked with the relationship between GDP growth, population, consumption and productivity. Chapter 4 illustrated that the countries with the best indicators for decent work and GDP per capita tend to have higher ecological footprints per capita, which is predominantly caused by high carbon consumption. There is therefore an urgent need to delink employment and welfare from environmental damage.

5.1.1 Green jobs

In recent years a serious discussion has emerged about the possibility and nature of green jobs and the low carbon economy (ILO, 2007, 2010, UNEP 2008, 2011, BLS, 2010). The idea is that the economy can continue to thrive through a focus on sustainable “green” growth that will produce “green collar” jobs in industries and businesses, old and new, while reducing environmental impacts (Global Unions, 2009). In short, it seeks to decouple employment-creating growth from

environmental damage. While this is a positive idea, the definition is still fairly loose. The ILO defines green jobs as:

> "*work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution.*" (ILO and UNEP, 2008)

Green jobs are understood to be more than just new jobs in new industries such as renewable energy. Reports predict that most of the jobs needed to move to a low carbon economy will on the surface look very much like the ones that exist now (Pollin and Wicks-Lin, 2008). Many existing jobs and industries are likely to continue to be part of the economy in the future. Some examples include construction, trains, making steel, aluminium, materials like plastics, printing, pharmaceuticals and food processing, albeit using different processes or materials. The ILO predicts that transitioning the economy towards greater sustainability will lead to four major changes in employment (ILO and UNEP, 2008):

i. The **creation** of additional jobs, for example in production of carbon reducing technologies.
ii. The **substitution** of some jobs, for example by shifting from fossil fuels to renewable energy or from land-filling and waste incineration to recycling.
iii. The **elimination** of certain jobs without direct replacement, for example in some areas of packaging.
iv. The **transformation** of many existing jobs through new skills and practices, for example the jobs of metal and construction workers, plumbers and electricians.

The challenge for policymakers in creating green jobs will therefore be to ensure

that the overall net change will result in an increased number of jobs of at least the same quality (Jackson, 2000). This will be no easy feat. The ILO World of Work report 2009 estimates that 38 per cent of jobs across the world are found in high carbon intensive sectors. The transition for these workers will be crucial if the global economy is to decrease its ecological footprint. If the transition is not managed correctly, many of these workers could view the greening of the economy as yet another assault on their jobs and working conditions (in line with the observations of Altvater in Chapter 1). It is these concerns that motivate the demand for a "just transition" (Global Unions, 2009, UNEP 2008, TUC and Allen, 2008, Canadian Labour Congress, 2000), i.e. a transition that supports workers and communities affected by the changes. These reports argue for greater fairness and redistribution in any transition. They therefore call for investment in re-skilling, new jobs in areas affected by changes, support for families, and progressive redistribution policies whereby the wealthier carry the larger share of the burdens for change, including consumption costs. These ideas challenge ecological policymakers to include a social dimension and therefore ask to what extent "green" policies will also produce a "double dividend" of environmental and employment gains (ILO, 2009b).

5.1.2 Industrial policy, green new deal and green growth

The main proposed solution to the "double dividend" problem is the creation of a "Green New Deal" (Elliott et al. 2008, Steiner and Sukhdev, 2009, Barbier, 2010). Since the financial crisis of 2007/8, there have been regular calls for a return to Keynesian stimulus policies and the use of government intervention to stimulate growth and employment. Many have emphasised that any policy seeking to increase employment must also consider the implications for the environment and the use of resources. There is no point promoting jobs now that will result in worse conditions and standards of living for people in the future. The basic idea is to use government money to stimulate the economy and use industrial policies to plan and support the environmental transition. A Green New Deal would involve investment in areas that contribute to reducing the resource use and environmental footprint of the economy.

Government would have to provide funding for green projects and set the overall goals and standards that will have implications beyond the time horizons typical in the business world. Governments need to provide infrastructure that private enterprises cannot or will not create and regulate the market to create a level playing field or preference for lower impact businesses. Some examples include investment in the development of more efficient products and industrial processes, promotion of alternatives such as electric cars, the construction of a renewable energy sector, a larger more efficient train network or the building of low energy social housing projects (Global Union, 2009). It would also include the funding of new skills and training (Cedefop and ILO, 2010), for example to train construction workers how to retro-fit old houses to make them energy efficient.

As part of this, governments would need to put in place a framework of incentives, funding and penalties that encourage companies to invest in new technologies, products, processes and services (CBI, 2008, Unite, 2010) while guaranteeing a fair and equitable outcome for all those affected. Employment targeting could thus be coupled with environmental industrial policies to achieve the coveted “double dividend”. There have been a range of theoretical and practical suggestions regarding these policy instruments. For example, the ILO suggests the following (ILO and UNEP, 2008):

i. **Subsidies**: Phase out subsidies for environmentally harmful industries, and shift a portion or all of these funds to renewable energy, efficiency technologies, clean production methods and public transit.

ii. **Carbon Markets:** Fix the current shortcomings inherent in systems of carbon trading so that they become reliable and adequate funding sources for green projects and employment.

iii. **Tax Reform:** Eco-tax revenues could be used to lighten the tax burden falling on labour while discouraging polluting and carbon-intensive economic activities.

iv. **Targets and Mandates:** Ensure that regulatory tools are used to the fullest extent in the drive to develop greener technologies, products, and services—and thus green employment. This includes land-use policies, building codes, energy-efficiency standards (for appliances, vehicles, etc.), and targets for renewable energy production.

v. **Energy Alternatives:** Adopt innovative policies to overcome barriers to renewable energy development, including feed-in laws that secure access to the electrical grid at guaranteed prices.

vi. **Product Take-back:** Adopt "extended producer responsibility" laws (requiring companies to take back products at the end of their useful life) for all types of products.

vii. **Eco-Labelling:** Adopt eco-labels for all consumer products to ensure that consumers have access to information needed for responsible purchasing decisions (and hence encouraging manufacturers to design and market more eco-friendly products).

viii. **R&D Budgets:** Reduce support for nuclear power and fossil fuels and provide greater funding for renewable energy and efficiency technologies.

ix. **International Aid:** Reorient the priorities of national and multilateral development assistance agencies as well as export credit agencies away from fossil fuels and large-scale hydropower projects toward greener alternatives.

A crucial argument for green growth models is that failure to change the economy to low emissions industries will in the long run cost more than investing in change. This was one of the key findings of the Stern review (Stern, 2006) and has been a significant finding of all major economic valuation exercises since. For example, the UNEP evaluation in 2008 concluded that

> "*Although environmental policies are sometimes seen as a potential threat to jobs, employment losses from not addressing the environmental crisis are likely to be far more serious: resource depletion, loss of biodiversity and ecosystem services, and storms, floods and droughts induced by climate change will exact ever growing costs and increasingly undermine the viability of many businesses and of livelihoods in agriculture"* (UNEP, 2008).

It is argued that new green jobs would also have the knock-on effect of building a systemic saving for previously less green sectors of the economy. For example, creating renewable energy would mean that high energy users would make environmental gains without many changes to their processes (UNEP, 2008).

