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SESSION 2

INCLUSIVE LABOUR MARKETS FOR GREEN GROWTH

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GREEN GROWTH AND SUSTAINABLE DEVELOPMENT FORUM

ISSUE NOTE

SESSION 2, 2014 GREEN GROWTH AND SUSTAINABLE DEVELOPMENT FORUM
"INCLUSIVE LABOUR MARKETS FOR GREEN GROWTH"

OECD GREEN GROWTH AND SUSTAINABLE DEVELOPMENT FORUM

The GGSD Forum is an OECD initiative aimed at providing a dedicated space for multi-disciplinary dialogue on green growth and sustainable development. It brings together experts from different policy fields and disciplines and provides them with an interactive platform to encourage discussion, facilitate the exchange of knowledge and ease the exploitation of potential synergies. By specifically addressing the horizontal, multi-disciplinary aspects of green growth and sustainable development, the GGSD Forum constitutes a valuable supplement to the work undertaken in individual government ministries. The GG-SD Forum also enables knowledge gaps to be detected, to facilitate the design of new works streams to address them.

Authorship & Acknowledgements

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SUMMARY

- Advocates of green growth, while emphasising efficiency gains from correcting market failures related to the environment, have acknowledged the importance of understanding the distributional implications of green growth policies.

- These consequences can arise from relative price changes affecting households, changes in aggregate demand, adoption of new technologies with different labour and capital requirements, and factor market adjustments in response to the structural changes induced by policies. So some projections are required of the size of the structural changes being induced by green growth policies and of how labour markets are likely to react.

- Progress is being made in defining standards for counting 'green jobs', which is useful for assessing the size and direction of structural change induced. But data collection is lagging. The size of the labour force in the environmental goods and services sector is probably of the order of 2% in advanced industrial countries, less in the developing world as a whole (although some developing countries, such as China, are developing a comparative advantage in machinery needed for renewable energy production). The emerging statistical standards do not apply any test of the quality of jobs classified as 'green'.

- Microeconomic studies of the effects of environmental regulation on jobs and productivity in regulated entities generally find only small effects. The effects on productivity appear to be positive in more efficient firms but can be adverse in less efficient firms. The relative size of employment losses has been larger in some sectors subject to more stringent environmental regulation. The estimated competitiveness effects, through relocation of industry (e.g. through 'carbon leakage'), have tended to be modest.

- However, policy-makers are often more interested in the impact of green growth policies on the net number of jobs across the whole economy, which requires taking account of job losses in environmentally harmful activities and the economy-wide responses of employment demand, supply and wages.

- Net changes in employment depend not only on the mix of green growth policies (e.g. environmental taxes versus increased public investment) but also on how labour markets work in a particular country, its openness to trade, its endowments of raw materials and its macroeconomic situation. Studies often assume either that increases in labour demand affect only the level of employment, not the level of wages, or that employment is determined by a fixed labour supply. Neither assumption is valid in all countries at all times. A wider range of labour market assumptions (already available in the literature) ought to be utilised to 'stress test' findings about net job creation.

- The impact of green growth policies on the overall pattern and level of demand for skills is also important to policy-makers. It is already known that some specialised skills are likely to be in higher demand but the complete picture is unclear, particularly given the likelihood of widespread green innovation in the future. The effects of green growth policies on skills are likely to differ widely across regions and local areas. In this context, coordinated strategies at local level and flexibility to tailor the response of employment and training services are necessary. But in the long run, green growth is likely to depend on the growth of the knowledge economy and the substitution of ideas and human capital for natural resources.

- There are likely to be several effects on the distribution of real incomes. Increased investment to replace polluting, carbon-intensive production with cleaner activities may in some circumstances increase net employment, helping low-income households. Green growth may be more labour-intensive than brown growth (although this is not clear-cut), which may also push up employment and/or wages relative to returns to capital (but with possible adverse consequences for capital accumulation). However, increased environmental taxation may hurt lower-income families more in the short run (before large-scale technological changes have kicked in) because of the larger share of their budgets spent on energy.

- The effects are likely to differ according to countries' income per capita, resource endowments and labour market characteristics. Green growth policies must be sensitive to the need to raise more people out of poverty. The desired mix of policies is therefore likely to differ between advanced industrial economies and the least developed countries. Policy-makers should also consider how to raise the quality of any new jobs; green jobs are not automatically good-quality jobs.

- Adverse distributional effects can be mitigated, if they are understood, through three main strategies: using revenues from environmental taxation to reduce taxes on labour; using the welfare system to target assistance to poorer families; and promoting active labour market policies, especially training, to facilitate smooth structural adjustment across industries. In the long run, the general skills and education levels of workforces need to be augmented to prepare them for a less natural-resource-based, more knowledge-based economy. The costs of structural change may also be reduced if policy-makers take steps to ensure the credibility of their policies over the long term, provide the appropriate frameworks for infrastructure provision and planning and give clear signals about the overall direction of travel – towards green growth.

- The research priorities suggested by this review include:

    - The application of more sophisticated models of how labour markets function in macroeconomic studies of net job creation and the use of 'stress tests' to investigate the robustness of investigators' conclusions in the face of uncertainty about how labour markets work in practice.
    - The choice of models more tailored to the endowments, income levels and labour market characteristics and institutions of the particular country under investigation.
    - More modelling of how green growth policies may affect wages relative to other factor returns and the relative pay associated with particular skills.
    - More empirical study of the interaction of tax-benefit systems, labour markets and green growth policies to complement the theoretical literature on the 'double dividend' and taxation in a second-best world.
    - More rigorous microeconomic studies of the impact of both particular projects (e.g. setting up and running a wind farm) and particular policies (e.g. subsidies for home insulation) on employment and wages over different time horizons. This could include explicit policy experiments designed to make ex post evaluation easier.
    - More study of the implications for labour markets of the transition to green growth outside the energy sector and specific high-pollution industries (e.g. in transport, urban design, construction and, especially in the least developed countries, rural land use).
    - More studies and indicators for evaluating and monitoring efficient policy coordination mechanisms to link labour and environmental policies.

Key Issues for Discussion

- How will the quantitative impact of green growth policies compare with that of other recent developments such as the rise of the ICT sector and globalisation?

- Is the transition to green growth a sufficiently radical structural change materially to affect the relative demand for skilled and unskilled labour? How will this differ across countries and local areas because of their different comparative advantages, endowments and levels of development?

- How should education and training policies be oriented to facilitate green growth and enable workers (including lower skilled workers) to benefit from new opportunities?

- Has enough attention been paid to the impact of green growth policies on 'brown' jobs, especially those in relatively isolated labour markets? What should the balance be between retraining workers in currently brown jobs in situ and promoting geographical and inter-industry mobility? To what extent should firms and workers in adversely affected industries be compensated and what compensation mechanisms would least inhibit the transition to green growth?

- How does international competition through trade and investment alter the picture?

- How can policy-makers reconcile poverty reduction and green growth in the short run, especially in the poorest countries? What should the balance be between measures to employ the rural poor in green activities and measures to promote migration and low-carbon, environmentally friendly industrialisation?

- How do environmental improvements affect labour supply and wellbeing?

- If green growth in the long run will rely more on the accumulation of human capital and ideas and less on an increasing throughput of materials and energy, what will the consequences be for labour markets?

- What are the distributional consequences of green growth policies, both the high-profile policies of environmental taxation and increased investment spending, and other policies such as R&D subsidies, renewables targets and land-use planning?

- How should the revenue from environmental taxation be divided amongst (i) distributional goals, (ii) increasing static efficiency, (iii) increasing dynamic efficiency, (iv) achieving other environmental objectives and (v) reducing public debt?

I. INTRODUCTION

1. The OECD defines green growth as "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD, 2011). The emphasis on development is a reminder that green growth is about more than maintaining GDP growth in the face of environmental constraints. It is closely related to the concept of sustainable development, defined in the famous Brundtland Report of 1987 as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987: paragraph 27) – a concept that is as relevant for advanced industrial economies as for developing countries. The 1992 Rio Earth Summit consolidated the Brundtland argument that sustainable development must comprise three pillars – economic, environmental and social. The social pillar recognises that sustainable development must be inclusive and improve welfare in the broad sense of the term. Green growth can be seen as a way of bringing about sustainable development in practice.

2. The greater emphasis on 'growth' in the term 'green growth' perhaps reflects two factors. First, the recent global economic and financial crisis has reminded policy-makers in both rich and poor countries of the serious economic and social consequences when the resilience and sustainability of growth cannot be assured. Second, policy-makers have observed the success of fast-growing countries such as China in raising people out of poverty, leading to greater consensus that growth is essential for long-run development, even though these concepts are not synonymous. Hence the World Bank explicitly argues that "inclusive green growth is not a new paradigm. Rather, it aims to operationalize sustainable development by reconciling developing countries' urgent need for rapid growth and poverty alleviation with the need to avoid irreversible and costly environmental damage" (World Bank, 2012). UN-ESCAP/ADB/UNEP (2012) states, "Green growth is, in general terms, economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development." According to ADB/ADBI (2012), "Low-carbon green growth is a pattern of development that decouples economic growth from carbon emissions, pollution and resource use, and promotes growth through the creation of new environment friendly products, industries and business models that also improve people's quality of life." Green growth gives rise to difficult problems of political economy because it changes the distribution of costs and rewards across time and place.

3. Thus green growth advocates, while emphasising the efficiency gains from correcting market failures connected with the environment, have acknowledged the importance of understanding the distributional consequences of policies for green growth. These consequences can arise from relative price changes affecting households, changes in aggregate demand, adoption of new technologies with different labour and capital requirements, and factor market adjustments in response to the structural changes induced by policies. In particular, if policy-makers are to ensure that green growth is inclusive, they need to have an understanding of how labour markets work and the likely social impact of green growth policies. This understanding can then inform policy design. However, the social consequences of green growth have so far received less attention than the economic and environmental consequences. There is a need to articulate better the possible social implications of green growth, not least to help secure public support for green growth policies and successful reform implementation.

4. This note focuses on one aspect of the social consequences of green growth, the labour market aspect, bearing in mind the importance of differences across countries, particularly by level of development, with the hope that it can provide some ideas for improving policy formation and analysis. It discusses the analytical frameworks that have informed past economic analyses of the potential impact of various green growth policies on labour markets, suggesting possible directions for future development of models to enable better analysis of potential impacts (Section 2). It then sketches some of the implications of the various frameworks for the likely distributional impacts of green growth

policies (Section 3). In Section 4, evidence from countries' experience with environmental policies is considered, along with empirical work on the likely future impacts of green growth policies. This leads to a discussion of how to mitigate potential adverse impacts of green growth policies on workers and households (Section 5). Section 6 concludes, suggesting priorities for future research.

II. ANALYTICAL FRAMEWORKS

5. In order to understand the labour market impacts of green growth policies, two different questions are often asked. First, what is the scale of the structural change in the composition of employment and skills required by the transition to green growth? Second, what is the net impact of green policy measures on labour demand, labour supply and pay likely to be? This will depend on the policy measures actually used to bring about the structural change required. These may have wider consequences for labour markets.

Counting 'green' jobs

6. The first question requires some definition of jobs specifically associated with green, as opposed to traditional, growth – often labelled 'green jobs'. However, efforts to estimate the impact of environmental policies on jobs are bedevilled by poor data as well as insufficiently rigorous empirical models, as Deschênes (2013) has stressed. The collection of statistics on jobs in environmental sectors using an internationally agreed framework would be an important step towards improving the situation. As the Box shows, progress is being made in this respect but there is more to do.

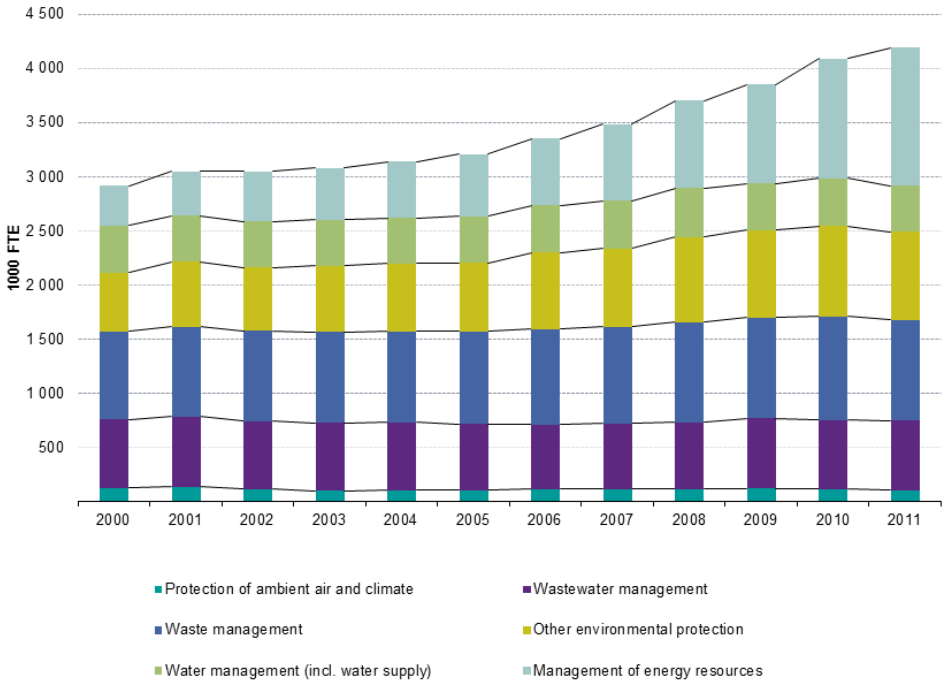
Box 1. Standardising the measurement of green jobs

A consensus is beginning to emerge among statisticians about how to operationalize the concept of 'green jobs', focusing on a subset of industries producing environmentally desirable outputs. Several studies, notably by the European Commission's Environment Directorate, have used the OECD/Eurostat definition of the environmental goods and services industry (OECD, 1999), comprising "activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources." That covers pollution management (e.g. air pollution control) and resource management (e.g. renewable energy plants and water supply). Jobs in the nuclear power sector are not included, even though they are in a low-carbon sector, given the environmental risks associated with the industry. On this basis, green jobs constitute a small but significant share of total employment in Europe – estimated by Eurostat at over four million full-time-equivalent jobs in 2011, substantially higher than in 2000, largely because of the expansion of renewable energy (Chart 1). This amounts to somewhat less than 2% of the EU workforce.[1] Eurostat notes that the statistical base for such estimates needs to be improved, including by widening the number of EU countries with regular and reliable estimates of such jobs nationally, as at the moment the national estimates are not strictly comparable. The OECD has also flagged the difficulties of defining, measuring and interpreting data on the environmental goods and services sector (OECD (2014a)).

Box 1. Continued

[1] For 2012, extrapolating from reported figures, Ecorys (2012) estimate (using a broadly similar definition to Eurostat's) that around 3.4 million people worked in eco-industries in the EU, about 1% of the total workforce aged 15-64.

EGSS employment for EU28 (1000 full-time equivalents)



Source: Eurostat (2014)

In the USA, the Bureau of Labor Statistics has counted Green Goods and Services (GGS) jobs. Under its 'output' approach, it counted as green jobs 'jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources,' a slightly broader definition than Eurostat's. To implement the output approach, the BLS carried out a large-scale Green Goods and Services (GGS) survey. GGS jobs accounted for 2.4% of total employment in 2010 and 2.6% in 2011 (the share of public sector employment was almost twice the share of private sector employment). Unfortunately, because of US budget cuts, the BLS decided to discontinue all 'measuring green jobs' products – data on employment by industry and occupation for businesses that produce green goods and services; data on the occupations and wages of jobs related to green technologies and practices; and green career information publications – after only two years' publication.

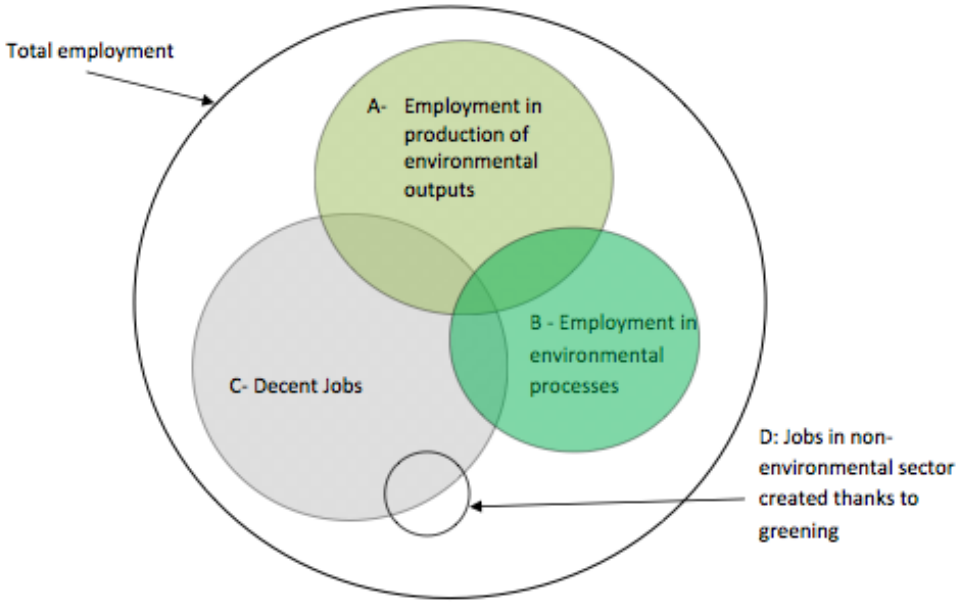
At the world level, UNEP suggest that, at a conservative estimate, there were more than 2.3 million jobs in the renewable energy sector around the world in 2006, and more in construction, providing improved energy efficiency in buildings, in low-carbon transport and in other environmental activities. But that compared with employment globally of around three billion. Less is known about employment in the other sectors of the environmental goods and services industries. More recently, IRENA (2014) estimates that renewable energy jobs reached 6.5 million in 2013. As UNEP notes, most of the documented growth in green jobs up until the early years of this millennium occurred in developed countries (UNEP/ILO/IOE/ITUC, 2008) but IRENA points out that much of the recent increase in employment in renewable energy has taken place in China.

More work is needed to put the global statistical evidence base on a firmer footing. Fortunately, 'guidelines concerning a statistical definition of employment in the environmental sector' were adopted at the 19th International Conference of Labour Statisticians (ICLS, 2013) to help countries develop statistical standards and methods for green jobs, the green economy and employment in the environmental sector and to improve international comparability. These are broadly consistent with the approach taken by Eurostat (and do not apply an ILO-style 'decent jobs' criterion, that the jobs offer adequate wages, safe working conditions, job security, reasonable career prospects, and worker rights,). The ICLS defines the environmental sector as comprising all economic units that carry out environmental activities – those defined in the Central Framework of the United Nations' System of Environmental-Economic Accounting (SEEA) as economic activities the primary purpose of which is to reduce or eliminate pressures on the environment or to make more efficient use of natural resources. They are grouped into two broad types of environmental activity:

- Environmental protection activities are those activities whose primary purpose is the prevention, reduction and elimination of pollution and other forms of degradation of the environment.
- Resource management activities are those activities whose primary purpose is the preservation and maintenance of the stock of natural resources and hence safeguarding against depletion.

7. Figure 1 below (from the Annex of ICLS, 2013) helps to distinguish different categories of employment relevant to the 'green jobs' debate. The focus of statisticians developing a statistical reporting framework has been on employment in the production of environmental outputs and environmental processes (jobs in sectors A and B in the diagram). However, as the chart illustrates, these are not the only jobs about which policy-makers should be concerned when designing green growth policies. First, these jobs are not necessarily 'decent' jobs in the ILO sense (sector C) – i.e. jobs that offer adequate wages, safe working conditions, job security, reasonable career prospects, and worker rights – as some argue is essential if the jobs are to be regarded as 'green' (UNEP/ILO/IOE/ITUC, 2008). Second – and crucial for the overall impact of green growth policies – sectors A and B do not cover jobs created in the supply chains of environmental-sector activities ('indirect' job creation, both upstream and downstream of the activities) and 'induced employment' effects of green policies through their 'multiplier' impact on aggregate demand and their adverse effects on environmentally harmful sectors. Nor do they include jobs for which the job content changes significantly as a result of green growth policies but which are not primarily devoted to the production of environmental outputs and processes (e.g. farmers adopting new tillage techniques, car workers working on new types of engine). These indirect and induced effects of green growth policies together could have a negative or positive net impact on employment, represented by sector D in the diagram.

Figure 1. Categories of employment



- Employment in environmental sector= A∪B
- Employment created thanks to greening = A∪B∪D
- Green jobs (Employment in Environmental Sector that is decent)= (A∪B)∩C

Source: ICLS (2013)

8. There are difficult questions to be resolved in practice, for example, about the classification of various land-use and agricultural practices and the treatment of incremental technological improvements that help the environment (for example, is the production of each new generation of more efficient internal combustion engines to be counted as outputs of the environmental sector and if so how is the previous generation to be treated?).[2] Nevertheless, this is a vital first step in standardising measurement. It would be helpful if national statistical bodies accelerated this work, including in developing countries. Clearer links between the various national definitions and the international statistical standard integrated in the UN System of Environmental-Economic Accounting would help improve the credibility of indicator-based policy reports.