5.1.3 Environmental tax reform and the double dividend

Environmental tax reform in particular has been cited as having a double dividend when it comes to employment creation (OECD, 2004). The idea is to move taxation away from social goods such as employment, income and profits and instead focus it on social ills such as pollution, carbon emissions, waste and energy use. Environmental taxes can be viewed as natural capital depletion taxes that try to incorporate the environmental costs of resources while providing incentives for innovation to minimise impacts (Costanza and Daly 1992). The ILO World of Work 2010 report predicted that if a price were imposed on CO_2 emissions and the resulting revenues were used to cut labour taxes, employment would rise by 0.5 per cent by 2014. This is equivalent to over 14.3 million net new jobs for the world economy as a whole. Even larger gains would arise due to technological change induced by green policies (ILO, 2010).

This is supported by a paper by Benoît Bosquet who surveyed 139 eco-tax simulations from 56 studies and showed that in 84% of the relevant scenarios resource consumption decreased. At the same time 73% of studies showed associated increases in employment (Bosquet, 2000). Bosquet argues that, when environmental tax revenues are redistributed to cut distorting taxes on labour, environmental quality improves leading to small gains in the number of jobs and

output in non-polluting sectors. Bosquet recognises that long term trends are, however, more ambiguous and that taxes may cause some harm to energy-intensive sectors which would imply the need for government support for the displaced workers. Patuelli et al. support this conclusion although stress that the level of employment dividend is very dependent on the structure of the policies and how they are implemented (Patuelli et al. 2005).

Baker and Kohler's study on EU environmental tax reform found an increase in personal disposable income from the baseline case for all socio-economic groups (Baker and Kohler, 1998). They concluded that there was an increase in employment in all countries, although there had been some trade-offs with regressive effects, due for example to taxation on domestic energy consumption. Baker and Kohler argue that these benefits were not automatic and were heavily dependent on deliberate government intervention, such as targeting reductions in employer taxes on employment of the lower-paid. This intervention included using some of the revenues to improve the energy efficiency of domestic fuel use by lower income groups or to raise incomes of vulnerable groups directly via social security payments.

Others are less convinced. Tony Jackson argues that it is difficult to assess the impacts of environmental taxation because, while in principle they should work well, in practice tax regimes rarely function perfectly - "*environmental taxation based on first-best assumptions have difficulty in coping with the second-best realities of actual tax regimes*" (Jackson, 2000). Jackson argues that political factors affect the results, contrasting taxation motivated by revenue-raising with taxation motivated by reducing demand. Similarly, the OECD questions the double dividend effect of environmental taxation and other instruments (OECD, 2004). They argue that while in most applied models:

> "*an employment dividend is possible when the revenues raised by economic instruments (taxes or auctioned emission permits) are recycled in the form of lower labour taxation, and particularly in the form of reduced payroll taxes.*" [However] "*an employment dividend is conditional upon a reduction*

in the cost of labour. The larger the amount to recycle, the larger the employment impact can be obtained. A reduction in labour costs is likely to be only temporary; hence the employment dividend can be expected to disappear over the long run. The models also indicate that employment raises more when recycling is targeted at low wage earners and more durably when wage pressures remain moderate" (OECD, 2004).

The OECD argues that employment gains are conditional on other factors. For example, "*employment may rise when environmental policy induces product innovations, while it may decline in the case of process innovations*". They argue that, if environmentally related taxes succeed in changing behaviour, this will lead to lower revenues in the long run. Factors such as wage levels, high initial taxes on labour, and conditions in the labour market also make a difference, as do environmental taxes that can be passed on to factors that are in-elastically supplied and relatively under-taxed. The OECD concludes that, when a double dividend does exist, it appears limited and conditional upon a number of prerequisites.

This concern was mirrored by Holmlund and Kolm who argue that environmental taxes which are recycled into the payroll can reduce unemployment, but only if there is a wage premium in affected sectors (Holmlund and Kolm, 2000). While this may boost employment, it may not affect overall welfare. They argue that tax reform could lead to unions in certain sector having stronger bargaining positions than unions in other sectors, which could create wage inequalities and in some cases unemployment. They therefore remain sceptical about the case for a double dividend.

These studies show that environmental taxes can have a beneficial role but they are not a magic bullet. They need to be introduced carefully and their effects need to be modelled and monitored to make sure they are creating the desired benefits.

5.1.4 UNEP green economy project 2011

Modelling and monitoring is an important part of green economic policies. One of the most recent and comprehensive green growth studies is the UNEP green

economy project. In their 2011 report, UNEP set out the conditions they perceive are needed to develop environmentally sustainable growth and poverty reduction (UNEP, 2011). The report argues that

> "*a transition to a green economy is possible by investing 2% of global GDP per year (currently about US 1.3 trillion) between now and 2050 in a green transformation of key sectors, including agriculture, buildings, energy, fisheries, forests, manufacturing, tourism, transport, water and waste management. However, such investments must be spurred by national and international policy reforms*" (UNEP, 2011).

The UNEP report uses a macroeconomic modelling exercise to consider the employment and growth changes under various investment scenarios. Crucially, the report concludes that the transition to a green economy "*not only generates growth, and in particular gains in natural capital, but it also produces a higher growth in GDP and GDP per capita.*" It argues that the green investment scenario "*achieves higher annual growth rates than a business as usual scenario within 5-10 years,*" with economic growth characterised by a significant decoupling from environmental damage scenarios. The model shows that global demand for energy rises initially but "*returns to current levels by 2050, which is about 40% less than what is expected under business as usual, thanks to substantial advances in energy efficiency.*" It also predicts that this would reduce emissions by around a third compared to current levels and keep them within the IPCC´s sustainable climate change limits (IPCC, 2007).

In terms of jobs, the report suggests that much of the investment should be in natural capital with around one quarter of proposed investments allocated to natural capital sectors: forestry, agriculture, freshwater and fisheries. Over time the report shows how in these sectors, in particular, new jobs will exceed job losses.

> "*However, in sectors whose capital is severely depleted, such as in fisheries, greening will necessitate the loss of jobs and income in the short*

> *and medium term in order to replenish natural stocks and prevent a permanent loss of income and jobs. It may also require an investment to re-skill and re-educate the workforce"* (UNEP, 2011).

As in other green new deal proposals, the report calls for "*prioritizing government investment and spending in areas that stimulate the greening of economic sectors,*" in particular, reforming systems of subsidies to dirty industries and using instruments, such as taxes, incentives and tradable permits to promote green investment and innovation. It would also require "*investing in capacity building, training and education,*" while "*strengthening international governance and global mechanisms that support a transition.*"

Finally, the report highlights the progress that has already been made in green new deals, pointing out that in 2010 new investment in clean energy was expected to reach around US$180-200 billion, up from US $162 billion in 2009 and US $173 billion in 2008. Much of this investment was in non-OECD countries particularly Brazil, China, and India.

5.2 Green growth and ecological limits to the economy

While this seems incredibly optimistic, the proposers of a Green New Deal and green growth are not without their critics.

> "*There are good reasons to think that the concept of "green growth", "green new deal", "sustainable development", "cleaner technologies" alone are not adequate for heading towards a more sustainable society. These concepts do not take into account the idea of limits of the availability of natural resources and the idea of reduction of the societal capacity to extract natural resources." (*Schneider, 2009)

5.2.1 The rebound effect

Schneider points out that efficiency savings do not always lead to reduced consumption. In many cases, efficiency savings are simply used to increase consumption, referred to as the rebound effect (Schneider, 2009). One example of

this is the case of road building where evidence shows that increasing road capacity usually leads to more traffic not less (Schneider 2002, quoted in 2009). Schneider also points to the time rebound effect for labour productivity.

> "*When the length of the time dedicated to working or consuming is maintained, and labor productivity and time efficiency increases (involving faster consumption and production), more time is made available for work and consumption. In that case, there is unused time capacity that can be used for additional work and consumption. Labor productivity, for example, has increased by a factor from 30 to 50 in the last century, but this did not lead to an equivalent size reduction of working time. The gains have mainly been used for increasing production*" (Schneider, 2009)

Schneider emphasises that the rebound effect can be caused by various other factors such as unawareness, incentives caused by inequality and lifestyle competition, deregulation in the social, environmental or economic sphere, short lived products and planned obsolescence, as well as poor public commons.

The rebound effect could in theory be avoided, but many ecological economists would argue that this is not sufficient. At least for wealthy countries, they view green or sustainable GDP growth to be a contradiction in terms. These countries are now using much more than their share of global natural resources and some ecological economists argue that any kind of growth in activity would be unsustainable in the long term. As Martinez-Alier put it:

> *"If public investment must grow, as indeed it must to contain the rise in unemployment, it is better to channel it to the welfare of the citizens and to "green" energy production, than into motorways and airports. However, Green Keynesianism should not become a doctrine of continuous economic growth"* (Martinez-Alier, 2009).

5.2.2 The myth of decoupling

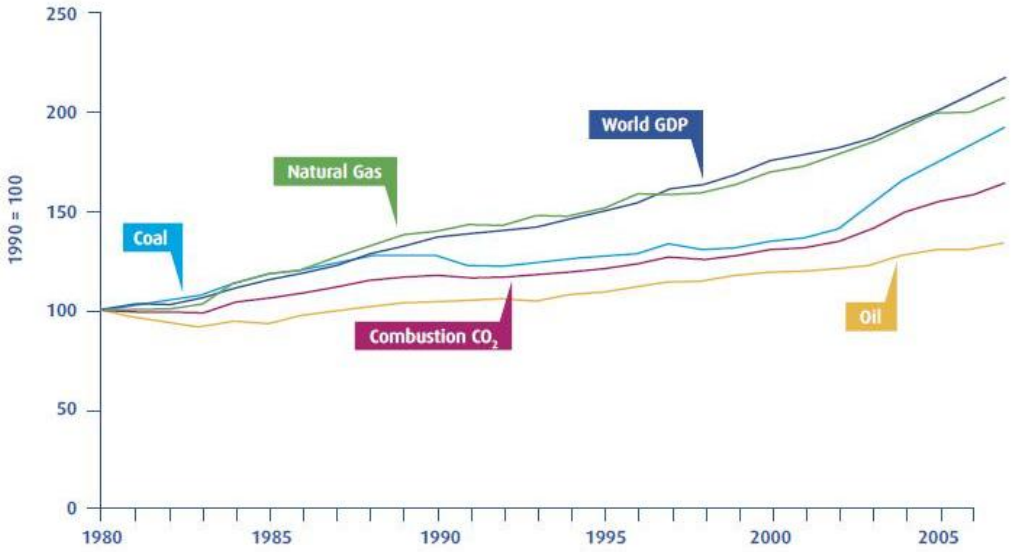
Green Growth theories, in the long term, rely on the idea of decoupling. This is one of the key drivers of the UNEP model discussed in section 5.1.4. The basic argument behind decoupling is that improvements of resource efficiency and

innovation allow the delinking of growth and resource consumption, i.e. we will be able to make more with less. This is the idea behind the Environmental Kuznets Curve Theory. As shown in chapter 4, there is no convincing evidence of automatic decoupling of growth and resource use based on EKC relationship, but could decoupling be possible with the correct policy instruments?

In his book *Prosperity Without Growth*, Tim Jackson tackles the issue of decoupling head on (Jackson, 2009). Jackson argues that there are two types of decoupling, relative and absolute. Relative decoupling refers to a decline in the ecological intensity per unit of economic output, i.e. resource impacts decline relative to GDP. This is very much a part of the logic of capitalist production, as producers seek to reduce costs by increasing efficiency of production and reducing input costs. Efficiency, however, does not necessarily mean that resource use is declining in absolute terms. Resource use may simply increase at a slower pace to GDP, as each unit of activity is using less resources but cumulatively more activity is taking place. Current models suggest that at least for some resources, notably carbon, it is absolute decoupling that is crucial for us to remain within the planet's absolute environmental limits (IPCC, 2007). Jackson uses the example of climate change, where "*absolute reductions in global carbon emissions of 50-85% are required by 2050 in order to meet the IPCC's 450 ppm stabilisation target.*"

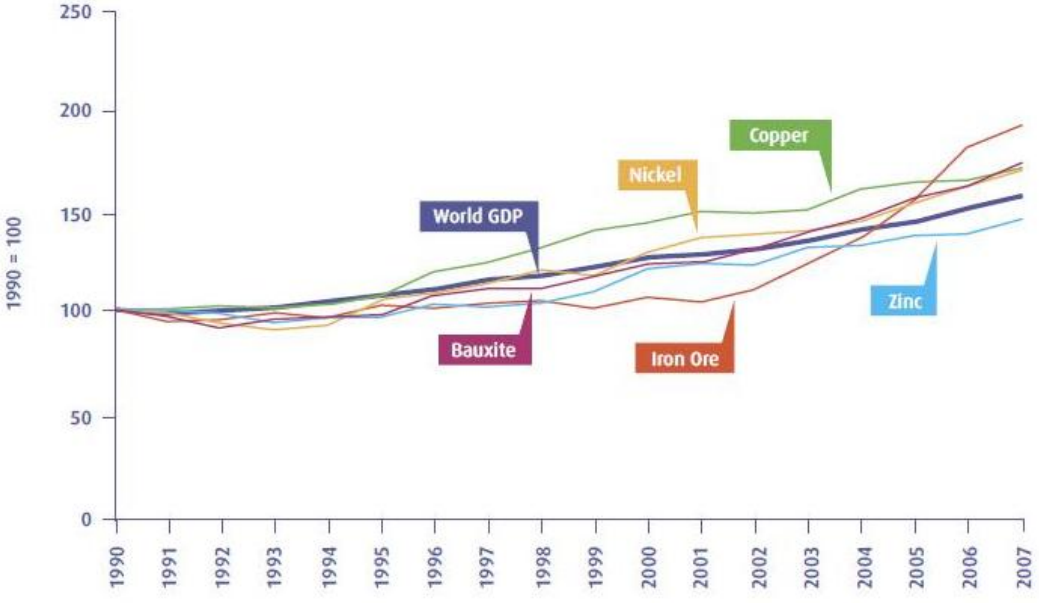
Jackson shows that, while there has been some relative decoupling, the amount of primary energy needed to produce each unit of the world's economic output, for example, has declined more or less continuously over most of the last half century. The global 'energy intensity' is now 33% lower than it was in 1970 according to the IPCC 2007 (quoted in Jackson 2009) and this has been much faster in OECD countries. Jackson claims, however, that this has not been the case for absolute decoupling, where resource efficiencies must increase at least as fast as economic output (see figures 7 and 8).