A major drawback of counting 'green jobs'

9. One major drawback of this approach to counting the number of green jobs is that it focuses on just one aspect of the transition to green growth, the provision of more output from the environmental goods and services sector. This does not fully account for the transition to a less resource-intensive, more knowledge-intensive economy, a necessary corollary of green growth in the long run (Hepburn and Bowen, 2013). The growth of GDP will have to rely to a greater extent on ideas and knowledge as inputs and to a lesser extent on physical resource and energy inputs, taking advantage of the scope to exploit the potential for increasing returns to scale from new ideas. Yet the definition of the environmental goods and services sector does not encompass many of the jobs that would be created in such a shift, given its narrow conception of environmental protection and resource management. All economic activities affect the environment one way or another along the supply chain. The data compiled by Elliott and Lindley (2014) for the USA in 2011 illustrate this point. Using the US BLS Green Goods and Services (GGS) survey, they find that whereas 12.9% of employment in the utilities industries and 8.9% of employment in the construction industries could be classified as 'green' on the BLS definition, only 0.1% of employment in education and health services, 0.2% of employment in leisure and hospitality industries and 1.1% of employment in the information sector could be so classified, even though green growth will ultimately require a structural shift towards the latter.[3]

Net employment changes due to 'green growth' policies

10. The second question posed at the beginning of this section, concerning the net impact across labour markets on labour demand, labour supply and pay, is perhaps of greater interest to policy-makers outside the environmental sphere, such as ministers of finance. Bowen (2014) suggests that 'green growth' appears to have gained traction with politicians in recent years in part because of the recent global economic crisis. Growth and employment creation have become very immediate concerns. To answer this question requires implicit or explicit economic modelling of the policies, to enable a comparison of labour market developments with and without the environmental policies under consideration.

[2] Various such issues are discussed by the London Group on Environmental Accounting, a group of statisticians from official statistics bodies in the developed world, in London Group (2013). Their note reminds the reader that "National studies suggest that the scope of the green economy is sometimes understood to extend well beyond the [environmental goods and services sector] to include all kinds of clean technologies and clean and low carbon products and investments, whereas some traditional areas covered by the [environmental goods and services sector] (e.g. waste collection) are not considered to be 'green' enough."

[3] The proportion of employment in financial services classified as green is very close to zero.

11. Green growth policies are likely to cover a range of interventions in economies, including taxes to internalise harmful environmental externalities, subsidies to internalise benign externalities, the provision of infrastructure and other public goods providing environmental benefits, and other measures designed to correct market failures affecting the environment, including direct regulations where the theoretically appropriate taxes and subsidies are difficult to calculate or apply in practice (see, for example, the discussion in OECD (2011a)). Many of these policies are likely to have impacts on labour markets, for example, by changing real consumption or producer wages and changing aggregate and sectoral demands for labour and skills. However, few studies of major policy interventions, such as measures to halt anthropogenic climate change, take full account of these possible impacts. For example, most of the Integrated Assessment Models used to evaluate climate-change mitigation policies do not model labour markets at all (e.g. the models used in the LIMITS project, introduced by Kriegler et al. (2013)).[4] Nevertheless, several studies have taken steps to investigate some labour market aspects.

Net employment changes: the input-output approach

12. One class of studies has focused on the impact on employment of additional investment in low-carbon electricity production. This is an important element of the transition to green growth, although by no means the only one (and more research on other employment aspects of going green, such as increased recycling and more switching from private to public transport, would be desirable). Kammen et al. (2004) and Wei et al. (2010) review several studies that estimate direct employment effects of promoting renewable and other low-carbon energy supply and energy efficiency, focusing on the specific labour requirements of particular technologies ('bottom up' estimates, using simple spreadsheet-based models in conjunction with engineering estimates). These emphasise the jobs created by investing in electricity generation capacity derived from renewable energy. The authors find that most renewable sources of energy generate more job-years per GWh of energy output than do fossil-fuel-based generators.

13. Kammen and his colleagues also consider studies that use input-output (I-O) tables to estimate both direct and indirect employment effects, taking account, for example, of the jobs created in business services provided to the renewable energy sector. These extend the scope of the estimates while sacrificing the greater granularity derived from engineering studies of specific energy projects. The focus is on inputs to the sector rather than the extra employment that may be generated downstream by the provision of new energy services (e.g. off-grid solar power investments in developing countries allow new activities to take place by providing access to electricity for the first time). I-O based studies also fall prey to the usual criticisms of input-output models: that they do not allow for changes in input-output coefficients induced for example by relative price changes and technological progress; that they are often out-of-date; that they depend on industrial classifications that do not distinguish some of the key sectors of interest; and that they are highly aggregated. The meta-studies by Kammen and his associates attempt to derive standardised measures to compare estimates of jobs created per average megawatt over the life of an energy facility. The authors also explore the implications of various scenarios of exogenous energy efficiency improvements and renewable energy portfolio standards for US employment in total. As they take into account jobs destroyed when fossil-fuel-based energy is displaced by low-carbon sources, their projections are for a net concept of employment change, but they do not take into account general equilibrium effects due to any relative wage changes. Nor do they consider the profitability of electricity generation by different technologies, begging the question of how a switch to renewable energy would actually be brought about.

14. An important issue that arises is the timing and duration of job creation. There is a key distinction between construction, manufacture and installation (where jobs may be relatively short-lived)

[4] However, some of these models could be extended to encompass labour market aspects, e.g. Bosetti and Ghersi (2012) introduce national preferences in labour-leisure preferences in the WITCH integrated assessment model.

on the one hand and ongoing operation, maintenance and fuel processing on the other, where the length of jobs depends on the durability of the relevant plant. The research and development stage constitutes a third category, with longer-lived jobs but much higher human capital requirements. Lambert and Silva (2012) point out that many individual jobs studies of the kind reviewed by Kammen et al. and Wei et al. are not clear about the temporal structure of employment assumed, the difference between gross and net employment effects, and the distinction between direct and indirect job creation. The studies also differ widely with respect to the assumption or estimate of the number of jobs created by generating a given amount of capacity from a specific technology. For example, Lambert and Silva note that Blanco and Rodrigues (2009) find the direct jobs per MW installed in the European wind sector vary from 6.97 in Belgium to 0.76 in Austria. Lambert and Silva conclude that more analytic work needs to be done at the plant or regional level, using extensive surveys, even though aggregate I-O methods may be appropriate for estimates at the national or international level.

15. Other I-O based studies go further still and include jobs created by the aggregate demand generated by the extra direct and indirect employment ('induced' employment effects), even if they are in sectors with no obvious direct relationship to environmental objectives (e.g. tobacco processing) or only a secondary relationship (e.g. construction). A question arises as to whether one should net off jobs destroyed in sectors disadvantaged by 'green' policies (e.g. coal mining). This issue is less relevant if one is simply trying to enumerate jobs associated directly with environmentally attractive goods and services. But it is crucial if one is trying to evaluate the overall labour market impacts of environmental policies. Some studies finesse this issue by focusing on the job creation implications of different fiscal stimulus packages with greater or lesser reliance on 'green' spending, none of which are expected to destroy jobs. Pollin et al. (2008) is a good example of this type of study, utilising an estimate of the macroeconomic multiplier effect of additional direct fiscal spending on total output to calculate induced employment creation. One shortcoming of some I-O based studies is that neither the source of finance for the initial investment in plant, equipment and infrastructure promoting green growth nor its opportunity cost is clear. Also, the time horizon over which the projection is made matters but it is not always specified. The longer is the horizon, the greater the adjustments that firms, workers and households can make in response to a new environmental policy, reducing any additional costs they face (Fankhauser et al. (2008); Ho et al. (2008)).

Net employment changes: neoclassical models

16. The 'I-O with macro multiplier' approach takes an essentially Keynesian view of the macro-economy, with labour supply constraints, and consequently real wage adjustments, ignored. An alternative approach is to assume that labour markets clear (at least, over the time horizon of interest), with real wages adjusting to equate labour demand and labour supply. Additionally, labour supply may be inelastic, so that investment in green technologies may create new jobs in green sectors but at the expense of jobs crowded out elsewhere in the economy by an induced rise in real wages relative to other factor prices. In other words, direct and indirect job creation is cancelled out by an induced reduction in employment elsewhere. In some models, if the green investment is in response to environmental taxes, such as a carbon price, aggregate labour supply may actually fall because of the increased wedge between producer and consumer wages due to the tax – workers choose to substitute leisure for now-more-expensive goods and services. Whereas the I-O style models have tended to be used to examine the employment consequences of direct spending on green investment, neoclassical models have tended to be the tool of choice for those more concerned with the impact of environmental taxes such as a carbon price. Responses to changes in relative prices are more difficult to integrate in the former while the impact of aggregate demand fluctuations are more difficult to analyse in the latter.

17. Goettle and Fawcett (2009) provide a good example of the neoclassical approach, using the IGEM general equilibrium model. In their analysis, introducing a cap-and-trade system to limit

greenhouse gas emissions in the USA induces households to substitute leisure for labour, while firms attempt to substitute labour for capital and energy.[5] The net effect comprises reductions in output and hours worked, their size dependent on whether the fiscal authorities undertake mitigating actions such as rebating the revenues from selling emissions quotas as lump sum transfers, investment tax credits or reductions in marginal income tax rates. It is considerations such as these that have led many to express scepticism about the potential for net job creation (see, for example, Helm (2011), Hughes (2011) and Furchtgott-Roth (2012)).

18. For any particular country, the pattern of their comparative advantages in trade also matters, particularly if the stringency of green growth policies continues to differ widely across countries.[6] For example, the importance of China in the global supply of manufactured goods and its success in ramping up production of solar panels suggest that Chinese manufacturing may benefit disproportionately from global investment in new renewables capacity. But OECD countries may benefit more from increased low-carbon R&D spending and demand for advisory services in low-carbon construction, engineering, ICT and finance.

Net employment changes: allowing for labour market imperfections

19. Attempts to allow for labour market imperfections in modelling the impact of environmental policies have drawn attention to the danger that green growth policies could increase unemployment, at least in the short run. Babiker and Eckaus (2007), for example, introduce labour market rigidities in the MIT EPPA recursive general equilibrium model. They consider the implications of sector-specific wage rigidity where, for example, workers in economic sectors that are declining are unable or unwilling to move into more rapidly growing sectors, but are still able to maintain their relative wages (whereas their wages should fall relative to wages in the economy as a whole in order to provide an incentive for labour reallocation). They find that wage rigidity increases mitigation costs and is more of a problem in China and India because of the larger sectoral reallocations of labour necessary in rapidly growing developing countries.

20. Similarly, Chateau et al. (2011) use the OECD ENV-Linkages computable general equilibrium model to contrast labour market outcomes with and without rigidities in real wage adjustment in response to a cap-and-trade scheme to reduce greenhouse gas emissions (by 50% by 2050 in the OECD, and 25% elsewhere, compared with business as usual). They too find that mitigation costs increase with the degree of labour market imperfection; this structural distortion reinforces the deadweight losses associated with a given carbon price. The authors also discuss the lessons for labour markets that can be drawn from analyses of the growth of the ICT sector and globalisation, while expressing some scepticism about the closeness of the parallels (with respect to the impact on real wages, skill demands, fiscal balances and innovation).