Figure 7: Trends in fossil fuel consumption and related CO2: 1980-2007



Source: Jackson, 2010. Using source data for the period 1980-2006 for fossil fuels taken from EIA 2008, Table 1.8; data for 2007 estimated using linear extrapolation over the period 2000-2006. Data for CO2 emissions was taken from EIA 2008, Table H1CO2.

Figure 8: Global Trends in Primary Metal Extraction: 1990-2007



Source: Jackson, 2010 using source data taken from the US Geological Survey Statistical Summaries.

These figures show that, on a global scale, there has been no absolute decoupling of either CO_2 emissions or resource intensities (the ratios of resource use to GDP). As Jackson observed, "*resource efficiency is going in the wrong direction. Even relative decoupling just isn't happening".*

Worse still, Jackson uses current predictions for resource reduction to highlight just how likely we will be to achieve absolute decoupling. Using the Ehrlich equation to describe the impact of human activity on the environment (Ehrlich and Holdren, 1971), Jackson illustrates that levels of efficiency gains required to achieve absolute decoupling are unachievable based on current trends. He argues that a convenient 'rule of thumb' to figure out when relative decoupling will lead to absolute decoupling is to compare it to the rates of population and income increase. If population is growing along with average income, absolute decoupling will only occur when the rate of relative decoupling is greater than the rates of increase in population and income combined (Jackson, 2009). Using current UN population predictions for 2050 and various income scenarios, he predicts the required decoupling. If income and population rates stay as predicted, decoupling for carbon emissions, for example, would require emissions to decline 10 times faster than they currently do. If this were coupled with genuine improvements in global equality, development and welfare statistics, this figure would have to be considerably faster. As Jackson concludes:

> "*The message here is not that decoupling is unnecessary. On the contrary absolute reductions in throughput are essential. The question is, how much is achievable? How much decoupling is technologically and economically viable? With the right political will, could relative decoupling really proceed fast enough to achieve real reductions in emissions and throughput, and allow for continued economic growth? These critical questions remain unanswered by those who propose decoupling as the solution to the dilemma of growth. More often than not, the crucial distinction between relative and absolute decoupling isn't even elucidated*" (Jackson, 2009).

5.3 An economy without economic growth

If decoupling is unlikely, what then are the alternatives? Can there be a successful economy without growth? This is the question that motivated Herman Daly's idea of the “steady state” economy (Daly, 1996, 2005, 2008) and subsequently the ideas of economic “degrowth” or “décroissance” (Rijnhout and Schauer, 2009, Martínez-Alier et al. 2010, Kerschner, 2010, Kallis, 2011). These ideas are attempts to move away from the obsession with GDP/GNP growth and look for ways to provide wellbeing without growth.

5.3.1 Steady state

The basis of the steady state is to “*distinguish growth (quantitative increase by assimilation or accretion of materials) from development (qualitative improvement, realization of potential)*” (Daly, 1996). Daly argues that qualitative changes should be the main priority of a steady state economy. The optimum economy would be an economy that seeks to exist within the planet’s limits but that provides a better life for those living on it. Daly cautions that:

> *“a steady-state economy is not a failed growth economy. An airplane is designed for forward motion. If it tries to hover it crashes. It is not fruitful to conceive of a helicopter as an airplane that fails to move forward. It is a different thing designed to hover. Likewise a steady-state economy is not designed to grow”* (Daly, 2008).

Daly argues that one of the key objectives will be to reduce resource per capita consumption to within the limits of the environment (Daly, 1996). He thus defines a steady state economy as an economy:

> “*with constant population and constant stock of capital, maintained by a low rate of throughput that is within the regenerative and assimilative capacities of the ecosystem. This means low birth equal to low death rates, and low production equal to low depreciation rates. Low throughput means high life expectancy for people and high durability for goods.*” (Daly, 2008)

Daly points out that the idea of a steady state has various historical roots. These include the works of Mill, Marx, Schumpeter and Keynes, all of whom described the

possibility of a final state where resource demand was not increasing as population, welfare and consumption stabilised (Kerschner, 2010).

As discussed earlier, it is now widely predicted that population is not growing exponentially but is likely to peak around 2050 at about 9 billion (UN, 2004). 9 billion, however, is nearly half as much again as the current population. Daly argues that this must mean a shift in how resources are valued and how use is allocated. The idea is that the right to deplete or pollute up to the scale limit should no longer be considered a free good but a valuable asset. Limits should be put on resource use, to keep them at a sustainable level. This means that the right to deplete or pollute also needs to be distributed justly (Daly, 1996). This necessitates active state interventions in society to regulate markets, consumption, resource distribution and also population trends.

5.3.2 Degrowth

Degrowth theories argue that Daly does not go far enough. They argue that, in the richest countries at least, the economy is already heavily reliant on uneconomic growth. It is therefore necessary for a process of retraction in the economy or "degrowth" (Schneider, 2009). Indeed, current resource crises, like climate change, make "degrowth" of the economy inevitable. They stress, however, that sustainable degrowth is not the same as negative GDP growth, i.e. recession, or depression (Spangenberg, 2010, Kallis, 2011). Recessions cause a range of negative effects in terms of unemployment, economic insecurity, a lack of credit and collapse of social peace (Spangenberg, 2010). For degrowth theorists, the question therefore is how negative growth *"can become socially sustainable, i.e. a prosperous and stable, rather than a catastrophic, descent"* (Kallis 2011). The difference is between managed decline and catastrophic crisis. Martinez-Alier, for example, advocates using the post 2008 recession as a way to reconstruct economies and lifestyles, so that they are less resource intensive and harmful to the environment, while at the same time maintaining or improving welfare. He points out that "*in rich countries a slight economic decline is already taking place and it could easily be socially sustainable"* (Martinez-Alier, 2009). The key for Martinez-Alier is redistribution.

> ***"****In Europe we have economies with incomes per capita of over 25,000*

Euros. Going back ten per cent (with a corresponding decrease in energy and material flows) can be managed if institutions of redistribution are in place. Thus, we shall enter into a socio-ecological transition. There is already an agreement in Europe for the carbon dioxide emissions to be cut by 20% compared to 1990. In fact, emissions and GDP are, in early 2009, decreasing faster than required to reach this target" (Martinez-Alier, 2009).

While degrowth theorists base the concept of degrowth on Georgescu-Roegen´s explicit rejection of the steady state proposed by Daly, (referenced in Kerschner, 2010) the reality is that they have a lot in common. Kerschner points out that "*economic de-growth is not a goal in itself, but the rich North's path towards a globally equitable SSE* [Steady State Economy]" (Kerschner, 2010). Kerschner also stresses that a steady state economy is unlikely to be achieved in any perfect utopian form. It should therefore be treated as a motivational "unattainable goal." As he describes it:

"Adopting the provocative spirit of degrowth writers, this goal should openly be defined as "unattainable". Same is true for sustainability and many other worthy policy goals promoted by economists (e.g. full employment). Despite being elusive, they can (and should) be approximated" (Kerschner, 2010).