21. In neither case are the increases in mitigation costs very large and in both cases the authors point out that there are complementary policies that can reduce or even eliminate the cost increases, misallocation of labour and/or unemployment. Babiker and Eckaus emphasise the benefits of a mix of sector-specific and general wage subsidies. Chateau et al. emphasise the merits of reductions in taxes on labour income.

[5] Note that this approach places less emphasis than the typical I-O approaches on the needs for incremental investment, embodying more environmentally friendly technologies, in response to new environmental policies. Hence it may make the substitution of labour for capital and energy in production appear easier than it is in practice.

[6] There is an extensive literature on the competitiveness effects of environmental policies in general (e.g. Copeland (2012)) and carbon pricing in particular (e.g. Aldy and Pizer (2011), Burniaux et al. (2013)), which will not be discussed here.

22. Guivarch et al. (2011) also emphasise the importance of short-run labour market effects in their work with the energy-economy model IMACLIM-R, which incorporates capital and labour market imperfections and adaptive expectations. In each region of their model, the labour market is modelled through an aggregate regional wage curve that links real wages to the unemployment rate. This approach leads to somewhat greater estimates of the costs of climate policy due to labour market imperfections, but these can be reduced by the judicious implementation of labour subsidies.

23. Böhringer et al. (2012), too, uses the wage-curve approach to modelling unemployment, this time in the context of a static computable general equilibrium model of the Canadian economy, in order to assess the labour-market impacts of the feed-in tariff policy used by the Government of Ontario (where the tariff is paid by electricity consumers). In other respects, the model is broadly neoclassical. They find that, although the policy is successful at increasing employment in the 'green' sectors of the Ontario economy, the policy is also likely to increase the rate of unemployment in the province, and to reduce overall labour force participation.[7] The increase in the price of energy has adverse effects overall on Ontario employment.

24. There have also been some more eclectic large-scale models that have incorporated mechanisms allowing for involuntary unemployment, such as E3MG and E3ME, which incorporate non-market-clearing characteristics of the type emphasised in the new Keynesian economic tradition and which rely more on econometric estimation than off-model calibration.[8] These reintroduce some of the Keynesian multiplier effects absent from conventional neoclassical general equilibrium models, generating much more favourable outcomes for climate-change mitigation policies introduced when there is involuntary unemployment, largely due to the multiplier effects on aggregate output from increased investment on low-carbon technologies. Some other modelling exercises have used models designed primarily for short-run economic forecasting to allow for the possibility of impacts on aggregate employment and unemployment.

Key issues for discussion

- How will the quantitative impact of green growth policies on employment compare with that of other recent developments such as the rise of the ICT sector and globalisation – or, in the energy sector, the U.S. shale gas industry? Are the shares of total employment in different sectors an adequate measure of each sector's significance to the labour market as a whole?
- How can more sophisticated labour market analysis improve on the contrasting Keynesian and neoclassical assumptions about how the aggregate labour market works that are made in most studies? Would 'real wage/unemployment' curves or search theories of unemployment be useful?

[7] The authors also review some other studies of the employment consequences of subsidies for renewable energy, noting that I-O approaches have generated positive estimates (Hillebrand et al. (2006), Lehr et al. (2008), Ragwitz et al. (2009)), while a computable general equilibrium model-based estimate of the impact of a subsidy to renewable energy capital in Europe suggests unemployment is increased (Küster et al. (2007)).

[8] For descriptions and bibliographies, see http://www.tyndall.ac.uk/macroeconomic-modelling and http://www.camecon.com/EnergyEnvironment/EnergyEnvironmentEurope/ModellingCapability/E3ME.aspx

III. HOW DO MODELS ENGAGE WITH DISTRIBUTIONAL EFFECTS?

25. The range of models discussed in Section 2 can all be used to consider the possible distributional effects of green growth policies. The I-O type studies emphasise the potential benefits for the unemployed of increased investment spending on, for example, electricity generation from renewable energy and home insulation. The general-equilibrium-style models emphasise the potential costs of new environmental taxes such as carbon pricing, via reduced energy and other environmental resource inputs as well as adverse labour supply responses to lower real consumption wages, with impacts on the number of the involuntarily unemployed often ruled out by assumption. Both tend to focus on differences across industries, reflecting the data upon which they primarily draw. They also both have potential implications for the functional distribution of income (i.e. the distribution of income across different factors of production, especially labour and capital). Different models have been used to focus on the distributional effects of environmental taxes across types of household, utilising disaggregated household data rather than industry or establishment data. These can also be used to examine the impact of subsidies to encourage households and firms to improve their energy efficiency. Other green growth policies are likely to have distributional consequences, too. In particular, green growth requires greater innovation and adoption of new low-carbon technologies. This is likely to increase the relative demand for technical and research skills, especially in the early stages of the low-carbon transition (Acemoglu et al. (2012) illustrate this in a simple analytical model).

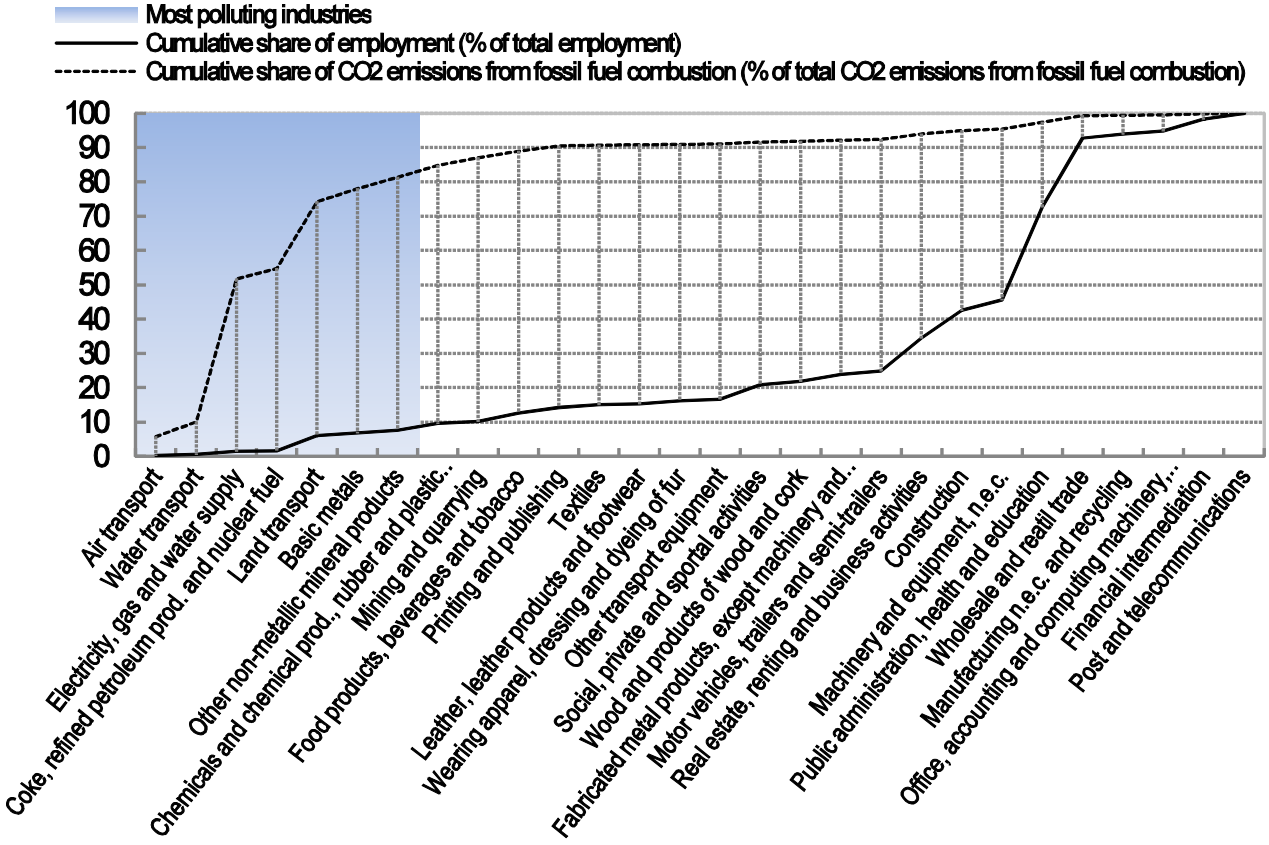
Distributional effects in I-O type studies

26. Pollin et al. (2009) point out that, in the USA, investment in the clean energy sector as a whole is likely to generate a higher proportion of lower-skilled jobs than would investment in the traditional fossil-fuel sector, reflecting the relatively high qualification levels in traditional high-carbon sectors such as oil and gas and the construction needs of low-carbon electricity production (the outcome might be different in countries more dependent on local coal-mining and use of traditional biomass). This compositional effect is additional to the higher *total* labour demand projected if a given increase in energy demand is met by investment in renewable instead of fossil-fuel energy. However, if there is no slack in the economy prior to increased investment in renewable energy (contrary to the situation analysed by Pollin et al.), the compositional effect may differ, depending on what activities get crowded out. And any increase in the demand for unskilled labour relative to skilled labour would initially be reflected in reduced wage differentials not changes in employment shares.

27. I-O type studies have also drawn attention to the dependence of the pattern of new jobs on the particular green spending initiatives taken. Pollin et al. (2009), for example, investigate the occupational and educational composition of new jobs in different green activities. Wind and solar power primarily benefit workers in the manufacturing and construction sectors. As the construction industry tends to be more sensitive to macroeconomic conditions than the average, expanding the use of these renewable energy sources is likely to be particularly beneficial in a deep recession triggered in part by the collapse of a house-building boom. Retrofitting home insulation is even more useful in this respect. However, smart grids are likely to generate larger demands for administrative and professional staff than other green spending. Energy production and distribution tend to be highly capital-intensive, so a given amount of spending is likely to generate fewer jobs in either case than spending on home energy efficiency improvements and on growing biomass for fuel. Barbier (2009) considers the likely employment impact of different elements of the Republic of Korea's green fiscal stimulus in the wake of the 2008 global downturn. Strikingly, he estimates that the same amount of spending on forest restoration as on low-emission vehicles and clean energy technologies would generate nearly eight times as many jobs. Restoration of waterways would only generate around twice as many.