5.3.3 Is an economy without growth possible?

These policies and innovations are a useful beginning, but they still do not provide an image of a functioning alternative to the growth economies that currently exist. This is partly because they have not consciously been tested, although some commentators have pointed to examples such as the low impact Cuban economy and its high social indicators (WWF, 2001) or Japan´s stagnated low growth economy (Victor, 2008). Van den Bergh highlights that:

"Since most governments and central banks are committed to realising a positive rate of growth, it is hard to say whether it is feasible – policy-wise and politically - to arrange a zero or negative rate of growth. From an economic perspective, an important derived question is whether without growth other macroeconomic goals, such as full employment and price

stability, can be reached. Within [Ecological Economics]*, no clear-cut answers to these questions have been formulated, due to the fact that the issue of controllability of economic growth has been largely neglected*" (van den Bergh, 2001).

Van den Bergh has also criticised proponents of degrowth, claiming that such ideas are vague, lacking in practical solutions and self-consciously radical (van den Bergh, 2011). Despite rejecting van den Bergh´s criticisms, Kallis illustrates that radicalism is definitely a part of degrowth´s agenda. Kallis claims that, radical or not, degrowth is not impractical:

"*Big social change does not take place by appealing to those in power, but by bottom-up movements that challenge established paradigms; scientists have a role to play as partners in these movements, offering – and problematizing – structuring concepts. Seen from this perspective, a radical idea, such as degrowth is not doomed to fail."* (Kallis, 2011)

In the final analysis, however, the disagreement between van den Bergh and Kallis appears to be more about semantics and tactics than about substantively different aims.

Despite all these debates it is clear that neither steady state nor degrowth models of economics have so far shown themselves to be either possible or stable (Jackson, 2009). As Tim Jackson put it:

"*What we still miss … is the ability to establish economic stability under these conditions. We have no model for how common macro-economic 'aggregates' (production, consumption, investment, trade, capital stock, public spending, labour, money supply and so on) behave when capital doesn't accumulate. Nor do our models properly account for the dependency of macro-economic aggregates on ecological variables such as resource use, reserves, emissions and ecological integrity. In short, there is no macro-economics for sustainability and there is an urgent need for one.*" (Jackson, 2009)

5.3.4 Modeling and economy with no growth

Peter Victor is one of the few researchers to attempt to model the possibility of a low or no growth economy (Victor, 2008). Using Canada as his focus, Victor explored a macroeconomic simulation of a rich country managing without growth (the LOWGROW model). Victor concluded that a policy of immediate steady state or ´no growth´ economy would lead to a disaster for the economy akin to the 1930s depression, with massive increases in hardships, poverty and, ironically, emissions and resource consumption due to factors such as lack of investment in efficiency. In contrast, pursuing a policy of ´low growth´ or slower growth would lead to stability around 2030. Victor argues this can "*be consistent with attractive economic, social, and environmental outcomes: full employment, virtual elimination of poverty, more leisure, considerable reduction in GHG emissions and fiscal balance."* These achievements require a significant departure from the macroeconomic status quo. Victor´s suggestions include redistribution policies and support for the most important consumption items like clothes, food and housing, as well as diverting consumption and investment from private positional goods to public social goods, the environment and other commons. Productivity gains should be passed on to workers through extra leisure time that would reduce unemployment. At the same time, there should be a rejection of net export policies for wealthy countries, controls on trade, policies to stabilise population and a more fair and just migration policy that does not prioritise attracting highly skilled workers from poor countries to stimulate growth. Victor also suggests environmental caps, taxes and incentive systems to protect the environment and reduce damaging resource consumption.

Victor´s model illustrates that there are various routes to these outcomes and these have varying results. He shows that, while the LOWGROW modelling system has limitations, it does illustrate that decreased dependency on growth can under the right circumstances continue, or even improve, welfare in a society. As Victor explains:

> *"This is not to say that zero growth should itself become a policy objective. Rather that the dependence on and defence of economic growth should not*

be an obstacle to fulfilling more specific welfare enhancing objectives of full employment, eliminating poverty, and protecting the environment." (Victor and Rosenblut, 2006)

Victor´s model echoes conclusions by Spangenberg, Omann and Hinterberger (Spangenberg et al. 2002), who carried out similar assessments based on models of the German economy. They showed that in one scenario resource productivity could increase faster than GDP, so that material inputs and CO_2 emissions decline in absolute terms despite a growing GDP. At the same time, labour productivity per hour could grow faster than GDP and per capita production could grow more slowly. This reflected the reduction of working time resulting in an increase of employment. The study concluded that:

"Theoretical considerations, as well as the empirical work with the model, demonstrate that there are indeed trade-offs between economic growth and environmental impacts, and a positive correlation of growth and employment. Nonetheless, it is still possible to develop carefully orchestrated strategies that combine economic competitiveness, low unemployment rates and an easing of the pressure on the environment. Social and technical innovation, reduced working time, a modernised social security system, green taxes and salary increases proportional to labour productivity growth are essential parts of any such strategy" (Spangenberg et al. 2002).

Nonetheless, in their final assessment they stressed this did not mean the trade-off between economy growth and the environment had been overcome. Their model clearly showed a negative correlation between unemployment and growth, and a positive one between growth and resource consumption.

5.3.5 Employment in an economy without growth

What are the implications of a steady state or degrowth for ideas of full employment? Daly´s response is to reverse the question:

"Can a SSE maintain full employment? A tough question, but in fairness one must also ask if full employment is achievable in a growth economy driven

by free trade, off-shoring practices, easy immigration of cheap labor, and widespread automation? In a SSE maintenance and repair become more important. Being more labor intensive than new production and relatively protected from off-shoring, these services may provide more employment. Yet a more radical rethinking of how people earn income may be required." (Daly, 2008)

There have been several suggestions that expand on Daly´s concerns. Firstly, there is wide consensus that a key to employment policy in a sustainable economy would be for productivity gains to be passed on to workers in terms of reduced working time and more leisure (Daly, 1996, Spangenberg, 2010, Marinez-Alier, 2009, Victor, 2008, Jackson, 2009). Cutting hours would not only improve welfare for workers but also open space for full employment, by using more workers to do the same amount of work. This has, to some extent, been the motivation behind European working time legislation (Spangenberg, 2010). This extra leisure time could involve other benefits such as greater parental leave, time off for studying, training and volunteering, longer retirement or more access to sabbaticals (Jackson, 2009).

The other dimension has been to think about remuneration. One problem faced in current economies is that of under-employment, where workers have paid work but not enough remuneration for a decent life. Cutting working hours would potentially have the same effect if wages were not increased to make up for the loss. This is the trend Altvater highlighted (see chapter 1), that productivity gains are increasingly leading to reductions in the amount of productive work required and thus a growth of the so-called informal sector/economy in all its various forms (Altvater, 2001).