28. Greenhouse gas emissions from sectors in developed economies are concentrated in relatively capital-intensive industries, so that the most polluting sectors are responsible for only a small share of employment. The ten most carbon-intensive industries account for nearly 90% of all CO_2 emissions but only 14% of employment on average, in the EU-25 (see Figure 2 below).[9] If low-carbon innovations adopt broadly the same factor input mix as the high-carbon technologies they replace, the impacts on jobs in a recession may be small, particularly if compared with, for example, increased employment in public education and health services. Some green growth policies to promote the sustainability of eco-services, such as improved management of agricultural land, wetlands and forest carbon sinks, have the potential to be much more labour-intensive, using in particular more unskilled labour (see, inter alia, ADB/ADBI (2013) and the chapters on food, agriculture and forestry in UNEP/ILO/IOE/ITUC (2008)). This would enhance output growth and employment growth but would adversely affect labour productivity growth in the short run. More generally, in the long run, green growth requires more reliance on new ideas – the 'knowledge economy' or 'weightless economy' – and less on raw materials and energy (see Aghion and Howitt (1998), Quah (1999) and Hepburn and Bowen (2013)), and will therefore boost the relative demand for highly educated workers and workers providing services that do not require a lot of material inputs. The implications for the growth of aggregate labour productivity and GDP are unclear, as they depend on, amongst other factors, the rate at which human and manufactured capital can be substituted for natural capital and the scope for increasing returns to knowledge over time as markets grow bigger (see also the discussion in Withagen and Smulders (2012)).

Figure 2. CO2 emissions and employment by industry in 25 EU countries, 2005



Source: EU-LFS, GTAP database, KLEMS database

[9] Of course, the share of employment may not be a good guide to the lobbying power of these industries.

Distributional effects in general equilibrium studies

29. General equilibrium studies of carbon pricing tend to be more pessimistic about the distributional effects of green growth policies, putting more weight on relative price effects from environmental taxes and on labour supply constraints (so ruling out effects via reductions in involuntary unemployment due to higher aggregate spending stimulated by higher investment in capital embodying greener technologies). Placing less reliance on grossing up from project-specific estimates of employment generated, they tend to draw attention to broader sectoral redistributions of labour, particularly from the energy sector as a whole (as well as fossil-fuel energy industries in particular) towards services (see, for example, Goettle and Fawcett (2009); Chateau et al. (2011); and OECD (2012a) Figure 4.2 'Simulated changes in sectoral composition of employment, OECD'). Some of the projections are perhaps surprising, such as the adverse impact of climate-change mitigation on employment in the European rice and livestock industries (Chateau et al., p.21) and the beneficial impact on the US tobacco and textile industries (Goettle and Fawcett, p. S250). The employment effects do not seem to be closely correlated with relative wage rates, so there is little suggestion from such studies that green growth policies would reallocate labour systematically to high-wage or low-wage sectors.[10] .

30. The discussion in the previous paragraph reflects analyses of distributional effects via induced changes in labour demand in different sectors of the economy. However, environmental taxes also affect households directly through their budgets for household spending. Focusing on the impact of changes in relative prices on the real value of household spending, most empirical studies of industrial countries appear to conclude that carbon pricing by itself is likely to be regressive, largely because energy tends to comprise a larger part of poorer families' expenditure. As EBRD (2011) reports, this conclusion emerges whether the studies are I-O based (e.g. Symons et al. (1994)), econometric (e.g. Barker and Kohler (1998)) or based on calibrated general equilibrium models (e.g. Hassett et al. (2007)). There have been counter-findings (e.g. for the UK and Italy – but not Germany, France and Spain – in Symons et al. (2002)) but a recent detailed study confirmed this finding for the UK, too (Advani et al. (2013)). The problem of the unequal incidence of carbon pricing may not be as pronounced for lifetime incomes, at least for fuel taxes (Sterner (2012)). There is more doubt about the regressivity of carbon pricing in developing countries. It would depend partly on the relative importance to the poor of traditional biomass (not subject to carbon pricing) and kerosene, which differs across countries. An accompanying 'Issues Note' by Heindl and Löschel reviews the extensive literature on the incidence of energy pricing reforms on households.

Small-scale analytic models

31. Many of the models discussed above that attempt to take account of the macroeconomic feedbacks from environmental policies across the economy are not designed to investigate labour market issues. Chateau et al. (2011), for example, write, "Because labour market policies and institutions vary widely across countries and interact in complex ways with policies in other markets, it is not possible to introduce a thorough representation of labour market structure into environmental CGE models that are already complex and not easily-tractable tools. Consequently, the labour market imperfections that are introduced into the ENV-Linkage model in this paper are somewhat stylised, taking the form of ad-hoc wage rigidities." Babiker and Eckaus (2007) also note the disadvantages of splicing sectoral labour markets on to a large-scale model designed for other purposes. An alternative approach is to use smaller-

[10] Even if these models did point in one direction or the other, one could not conclude much about the impact on aggregate labour productivity, as it is not clear whether the productivity of the individual workers reallocated would change in line with their new sector's prior average productivity. Neoclassical models typically assume that wages for any given type of labour are equated with the marginal productivity of labour in each industry and equalised across industries by competition in the labour market, so that small redistributions of workers across industries have insignificant effects on aggregate labour productivity.

scale analytic models that pay more attention to labour markets and less to the disaggregated energy system and mechanisms of decarbonisation.[11]

32. One thread of the literature does this by focusing on very simplified and abstract theoretical models of the interaction between environmental taxes and labour market imperfections. It explores the scope for using the revenues from environmental taxes to achieve a so-called 'double dividend': an environmental dividend and a tax efficiency dividend. In particular, if the existing tax system discourages employment by over-taxing labour, new environmental taxes may allow other distortionary taxes harmful to employment to be reduced. For example, Bento and Jacobsen (2007) argue that resource rents are under-taxed and a broad environmental tax reform would shift taxation from labour to all sorts of resources in fixed supply (not just greenhouse gas emissions quotas). Sjögren (2009) studies optimal taxation and environmental policy in the presence of trans-boundary environmental damage and labour market distortions, where the latter give rise to wage bargaining externalities between countries. In this setting, he finds that a trans-national authority (e.g. the EU) with powers over environmental regulation but not national taxation will use the environmental regulation partly to correct the wage bargaining externalities that they cannot tackle directly. Bovenberg and van der Ploeg (1998) study a small open economy with involuntary unemployment stemming from a rigid consumer wage, with three factors of production, labour, resources (whose use pollutes) and a clean input that is fixed in supply. The sources of inefficiency are three-fold: an adverse environmental externality, real wage rigidity and an inability to levy a lump-sum tax (all these aspects could in principle be included in large-scale CGE models). They find that environmental tax reform may raise employment by shifting the relative tax burden away from labour to the fixed factor, reducing wage costs (per unit of output) and boosting labour demand. There can be a triple dividend, because the increase in output brought about can increase net profits after taxes.

33. Other papers (e.g. Koskela and Schob (1999), Kuralbayeva (2013)) have analysed how green tax policy can in theory affect the level of unemployment in models with endogenous wage-setting (respectively via Nash bargaining and via equilibrium in job-worker matching in a search-theoretic framework). In their models, the double dividend arises from a different mechanism. If unemployment (or informal sector) benefits are fixed in nominal terms, introducing environmental taxation combined with reduced payroll taxes in the formal sector increases the real incomes of those employed in the formal sector relative to the unemployed (or workers in the informal sector). This weakens the bargaining position of formal-sector workers (who become more worried about losing their jobs), allowing the pre-tax wage to fall. Lower pre-tax wages in turn reduce labour costs and boost the demand for labour in the formal sector, thus reducing unemployment (or informal sector employment). Because the environmental tax pushes up the cost of living for both groups, real incomes for both could fall. If both these groups live in cities, the incidence of the environmental tax could fall in part on people in rural areas even if they do not consume the goods produced with 'dirty' inputs, because migration to the cities would become less attractive. Thus economic factors such as how the social security benefit system works and what equilibrates migration between sectors turn out to be important for the precise distributional impacts. This is likely to be particularly relevant in developing economies, where there may be larger divergences between labour productivity at the margin in different sectors (especially between the formal urban sector and the informal own-account rural sector). Green growth tax policies may give rise to a conflict between benefits for some people who are able as a result to join the more productive 'modern' formal sector, on the one hand, and the rural poor on the other. At present, the projections from theoretical models of this type have not been subject to rigorous empirical testing but they usefully identify potential impacts of green growth policies that need to be empirically investigated. Also, they suggest ways of further

[11] In due course, it might be possible to link such models with environmental CGE models, once the former's properties were properly understood. But the computational challenges could be considerable (as with, for example, the incorporation of endogenous expectations).

differentiating types of economy according to their labour market institutions, tax arrangements, production structure and endowments.

The distribution of income across factors of production

34. So far, this note has largely considered labour markets in isolation from other factor markets, while noting the importance for green growth of substituting human and manufactured capital for natural capital. However, as EBRD (2011) notes, "a carbon tax will affect the relative prices of the factors of production (labour or capital) used in carbon-intensive industries. The impact on factor prices will depend on how feasible and simple it is to substitute these production factors, and the relative factor intensity of carbon-intensive industries. A carbon tax will also increase returns from the factor that constitutes a better substitute for the polluting input. Furthermore, a carbon tax will reduce the production of fossil-fuel intensive products. This will tend to reduce, to a relatively greater extent, returns from the factor intensively used in the sector." In other words, a shift towards environmental taxation could change the functional distribution of income (that is, the distribution of income among factors of production) and hence the distribution of income across individuals given their widely differing ownership of manufactured capital and natural resources.

35. The rather sparse literature focusing on functional sources of income suggests that pollution taxes could be regressive because they could depress (unskilled) wages when emission-abatement measures are capital-intensive. Fullerton and Heutel (2007) and Fullerton and Heutel (2010) illustrate this in the context of analytical general equilibrium models for Japan and the USA respectively. However, their focus is on a particular narrow type of green activity and, as argued above, some switching from traditional to greener technologies and activities is likely to entail a switch towards *more* unskilled-labour-intensive activities. Rausch et al. (2009), in a model of the US economy, come to a different conclusion with respect to the imposition of a carbon cap-and-trade scheme. They find that carbon pricing depresses the return to capital relative to the return to labour (while still incentivising a switch from high-carbon to low-carbon investment). As the authors note, "while results based only on energy expenditure have shown carbon pricing to be regressive we find the full distributional effect to be neutral or slightly progressive. This demonstrates the importance of tracing through all economic impacts and not just focusing on spending side impacts." However, a full accounting for the distributional effect in the longer term would also have to take account of any slowdown in investment and growth as a result of the fall in the return to capital in their model. It is also important to note that the model abstracts from aspects of green growth policies that might increase risk-adjusted returns to capital in the private sector (such as a more credible long-term outlook for policy and more government support for green R&D and the public goods aspects of infrastructure).