Daly argues that since "*automation and off-shoring of jobs increase profits but not wages, then the principle of distributing income through jobs becomes less tenable.*" (Daly, 2008) He therefore calls for practical solutions such as "*wider participation in the ownership of businesses, so that individuals earn income through their share of the business instead of through fulltime employment*" (Daly 2008). Others, such as Gorz, Martinez-Alier and Forstater have discussed the

possibility of delinking work from remuneration (Gorz, 1994, Forstater 2003, Martinez-Alier, 2009).

Forstater envisaged the creation of a government environmental service scheme, like an environmental version of the peace corp. It would involve the state paying the unemployed to do environmental services that are normally ignored by the private sector. Government would use public debt to offer a job to anyone ready and willing to work, based on a social wage that would guarantee a basic standard of living. There would thus be "*a job for every worker unable to find one in the private sector and a pool of employed from which the private sector can draw to fill positions that arise.*" Forstater argued that unemployment was evidence that the government budget deficit was too low. The optimum level of public deficit is, therefore, the point of full employment.

> *"At that point, the deficit is just the right size to close the gap between the private sector level of activity and full employment. PSE workers can be employed in a variety of services that benefit the community. Since PSE activities are not-for-profit, they can be designed to promote social efficiency, that is, broader macroeconomic and social goals"* (Forstater, 2003).

According to Forstater "*there are a whole host of almost pure services that can benefit the community and yet use no natural resources and do not pollute.*" This idea is taken a step further by Martinez-Alier who, building on the work of André Gorz, argues that the right to receive remuneration should be separated from the fact of being employed.

> *"This separation already exists in many cases (children and young people, pensioners, persons receiving unemployment benefits), but it should be extended further. We have to redefine the meaning of 'job', taking into account the unpaid domestic services and the voluntary sector and we must introduce or expand the coverage of a universal Basic Income or Citizen Income. If a green Keynesianism is now relevant, even more relevant would be another Beveridge report, in the perspective of degrowth, an extension of*

the welfare state giving also much room for local initiatives" (Martinez-Alier, 2009).

While these ideas sound utopian, they are not so far removed from concepts like paid sick leave, maternity pay, unemployment benefits or universal education. With carefully thought-out policies, it is possible to imagine this salary being conditional on incentivised positive activities, such as exercise to improve national health, urban agriculture, education and learning, democratic participation, care work or cultural activities like music, art, and literature. It could be argued that shorter working hours coupled with financial incentives to contribute to the common wellbeing could be justified, not only based on environmental concerns but also on a new vision of the "good life" (Jackson, 2009).

5.3.6 Are these changes practical?

An obvious last question is whether any of these changes would be politically acceptable? Many authors express doubts that even modest Green New Deal policies could be adopted without substantial resistance. Kallis claims that "*it is naive to think that internalising [changes] is just a matter of "policy" and can be done without significant political and social change.*" He describes the possibility that entrenched interests would resort to violence to protect their privileged positions in growth economies, claiming that

> "*powerful interests will not sit back quietly, accept environmental caps and taxes and adapt to… "economic restructuring*". *On the contrary, they will use their political muscle and benefit from the potential impact on the poor to form cross-class alliances to repeal serious reforms*" (Kallis, 2011).

This image certainly fits some current trends, for example as speculation on carbon markets (Suppan, 2009), land grabs in poor countries (Friis, and Reenberg, 2010) and conflicts over resources such as oil (Greenspan, 2007) and water (Tulloch, 2008). Similarly Kerchner points out that many of the suggestions "*are not ideas that people would voluntarily vote for*," while pointing out that many of those who

would do so, may still not appreciate the potentially top-down and authoritarian state that Daly is promoting (Kerschner, 2010).

In the light of this, several papers have suggested the need for a substantial culture change particularly concerning consumption and status. This is the motivation behind Daly´s concept of “moral growth” (Daly, 1996), Jackson´s discussions about advertising and status goods (Jackson, 2009), degrowth´s revolutionary spirit of a grass-roots social movement (Kerschner, 2010, Kallis, 2011) or Romeiro´s vision of a new set of cultural values and altruistic bahaviour to promote the accumulation of “spiritual” wealth (Romeiro, 2000). Whichever way it is described there is clearly a consensus that any post growth society would require a different set of values to be accepted.

While it is difficult to directly impose societal norms, social values have changed many times in human history. Modern examples include changes in attitudes to smoking, drink driving, the status of women, gender and different sexualities. From a Marxian perspective changes in values are shaped by the dominant form of economic relation in the society at the time. This would imply that changes in attitudes would go hand in hand with changes to the economy. Whether attitudes are shaped by policy or more systemic changes, the fact that they can change does mean that a new ecological culture is not as utopian as it initially appears. Romeiro points out that “*history shows that non-economic motivation may emerge out of ideals or values societies have in deeper cultural layers*” (Romeiro, 2000). As with all previous conscious movements to change values, there is a vast array of tactics and methods that can be proposed. These range from ideas of radical organising and provocation, to public dialogue or state-led public education programmes. One factor that may aid changes in attitudes is that current growth and consumption-led models of economics appear to be failing to improve happiness (Victor, 2008, NEF, 2006, 2009). It could therefore be argued that far from creating a set of values that promote acceptance of sacrifices, these changes could drive themselves if people perceived their lives as improving. How this could be measured is a different problem.

5.4 Conclusions

This chapter has shown that there is a range of possibilities that could at least ameliorate the trade-offs between environmental degradation while providing employment and decent levels of welfare for all who need and want them. Policy avenues, such as green industrial policies, development of efficiency savings, new technologies and industrial processes, will be one part of the solution. As seen in chapter 4, the priority issue in most countries is to decrease carbon consumption and there are some optimistic claims that new technologies and changing patterns of consumption could make this possible without negative effects on employment.

Some researchers, however, are more pessimistic. They argue that efficiency gains will not lead to absolute decoupling of resource use from GDP growth unless economic activity, population and labour productivity gains are stabilised or decreased in already wealthy countries. Theories of steady state economies and degrowth imply a radical break with current economic models, but there are real questions about their practicability and ability to deliver welfare and employment. While models, like that produced by Peter Victor, illustrate the potential for low or no growth models of development, these need to be developed much further to be widely accepted. They would also have to be tested in practice, something that at the moment seems politically very unlikely to happen.

There are area of broad consensus regarding environmental transition, employment and welfare. Employment levels can be maintained by improving conditions of employment through sharing productivity gains with workers as leisure time and reducing inequalities through redistribution of wealth and resources. Workers and the environment could also benefit by focusing consumption on more public shared goods and services. Such policy changes should be some of the first steps towards ecologically sustainable economies. Finally the debate over ecological limits to the economy raises more philosophical questions about what is the real aim of the state and economy. It may be an opportunity to revisit ideas of happiness and what it means to have a truly fulfilling life.

Final conclusions and recommendations

The discussions throughout this thesis have identified serious dilemmas for policymakers and economists over employment strategies for the future. Traditional employment policies need to be adapted to take account of impacts the economy has on the environment.

It is widely recognised that GDP growth, population and labour productivity are the key factors affecting employment. At the same time, growth, resource productivity and population increases are the main drivers affecting the environment. It therefore appears that inbuilt in current economic models is a conflict between economic success and environmental sustainability. The idea of decoupling growth from resource consumption, while desirable, so far appears to be unachievable (Jackson, 2009). Similarly the proposed solutions, i.e. steady state economies and degrowth at the moment appear unstable and poorly defined.

There are several ideas for moving forward. Firstly, research should be done to evaluate the relationship between labour and resource productivity. To support employment creation, the focus should be on improving the latter not the former. It is clear that in the wealthiest countries labour productivity has grown much faster than resource productivity. There may therefore be scope to make greater resource productivity gains in the future.

Similarly it would be useful for further studies to conduct detailed analysis of the resource contribution of different kinds of economic activity and employment. It is clear that there are major differences between economies with roughly the same levels of GDP. Studying the cause of these differences may help find solutions. Once more ILO data is available, a more detailed study of the different indices of decent work and ecological footprint could be carried out. This could help provide a greater understanding of how jobs could be shaped in order to meet the dual aspirations of sustainability and welfare. Research could also be done into how many people are living within the planetary resource regeneration limits. This would highlight the considerable inequality within countries as well as between them,

which could make targeted consumption reductions and redistribution more possible.

There needs to be a fundamental change in how economic success is measured. GDP growth is clearly failing to meet the needs of humanity and the planet. Serious thought is required to devise a different gauge for economic success. As discussed in chapter 3, some initial work has been done on this issue, but it is evident that much more needs to be done to build consensus on one set of measurements (Shmelev and Rodriguez-Labajos, 2009).

Environmental taxes and other policy instruments have been shown to make some difference in changing behaviour and at least offsetting job losses with new jobs, if organised properly (Bosquet, 2000, OECD, 2004, Patuelli et al. 2005, ILO, 2010). These, coupled with the idea of a Green New Deal, could at least go some way to reducing dependency on greenhouse gas emissions which are the priority in most countries (Elliott et al. 2008, Steiner and Sukhdev, 2009, Barbier, 2010).

EF statistics describe resource use in total, but the reality is that not all resources are currently at crisis point. Some environmental issues are more of a priority than others, such as carbon dioxide emissions that account for 54 percent of the global total ecological footprint (Ewing et al 2010) or specific issues of over extraction like over fishing and deforestation. These problems could be solvable in the short term with appropriate political commitment and resourcing (Stern, 2006, IPCC, 2007, UNEP 2011).

In the long term, however, these questions require much more holistic solutions. With population possibly peaking at 9 billion in 2050 (UN, 2004), the focus should be on how to build an economic framework to accommodate this population and then pursue a policy of stabilisation to bring resource use back into the earth's sustainable limits.

One important implication of this study is that serious analysis of the relationship

between productivity and working time is needed. Working less for the same pay and a focus on resource productivity improvements, rather than labour productivity may hold some of the keys to finding equitable solutions. In the current competitive market system, this is unlikely to happen voluntarily as reducing wages and improvements to labour productivity are major drivers of competitive advantage in unregulated markets. It would therefore require government intervention to create a level playing field through formal limits to working time. This could include for example legislation on the working week, increased rights to parental leave, longer retirement and time out of work for education and training.

Redistribution is another possible solution. Not only will there have to be major redistribution on a global scale to allow poorer countries to improve welfare, but studies on the UK carbon emissions distribution illustrate that distribution of resources within a country is a significant factor for policy makers. If most of the changes will affect only the wealthiest minority of the population, then such changes might be politically acceptable for the majority.

Lastly it has been suggested that there should be a radical rethink of our societies. For example the nature of pay and employment could be altered. The industrial revolution created the current waged employment relations and the environmental revolution may force change again. It may be time to revisit suggestions of separating remuneration from work, and status from money. It could be that we need to think again about creating a society based on greater cooperation, social interaction, solidarity and communal ownership. This could create the opportunity to redress other persistent problems such as the gender division of labour and other unrecognised contributions to society. It also could be a chance to re-focus ideas of economic success onto issues such as happiness and the pursuit of the “good life” based on improved quality rather than quantity. Whether such an economy would still be recognisable as capitalism is a different question.

Conclusões finais e recomendações

As discussões apresentadas nessa dissertação identificaram sérios dilemas para os economistas e tomadores de decisões em relação às estratégias de geração emprego no futuro. Políticas tradicionais de emprego deveriam ser reformuladas para considerarem os impactos que o crescimento econômico tem sobre o meio ambiente.

É amplamente reconhecido que o crescimento do PIB, população e produtividade do trabalho são os principais fatores que afetam o emprego. Ao mesmo tempo, o crescimento da produtividade no uso dos recursos e o aumento da população são os principais motores que afetam o meio ambiente. Nesse sentido, parece haver um conflito entre o crescimento econômico e a sustentabilidade ambiental nos modelos econômicos tradicionais. A idéia de dissociar o crescimento do consumo de recursos, embora desejável, até agora parece ser inatingível (Jackson, 2009). Analogamente, as propostas atuais de economias de estado estacionário e decrescimento parecem instáveis e mal definidas.

Há vários caminhos para avançar. Em primeiro lugar, deve-se avaliar a relação entre o trabalho e a produtividade no uso dos recursos. Para apoiar a criação de emprego, o foco deveria ser na melhoria desta última e não da primeira. É claro que em países mais ricos a produtividade do trabalho tem crescido muito mais rapidamente do que a produtividade dos recursos. Deve-se, portanto, prever a possibilidade de maiores ganhos de produtividade dos recursos no futuro.

Analogamente, seriam necessários estudos mais apurados sobre os impactos no uso recursos dos diferentes tipos de atividade econômica e emprego. Há grandes diferenças entre as economias com níveis semelhantes de PIB e o seu estudo ajudaria a encontrar soluções para os problemas. Dados disponibilizados pela OIT (Organização Internacional do Trabalho) sobre diferentes índices de trabalho decente poderiam ser relacionados àqueles de pegada ecológica disponibilizados pela GFN (*Global Footprint Network*). Essa análise permitira uma melhor compreensão de como postos de trabalho poderiam ser criados com responsabilidade ambiental, satisfazendo as aspirações duplas de

sustentabilidade ambiental e bem-estar. Pesquisas sobre o número de pessoas que vivem sob os limites planetários também destacariam a elevado grau de desigualdade dentro dos países, bem como entre esses, além de viabilizarem propostas mais direcionadas de reduções de consumo e de redistribuição dos recursos.

É preciso haver uma mudança fundamental na forma como o progresso econômico é medido. O crescimento do PIB claramente não atende as necessidades da humanidade e do planeta, sendo necessária a elaboração de uma nova proposta. Como discutido no capítulo 3, algumas propostas iniciais já foram realizadas. Entretanto, muito ainda precisa ser feito para se chegar a um consenso sobre o conjunto de indicadores econômicos a serem utilizados como referência (Shmelev e Rodriguez-Labajos, 2009).

Estudos sugerem que impostos ambientais e outros tipos de instrumentos econômicos podem contribuir para a mudança de comportamento, pelo menos compensando as perdas de emprego (Bosquet, 2000, OCDE, 2004, Patuelli et al. 2005, da OIT, 2010). Esses instrumentos, juntamente com a idéia de um *Green New Deal*, poderiam, pelo menos, reduzir de alguma forma a dependência das emissões de gases de efeito estufa, prioridade na maioria dos países (Elliott et al. 2008, Steiner e Sukhdev, 2009, Barbier, 2010).