The demand for skills

36. The analytical models applied so far have been largely silent on the demand for skills. Some I-O approaches have projected occupational requirements by using detailed information on existing industries (e.g. Pollin et al. (2009); Pew (2009)). The heterodox E3ME model has been used to examine skills needs at a high level of aggregation (Cambridge Econometrics (2013)). This model can also be used to make more detailed skill projections (Cedefop (2010)). General equilibrium approaches need detailed data on occupational groups and wages, but can investigate policy issues if such data are available (see, for example, Ottaviano and Peri (2007), who investigate the impact of immigration to the USA). Other types of approach have also utilised detailed labour market data (e.g. Peichl and Siegloch (2010), who look at labour supply and labour demand in Germany using a structural econometric approach). General equilibrium approaches could be extended to examine skill needs and impacts by socioeconomic group using Social Accounting Matrices, as illustrated by, for example, Decaluwé et al (1999), who investigate the impact of a fall in the price of a major export crop and an import tariff reform on poverty. These could

be combined with computable general equilibrium models that are better designed to take into account a wider range of aspects of sustainable development than climate change alone (see the discussion in Böhringer and Löschel (2006)). There is also scope to follow some of the methods used by researchers who have examined the impact of ICT on skill differentials (e.g. Michaels et al. (2010); Heckman et al. (1998); Berman et al. (1998)) and possibly also those who have investigated the impact of globalisation (e.g. Haskel et al. (2012)).

Key issues for discussion

- If green growth in the long run will rely more on the accumulation of human capital and ideas and less on an increasing throughput of materials and energy, what are the implications for labour markets?
- Has enough attention been paid to the impact of green growth policies on 'brown' jobs, especially those that are concentrated in relatively isolated labour markets?
- Will environmental taxation together with an increase in investment raise or depress (i) real wages, (ii) the returns to manufactured capital and (iii) the returns to ownership of natural resources?
- How do environmental improvements affect labour supply and wellbeing?
- Is the transition to green growth a sufficiently radical structural change materially to affect the relative demand for skilled and unskilled labour?

IV. HELPING THE WORLD'S POOREST

37. Most of the studies of potential labour market effects of green policies have been carried out for advanced industrial economies (Kuralbayeva (2013), which is calibrated for Mexico, is an exception). However, the distributional effects in developing countries may be very different, requiring an appreciation of the different political economy considerations as well as different models of how labour markets work.

38. Dercon (2014) explores a range of potential conflicts in developing countries between green growth policies and alleviation of poverty amongst the world's poorest people. On the one hand, many of the world's poor are particularly dependent on the services provided by forms of natural capital, such as soil quality and forest eco-systems, and particularly vulnerable to environmental problems, such as water pollution, water scarcity and climate change. Climate change in particular is likely to hit marginalised communities hardest (Casillas and Kammen (2012)). Health problems from particulate pollution due to the use of solid fuels in cook stoves (Duflo et al. (2008)) impair labour supply. So does the increased morbidity and mortality from extreme weather events in rural areas (Burgess et al. (2014)). It is therefore helpful to the poor to safeguard the quality of the environment. This perspective has driven the work of international organisations such as the Global Green Growth Institute and the Asian Development Bank, which asserts that, "The transition to green growth requires nations to tackle environmental problems, especially human-induced climate change, which are threatening people's well-being and inhibiting the scope for sustained economic growth – particularly in some of the poorest countries, because of their vulnerability to climate change" (ADB/ADBI (2012)).

39. On the other hand, green growth policies may hurt the poor in the near term through impacts on consumption and production. For example, environmental pricing and regulation may force up the price of and restrict access to energy. Changing land-use practices to reduce greenhouse gas

emissions may reduce the access of the poor to land. Solving the problem of the commons by privatising land assets may impoverish the landless. Resnick et al. (2012) give a specific example, arguing that Malawi's Agricultural Input Subsidy Programme has been successful in reducing rural poverty and increasing food security but has increased greenhouse gas emissions because of its dependence on promoting the use of chemical fertilisers. Taxing fertiliser use due to its environmental impact would slow down the rate of poverty reduction. Dercon points out how, in practice, regulation is often designed and implemented in a way that benefits local elites. Putting up the price of fuel for transport may discourage trade and the development of comparative advantages for poor countries. Low-carbon infrastructure investment demands may crowd out investment in more labour-intensive projects more likely to hire the poor. Strong green growth policies may be warranted on a world scale using low discount rates that may be appropriate for a global social planner to use but not today's poorest in fast-growing countries. Dercon's main concern is that green growth policies may slow down the conventionally measured growth that has proved to be the key method of diminishing extreme poverty around the world.

40. The potential trade-offs between poverty alleviation and green growth thus require policy-makers to consider how to mitigate any adverse impacts of green growth policies on wellbeing, particularly among the poor (see section (5) below).

Key issues for discussion

- How can policy-makers reconcile poverty reduction and green growth in the short run?
- Will the skills needed for green growth differ significantly across countries because of their different comparative advantages, endowments, and levels of development?

V. EX POST EVIDENCE

41. Rigorous evaluation of the impact of green growth policies on labour markets has not been widespread as yet, not least because few countries can claim to have had comprehensive green growth policies in place until recently. Qualitative assessments have already given some guidance as to best practices, as illustrated by the Green Growth Best Practice initiative (http://www.ggbp.org/). Practical experience with green growth programmes has led practitioners to highlight employment creation opportunities but also to stress the need for active labour market and skills development policies to reduce the costs of induced structural change (GGBP (2014)). Their recent report argues that, "Governments should seek to assess, anticipate, and address the effects of green growth policies on employment. This can often best be done through joint initiatives with the private sector." But it cautions that, "… such active labour market policies are a particular challenge in many developing countries." Various strands in the empirical policy evaluation literature, such as studies of fiscal stimuli and of environmental regulation, can be drawn upon to give a firmer foundation for policy-making in the future, and these are discussed next.

Multiplier effects

42. Although the approach of using multipliers to estimate the impact of different types of tax changes and extra spending on aggregate output takes some account of macroeconomic adjustment in response to increases in investment, it does face criticism, not least for the relative lack of ex post evaluation.

43. First, there is uncertainty about the value of the fiscal multiplier linking changes in public spending (whether 'green' or otherwise) to changes in output (see the discussion in Bowen and Stern (2010)). Second, the fiscal multiplier with respect to output may differ systematically according to macroeconomic circumstances. Karras (2014), using a panel-data set of 61 countries for the 1952-2007 period, finds that fiscal policy is more potent during downturns than during expansions: the fiscal multiplier is twice as large when output is below its long-term trend. During downturns, the fiscal multiplier is greater than one, so private consumption is not crowded out, and the response of investment is strong. He finds that the differences between expansion and downturn fiscal multipliers are greater in low-income countries. The results of Wilson (2012), a careful investigation of the effect of the 2009 American Recovery and Reinvestment Act (ARRA), suggest that the job creation was of the order of magnitude implied by Pollin et al. (2009). He concludes that, "…the estimates imply ARRA spending created or saved about 2.1 million jobs, or 1.6 per cent of pre-ARRA total nonfarm employment, in that first year. The estimated employment effect is estimated to have grown further over time, reaching 3.4 million (based on announced funds) by March 2011…. Despite the use of a very different methodology, these estimates are in line with the range of estimates of the ARRA's impact generated by studies using the macroeconometric modeling approach." Hence ex post evaluation lends support to the I-O approach, at least in the circumstances of the aftermath of the global financial crisis of 2008.

44. Third, the multiplier effect on aggregate output may differ for different types of spending, depending on factors such as the saving propensities of the beneficiaries of the spending and the import content of the direct and induced spending. More needs to be known about the characteristics of green investment spending in these respects. Fourth, the multiplier effect on aggregate output of increased private sector investment spending in low-carbon sectors may differ from the fiscal multiplier for autonomous increases in public spending, for example, if the private sector simultaneously reduces spending on capital-intensive and carbon-intensive investment.

Productivity

45. Most of the projections for employment effects from climate-change policies have been for the long term and are therefore difficult to assess empirically yet. Nevertheless, there have been several careful studies of the impact of other environmental policy interventions on productivity and employment. Koźluk and Zipperer (2013) form the view that "Empirical research on the productivity effects of environmental policies is largely inconclusive." Hence the hypothesis that environmental regulation (such as carbon pricing) is bad for jobs because it reduces productivity (and thus increases output prices) does not find strong support. They note that "Finding significant effects of environmental policy changes may be hard because environmental compliance costs are usually only a small share of total costs." This draws attention to the relatively small scale of policy intervention in the economy for environmental purposes so far. The OECD's Working Party No. 1 on Macroeconomic and Structural Policy Analysis (OECD (2014b)), supported by OECD research (Albrizio et al. (2014)), recently concluded that:

- Tightening of environmental policy stringency appears to have no longer-term effects on productivity growth, but the short-term effects may translate into a permanent increase in productivity levels in some industries;

- Short-term effects are found to be positive for technological leaders, while negative for low-productive firms;

- Short-run effects are unlikely to be large for the economy as a whole;

- At the aggregate level, the anticipation of an environmental policy tightening may temporarily slow productivity growth – possibly due to increased investment in preparation for an expected policy change – but productivity levels subsequently rebound due to the temporary acceleration in growth rates;

- Adjustments to accommodate the change in environmental policy stringency are likely to be both within firms, through changes in production processes, and via firm entry and exit. Adjustments may entail the international relocation of activities.

46. Dechezleprêtre and Sato (forthcoming) are a little more pessimistic, concluding that good-quality recent studies have tended to find evidence of adverse productivity effects on regulated entities, at least in the short run – there is more uncertainty about long-run effects. They also stress that any such costs are small relative to the size of national economies but warn that they may be significant in some pollution-intensive or energy-intensive sectors. The survey by Pasurka (2008), for example, found that the percentage of manufacturing capital expenditure assigned to pollution abatement in 2000 ranged between 1% and 5% across OECD countries, suggesting green policies may have increased production costs for regulated sectors by a small but non-trivial extent.

47. Green growth policies are designed to promote sustainable development in the long run. This has led many to assume that the short-run impact of those policies on the labour market via their environmental effects can be ignored. Dechezleprêtre and Sato (forthcoming) note that, "Very few studies on the costs of environmental regulation compare these costs with the benefits from a cleaner environment, which justify the policy in the first place – for example, the employment costs from the Clean Air Act are two orders of magnitude below estimates of the health benefits of the policy. Systematically comparing the costs associated with green policies with their benefits is important." Dell et al. (2013) report various studies that find quantitatively and statistically significant effects of climate and extreme weather on labour productivity, implying that climate change mitigation could have positive impacts on productivity and pay. Some of these benefits of policies would be contemporaneous. Graff Zivin and Neidell (2013) review the literature on environment, health and human capital and conclude that "pollution does indeed have a wide range of effects on individual well-being, even at levels well below current regulatory standards." These effects include significant adverse impacts on labour productivity that can be mitigated by environmental policies. For example, Chang et al. (2014) calculate that if the adverse productivity effects they identify from ozone on the marginal productivity of indoor workers are extrapolated to all manufacturing workers throughout the USA, the reductions in PM2.5 that took place between 1999 and 2008, partly as a result of federal air quality standards, would have generated $19.5 billion in savings in labour costs.