A pegada ecológica descreve o uso agregado dos recursos naturais, mas a realidade é que nem todos os recursos estão sob pressão. Algumas questões ambientais são mais prioritárias que outras, como as emissões de dióxido de carbono, que representam 54% do total global da pegada ecológica (Ewing et al, 2010), ou questões específicas como a pesca excessiva e desmatamento. Esses problemas poderiam ser resolvidos no curto prazo com um maior comprometimento e capacidade das autoridades políticas (Stern, 2006, IPCC, 2007, UNEP 2011).

Em longo prazo, entretanto, essas questões requerem soluções muito mais holísticas. Com uma população de aproximadamente 9 bilhões de habitantes em 2050 (ONU, 2004), o foco deveria recair sobre a construção de uma estrutura econômica capaz de acomodar essa população. Em seguida, prosseguir uma política de estabilização para recuperar a capacidade de uso dos recursos aos

limites sustentáveis do planeta.

Uma implicação importante deste estudo é a necessidade de uma análise mais apurada sobre a relação entre produtividade e jornada de trabalho. A redução da jornada com manutenção dos salários e um foco na melhora da produtividade dos recursos, em vez de produtividade do trabalho, seriam algumas fundamentais para se chegar a soluções equitativas. No atual sistema de mercado competitivo, é improvável que isso aconteça voluntariamente, já que a redução de salários e melhora da produtividade do trabalho são os principais motores de vantagem competitiva em mercados não regulados. Seria, portanto, necessária a intervenção do governo para criar condições de concorrência equitativas através de limites formais ao tempo de trabalho. Isso poderia incluir, por exemplo, a legislação sobre a semana de trabalho, aumento dos direitos à licença parental, aposentadoria e maior tempo de afastamento para formação complementar e educação.

Redistribuição é outra possível solução. A redistribuição deve ocorrer não somente em escala global, para que os países mais pobres possam melhorar o bem-estar, como também dentro de cada país. Estudos sobre as emissões de carbono do Reino Unido sugerem que a distribuição dos recursos dentro de um país é um fator significativo para os decisores políticos. Caso as mudanças afetem apenas uma minoria rica da população, essas seriam politicamente aceitáveis pela maioria.

Por fim, este trabalho sugeriu uma mudança radical na maneira de pensar de nossa sociedade. Por exemplo, a maneira de pensar a remuneração e o trabalho poderia ser reformulada. Da mesma forma que a revolução industrial criou as atuais relações de trabalho assalariado, a revolução ambiental poderia forçar uma nova mudança de paradigmas. Poderia ser a hora de revisitar sugestões sobre a separação entre a remuneração do trabalho, o status e o dinheiro. Pode ser que precisemos repensar sobre a criação de uma sociedade baseada em uma maior cooperação, interação social, solidariedade e propriedade comunal. Isso poderia permitir a correção de outros problemas persistentes, como a divisão sexual do trabalho e outras contribuições não reconhecidas para a sociedade. Também poderia ser a oportunidade para se repensar idéias de crescimento econômico mais voltadas a questões como a felicidade e a busca de bem-estar com base na

melhoria da qualidade, não na quantidade. Se essa economia seria ainda reconhecida como capitalismo é uma questão diferente.

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Appendices

a. Fifths

Fifth 1: Afghanistan, Angola, Bangladesh, Burundi, Cambodia, Cameroon, Congo, Dem. Rep., Congo, Rep., Cote d'Ivoire, Eritrea, Ethiopia, Guinea-Bissau, Haiti, India, Indonesia, Kenya, Lesotho, Malawi, Mozambique, Pakistan, Rwanda, Senegal, Sierra Leone, Sri Lanka, Tajikistan, Tanzania, Timor-Leste, Togo, Yemen, Rep., Zambia

Fifth 2: Algeria, Armenia, Benin, Burkina Faso, Central African Republic, Chad, Dominican Republic, Egypt Arab Rep., Gabon, Ghana, Guinea, Iraq, Korea, Dem. Rep., Kyrgyz Republic, Lao PDR, Liberia, Moldova, Morocco, Nicaragua, Nigeria, Peru, Philippines, Somalia, Sudan, Swaziland, Syrian Arab Republic, Uganda, Uzbekistan, Vietnam, Zimbabwe

Fifth 3: Albania, Argentina, Azerbaijan, Bolivia, Bosnia and Herzegovina, Botswana, China, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Georgia, Guatemala, Honduras, Iran, Islamic Rep., Jamaica, Jordan, Madagascar, Mali, Mauritania, Myanmar, Namibia, Niger, Papua New Guinea, Romania, Serbia, South Africa, Thailand, Tunisia, Turkey

Fifth 4: Belarus, Brazil, Bulgaria, Chile, Croatia, the Gambia, Hungary, Israel, Japan, Kazakhstan, Korea, Rep., Lebanon, Libya, Lithuania, Malaysia, Mauritius, Mexico, Nepal, New Zealand, Panama, Paraguay, Poland, Portugal, Russian Federation, Slovak Republic, Trinidad and Tobago, Turkmenistan, Ukraine, United Kingdom, Venezuela RB

Fifth 5: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Kuwait, Latvia, Macedonia FYR, Mongolia, Netherlands, Norway, Oman, Qatar, Saudi Arabia, Singapore, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United States, Uruguay

b. Clusters

Cluster 1: Afghanistan, Bangladesh, Benin, Burkina Faso, Cambodia, Cote d'Ivoire, Croatia, Egypt, Arab Rep., Haiti, India, Kyrgyz Republic, Lao PDR, Malawi, Myanmar, Niger, Nigeria, Pakistan, Tajikistan, Timor-Leste, Vietnam, Yemen, Rep.

Cluster 2: Burundi, Congo, Dem. Rep., Congo, Rep., Ethiopia, Gabon, Ghana, Latvia, Liberia, Madagascar, Mozambique, Rwanda, Sierra Leone, Togo, Uganda, Zambia

Cluster 3: Argentina, Australia, Bolivia, Botswana, Brazil, Cameroon, Central African Republic, Chad, Colombia, Costa Rica, Ecuador, Eritrea, Guatemala, Guinea, Guinea-Bissau, Honduras, Kenya, Lesotho, Mali, Mauritania, Mongolia, Namibia, Nicaragua, Paraguay, Peru, Senegal, Somalia, Sudan, Swaziland, Tanzania, Uruguay, Venezuela RB, Zimbabwe

Cluster 4: Angola, Bulgaria, the Gambia, Indonesia, Mauritius, Norway, Panama, Papua New Guinea, Philippines, Portugal, Sri Lanka, Thailand

Cluster 5: Albania, Algeria, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Canada, Chile, China, Cuba, Czech Republic, Denmark, Dominican Republic, El Salvador, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Islamic Rep., Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Korea, Dem. Rep., Korea, Rep., Kuwait, Lebanon, Libya, Lithuania, Macedonia FYR, Malaysia, Mexico, Moldova, Morocco, Nepal, Netherlands, New Zealand, Oman, Poland, Qatar, Romania, Russian Federation, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Syrian Arab Republic, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, United Arab Emirates, United Kingdom, United States, Uzbekistan