Employment

48. Dechezleprêtre and Sato (forthcoming) review the (not very substantial) literature on the employment effects of green growth policies in the light of the theoretical arguments for negative impacts on employment in high-carbon and other 'brown' sectors, not least via competitiveness effects in a world of widely varying intensity of environmental policies. They conclude that, although the effects are difficult to estimate accurately, the employment effects have probably been small so far (although this may in part reflect the lack of ambition of policies up until now – it is not clear that these results could be extrapolated in the context of stronger policies). Many job losses are transitory and the international competitiveness of environmentally regulated industries has only marginally been impaired. For example, they discuss the evidence about the impact of the EU Emissions Trading System on jobs. Anger and Oberndorfer (2008) and Commins et al (2011) find no statistically significant effect. Chan et al. (2013) find no effect on steel and cement sector employment, but an ambiguous effect in the power sector. Abrell et al (2011) also find ambiguous impacts on employment in the cement sector. But Wagner et al. (2014) are more pessimistic, finding a significant reduction of employment in regulated firms in the French

manufacturing sector of about 7% in Phase II. The UK Climate Change Levy also appears to have had little adverse impact on employment (Martin et al. (2009)).

49. Greenstone (2002) is a good example of the strengths and limitations of careful empirical work in this area. He finds that in the first 15 years of the operation of the US Clean Air Act (1972-87), US counties subject to strict regulation lost approximately 590,000 jobs, $37 billion in capital stock, and $75 billion (1987 dollars) of output in pollution-intensive industries relative to the less strictly regulated counties. The job losses amounted to 3.4% of manufacturing employment in the USA (and less than 0.5% of total employment). Greenstone points out, however, that some of the economic activity lost by strictly regulated counties may have moved to the other counties, so that the net national effect on employment is likely to have been smaller. Also, many of the job losses are unlikely to be permanent, as laid-off workers ultimately find other jobs. These countervailing adjustment effects are not captured in his empirical work. The environmental policy investigated did not entail increased public spending, so this aspect of green growth policies is not examined in this case (although the impact of the regulation on private investment in this case was to reduce it).

Skills[12]

50. The evidence about skill needs for green growth is patchy. Fankhauser et al. (2008), in their review of the literature on climate policy and jobs, note that there is relatively little information on the productivity, pay and other attributes of jobs created and destroyed by climate-change policies. Cedefop (2009) complains that "We have not paid enough attention to the social dimension of sustainable development: its implications for employment, training and skills." Even in countries with relatively good labour market data, it is difficult to identify which job skills are most likely to be affected by green growth policies. For example, Hatfield-Dodds et al (2008) note that in Australia "current information on green skills and workforce capabilities is very poor." While there are some data for renewable energy and construction trades, there are few for transport and agriculture. Jagger et al. (2012) argue that efforts to identify the skill requirements of the low-carbon transition have suffered from two main drawbacks. The first is that the occupational or skills data collected have often been too general to inform the planning of education and training. The second is that projections of future skill needs have been too dependent on the specific transition paths assumed for the relevant economy.

51. Perhaps the most thorough study of green growth and skills so far is ILO/Cedefop (2011), which reports the results of 21 country reviews and provides a synthesis. It finds that the demand for skills is being affected in three ways by the transition to green growth:

- First, there is induced structural change across industries, increasing the demand for the skills specific to expanding industries such as renewable energy and reducing the demand for skills such as those associated with coal-mining. On the one hand, many of the expanding industries are likely to be using new products and processes, reflecting the transition to low-carbon technologies, so the generic skill requirements of many of the new jobs created are likely to be higher than average as they have to allow for assimilation of unfamiliar tasks and working methods and 'learning by doing'. On the other hand, a larger proportion of jobs in the renewable energy sector and in energy efficiency are low skilled than in the oil and gas industries, which tend to have relatively well-paid workers and a high proportion of highly qualified engineers and technicians (Pollin et al., 2009). Also, energy efficiency improvements tend to require relatively unskilled construction labour. But there is much heterogeneity, with, for example, smart grid technology management requiring more input from high-level engineering services than do building retrofits.

[12] This section draws heavily on Bowen (2012).

- Second, some new occupations are emerging, such as photovoltaic fitters and carbon-footprint assessors. But there appear to be relatively few unique green skills.

- Third, the content of many existing jobs in existing industries is changing to reflect facets of the transition to green growth, such as increasing emphasis on energy efficiency, switching from fossil fuel sources to renewable energy and producing capital equipment for expanding green industries. In agriculture, low- and no-till agriculture and reduced use of fertilizers and pesticides will entail changes in farmers' practices, as will increased production of biofuel crops and efforts to increase forest cover.

52. Reports such as ILO/Cedefop (2011) have found that skill shortages are already impeding the transition to green growth. OECD/Cedefop (2014) argues that "Skills shortages and gaps are a major impediment of many emerging industries. In a low-carbon economy these bottlenecks can lead to increased costs to climate change mitigation and adaptation." The OECD draws attention to widespread skill shortages in energy-efficient construction and retrofitting; renewable energy; energy and resource efficiency; and environmental services. Particular countries have reported specific bottlenecks, such as the shortage of skilled PV workers in Germany and the lack of design engineers for smart grids in the UK. Schwartz et al (2009), in their study of Peru, Brazil and Honduras, draw attention to the rather skills-intensive nature of the projects undertaken as part of those countries' fiscal stimuli, giving rise to a concern that a more aggressive stimulus could run up against skills bottlenecks. Problems in rolling out ambitious green growth policies for energy efficiency (e.g. the Australian home insulation programme: see Australian National Audit Office (2010)) have illustrated the importance of higher-level management and planning skills in a policy-induced transition to green growth that is likely to take sustained effort and policy credibility over a long period.

Key issues for discussion

- Who gets the extra jobs created by a green fiscal stimulus? How much crowding out of other jobs takes place and what are their characteristics?

- How does a broad portfolio of green spending projects compare with other options in terms of employment creation?

- Should there be more stress-testing of the distributional consequences of green growth policies by modelling them in a range of models and using more checks of robustness of results (e.g. by varying the parameter values assumed)?

- What are the distributional consequences of green growth policies beyond the high-profile policies of environmental taxation and increased investment spending, such as R&D subsidies, renewables targets and land-use planning?

- Should policy-makers carry out explicit policy experiments and evaluations before rolling out a new environmental policy at full scale?

- How much has empirical investigation been impeded by poor data on either environmental outcomes or labour market outcomes?

VI. MITIGATION OF ADVERSE IMPACTS ON INCOME DISTRIBUTION

53. Cushioning or compensating for any adverse impacts of green growth policies on the distribution of income is important for their political acceptability, as argued in Chapter 3 of OECD (2011a). At the current economic conjuncture, ensuring that they do not make the management of government budget deficits any more difficult is also a major consideration. Drawing attention to the near-term benefits of environmental policies, for example, for human health and labour productivity, is likely to help with the political economy challenges. Similarly, pointing to the opportunities for new industries and technologies is appropriate to balance undue focus on the challenges to incumbent firms responsible for environmental harm. However, political economy considerations suggest that more direct action is appropriate. Three main strategies have been put forward for mitigating any adverse impacts of green growth policies on income distribution in the short run:

- Using revenues from environmental taxation (especially carbon pricing and the taxation of natural resource rents) to reduce taxes on labour to boost labour demand in general, achieving the so-called double dividend;

- Using the tax-benefit system to target assistance to the poor, given their vulnerability to energy price rises in particular;

- Promoting active labour market policies, especially training, to facilitate smooth structural adjustment across industries, including the adjustment necessary in rapidly growing developing countries.

The 'double dividend' and the labour market

54. Babiker and Eckaus (2007), Guivarch et al. (2011) and Chateau et al. (2011) can be regarded as contributions to the so-called 'double dividend' literature, whereby using the revenues from new environmental taxation to reduce tax distortions elsewhere in the economy can generate a second benefit on top of the environmental objective (see, inter alia, Fullerton and Metcalf (1997), Sartzetakis and Tsigaris (2007) and Goulder (2013) for a general discussion). Thus environmental taxes can help to reduce unemployment, increase aggregate labour supply and improve the allocation of labour across sectors. It has also been suggested that environmental taxes can reduce government reliance on labour taxation in the formal sectors of developing economies, leading to faster reallocation of labour to more productive activities (Bento et al (2014), Markandya et al. (2013)), and switch taxation from activities where tax evasion is easier (Liu (2013)). General principles for environmental taxation are summarised in OECD (2011b). The scope of environmental taxation could usefully be extended given the number of as-yet-unpriced environmental externalities amenable to regulation by price. The pricing of ecosystem services similarly could generate more revenue as well as improving environmental (and possibly, in the long run, narrowly defined economic) outcomes (although with the caveat that this first requires clarifying or establishing ownership rights in many cases, a process which can itself give rise to ethical issues and the opportunity for unproductive rent-seeking).

55. However, the double-dividend argument has been subject to criticism. First, the label fails to draw attention to the allocative costs of higher environmental taxes. Second, advocates do not always explain why the pre-existing tax system incorporated tax distortions that can however be reduced suddenly when environmental taxes are raised. If the pre-existing tax system was indeed optimal given the need of governments to raise revenue for public spending, the second dividend is likely to be offset almost entirely by the distortionary impact of the new environmental taxes. Third, it may not be optimal to use the revenues simply to reduce tax-induced labour market distortions. For example, if the distortionary burden of taxes on capital exceeds the burden of taxes on labour, revenues from environmental taxes should be

used to reduce capital taxation, even though that would tend to depress real wages in the short run (by encouraging firms to substitute capital for labour). The merits and demerits of the taxation of income from capital have been much debated (see, for example, Mankiw, Weinzierl, and Yagan (2009), who argue against it, and Diamond and Saez (2011), who argue for it). Fourth, green growth policies themselves may require more public spending, for example, to subsidise innovation in green technologies and innovation generally (e.g. Acemoglu et al. (2012)) or to provide environmental public goods by, for example, maintaining the quality of environmental services contributed by ecological systems.

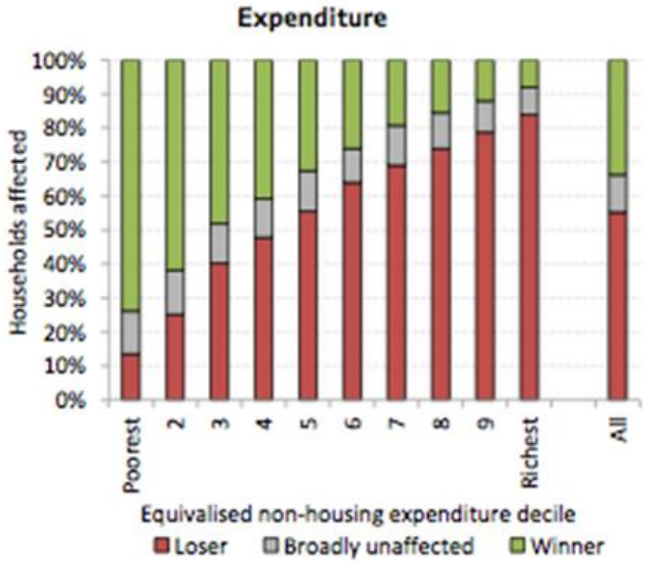
Using the tax-benefit system

56. Making adjustments to benefit rates in the tax-benefit system has been a popular response to complaints about the incidence of environmental taxes. The accompanying 'Issues Note' by Heindl and Löschel discusses use of the tax-benefit system in more depth. Some countries make provision for changes in heating/energy costs in their benefit schemes (generally as part of social assistance or housing benefits), either as explicit amounts or as a percentage of the main benefit (e.g. the Winter supplementary assistance in Japan and means-tested supplement for heating expenses in Norway). One possibility is simply to offer a rebate along with any new environmental tax, as in Boyce and Riddle (2009) and Parrott et al. (2009), who argue that "Consumer assistance should cover increases in households' various energy-related expenses, not just in their utility bills. It should be designed so it operates through proven delivery mechanisms and does not undercut incentives to conserve." They propose that low- and middle-income households would receive a 'climate rebate' and argue that, "This proposal would reach 95 per cent of the people in the bottom income quintile and 98 per cent of the people in the next two quintiles – and would do so automatically and efficiently, with no new bureaucratic structures and low administrative costs." The Van Hollen cap-and-dividend bill in the US House of Representatives proposed a national scheme in 2009. Such a scheme is now being implemented by the state of California in connection with its new cap-and-trade system for greenhouse gases, but with the delivery of the flat-rate rebate via utilities' billing systems. A flat-rate dividend is likely to be progressive (certainly relative to proportional relief of payroll taxes or income taxes, or relative to free distribution of emissions permits) but not necessarily sufficiently so to compensate for the regressivity of increased energy prices.

57. In poor countries, the evidence for the regressivity of carbon pricing is less well established. Many of the very poor do not use gasoline or diesel but traditional biofuels (which would be difficult to subject to carbon pricing in the first place), yet kerosene is an important fuel for poor people in many countries. The existing incidence of subsidies to energy (except those to kerosene) tends to be regressive in less developed countries (Arze del Granado et al. (2012)). The World Bank and other agencies have carried out extensive research into the distributional effects of reducing energy subsidies (e.g. Vagliasindi (2012a and 2012b)) and this can be a guide to the likely impact of going further by imposing a carbon price. A common policy response is to offer a targeted cash transfer to the poorest (not an equal dividend to everyone) at the same time as the energy price reform is implemented. Outreach to the public to explain the point of reform has been vital for success, too, as illustrated by the case of Iran (Guillaume et al. (2011)), where cash transfers were deposited in around 19 million bank accounts prior to the day of implementation of energy price reform but frozen until the reform went through. The OECD has been carrying out detailed analysis of the impact of energy subsidies and the consequences of reducing them (http://www.oecd.org/ctp/fossilfuelsubsidies.htm). Following on from earlier studies (e.g. Mourougane (2010)), the OECD has been examining subsidy reform in a general equilibrium context, using the example of Indonesia, allowing for the second-round effects through changes in spending patterns and saving rates as subsidies are reduced, cushioned by different types of compensatory schemes. Provisional findings suggest that the form of compensatory scheme matters, with cash transfers to households better for growth and income distribution than would be either food subsidies or payments related to labour incomes. That suggests that a cash transfer system may be a valuable supplementary policy instrument when widespread carbon pricing is adopted.

58. Advani et al. (2013) review a number of studies of potential compensatory packages to accompany energy tax reform. They argue that, at least in the UK case, a more sophisticated approach would beneficial. They propose a reform to the VAT charged on domestic energy and a new domestic gas tax, compensated by a range of adjustments to several elements of the UK benefits system[13], which would mitigate the distributional impact (see Figure 3). Some poor families would still be net losers because of factors such as their housing tenure and the age of their dwelling.

Figure 3. Proportion of 'winners' and 'losers' from proposed UK reform package including additional measures, by decile.



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. 'Winners' are those who gain at least £1 per week from the overall reform package. 'Losers' are those who lose at least £1 per week. Excludes Northern Ireland.

Source: IFS (Advani et al. (2013), Figure 6.8)

Active labour market policies, including skills training

59. The Asian Development Bank has argued that "… if climate change policies have regard for social inclusion, they can benefit development more broadly than just by reducing climate change risks" (ADB/ADBI (2012)). It also suggests that "…empowering the poor will help the most vulnerable to develop the capacity to adapt to climate change that is now unavoidable" (see Ayres and Huq (2008) for an example of a case study supporting this view). In other words, green growth policies should have regard for the social pillar of sustainable development from the outset. EBRD (2011) also emphasises the need to take account of political economy when considering the adoption of green growth policies, drawing attention to the potential adverse consequences for several of the countries covered by its remit that are currently heavily dependent on fossil-fuel exports. Active labour market policies are required to retrain workers who lose jobs in 'brown' sectors and to develop lower-carbon industries in the regions where those sectors are currently concentrated because of the geographical distribution of fossil-fuel fields

[13] These include changes to pension credit, job-seeker's allowance, the benefit cap, the working tax credit child tax benefit and long-term incapacity benefit.

and deposits. Attention also needs to be paid to making green jobs good-quality jobs, which is likely to require greater outreach by training organisations and educators.

60. The increasing appreciation of the need to tackle environmental externalities of economic activity, especially climate change, naturally leads to the consideration of pre-existing market failures in the provision of skills as well as in stimulating innovation and satisfying infrastructure needs. Many of the skill shortages already reported in connection with green growth strategies appear to result from generic failings in education and training and reflect long-standing issues such as the lack of incentives for employers to invest in developing the transferable skills of their workforces, the lack of access to time and finance for training on the part of the disadvantaged and the stickiness of relative pay rates. ILO/Cedefop put forward a number of recommendations to help labour markets respond effectively to green growth policies:

- Capacity building for employers in the informal economy and micro and small enterprises, helping them to enter markets for green goods and services

- Entrepreneurship training and business coaching for people to start up green businesses in conjunction with microfinance projects

- Promotion of environmental awareness among decision-makers, business leaders and administrators as well as institutions of formal and non-formal training systems

- Capacity-building of social partners to strengthen social dialogue mechanisms, using these to help improve accessibility to training for green jobs

- Increased capacity of formal education and training systems and institutions to provide basic skills for all and to raise the skills base of the national workforce.

61. These recommendations were originally formulated for developing countries but are also applicable to advanced industrial countries. They echo the findings of the OECD Local Economic and Employment Development (LEED) Programme, which has emphasised that the transition to the green economy requires strong institutional capacity (and a robust system of labour market data) (OECD (2012b)). It has also found that the training needed for workers in the green economy is not very different from the training needed in the traditional economy, even though there are likely to be pervasive changes in job content to reflect the greater emphasis on materials and energy efficiency. There are some very specific specialised skills that will be required but the most important enabling factor is the enhancement of general skills. This is even clearer if a long-term view is taken of green growth, recognising the growing role that the knowledge economy will play. Martinez-Fernandez et al. (2010) argue that there is a big role for local labour market institutions in identifying and satisfying specific training needs, with a particular responsibility on local government with respect to home energy efficiency, waste and water management, transport and urban development. The transition to green growth requires coordination of technology changes, land use changes and infrastructure decisions. Local and central government need to play a key role in ensuring this coordination takes place, not only in labour markets but in product and capital markets too. The LEED programme continues to study efforts at the local level to seize the opportunities for development from green growth, not least by supporting transitions out of 'brown' industries through the identification of transferable skills in their workforces.

62. The observation that active labour market policies are warranted to facilitate green growth does not establish how much money should be spent on them or which types of labour market policies should be emphasised. Policy-makers can nevertheless draw on an extensive literature on

evaluating such policies, including those in the OECD (e.g. Martin and Grubb (2001)). Card et al. (2010), for example, carry out a meta-analysis of 97 micro-econometric studies of 199 programme impacts conducted between 1995 and 2007. They find that "Job search assistance programmes yield relatively favourable programme impacts, whereas public sector employment programmes are less effective. Training programmes are associated with positive medium-term impacts, although in the short term they often appear ineffective." However, in some countries with less well-developed labour market institutions, public employment programmes are likely to be part of the solution (Lieuw-Kie-Song and Lal (2010)).

Key issues for discussion

- Do 'double dividend' arguments warrant spending revenues from environmental taxation on reducing taxes on labour? Or would the general efficiency of tax systems be improved more by a broader range of tax reductions?
- More generally, how should the revenue from environmental taxation be divided amongst (i) distributional goals, (ii) increasing static efficiency, (iii) increasing dynamic efficiency, (iv) achieving other environmental objectives and (v) reducing public debt?
- Is there scope for combining an increase in taxes and subsidies to promote green growth (perhaps including higher taxation of land and other natural resource rents) with a more general tax-benefit system reform?
- What should the balance be between retraining workers in currently brown jobs in situ and promoting geographical and inter-industry mobility?
- In poor countries, with poverty alleviation in mind, what should the balance be between measures to employ the rural poor in green activities and measures to promote migration and low-carbon, environmentally friendly industrialisation?

VII. CONCLUSIONS

63. Green growth can be thought of as the route to sustainable development, yet its implications for equity and social inclusivity – the 'social pillar' of sustainable development – are not yet fully understood. This is evident in the burgeoning literature about the implications for labour markets of green growth. There are probably several reasons for this. One is that key pieces of the jigsaw are missing because of poor data and missing data. Another is that different green growth policies may have very different implications for changes in the level and composition of labour demand, a point that can be missed if one focuses exclusively on individual policies such as carbon pricing. A third is that green growth requires non-marginal changes in economies, so that partial equilibrium methods of analysis are inadequate. Many researchers recognise this but, implicitly or explicitly, use quite different models of how economies function to work through the full range of policy impacts. Some of these models are overly simplistic or inappropriate in some circumstances.

64. In the short to medium term, green growth policies have the potential to promote inclusive labour markets. Increased investment, focused on the low-carbon transition and more broadly the growth of environmental goods and services, is likely to generate an increase in jobs, net, although that depends on how the investment spending is financed. Given continuing spare capacity and involuntary unemployment in many advanced industrial countries, a rapid increase in the demand for workers to fill 'green jobs' is helpful. However, more attention needs to be paid to the consequences of the destruction of 'brown jobs'. Also, fiscal reforms leading to greater reliance on environmental taxation (and removal of energy subsidies) could be problematic, pushing up costs in some important sectors such as energy and reducing the real consumption wage, with ramifications, throughout economies, that are not fully understood – models differ in their projections of these effects. Any adverse effects can be mitigated to a large extent by

judicious use of environmental tax revenues to reduce taxes on labour and to compensate poor consumers of currently high-carbon products – but there are many competing claims on these receipts. Developing countries with unsophisticated fiscal systems may face a bigger challenge in reconciling poverty alleviation and green growth (one reason why international climate finance is such an important element of any global deal on limiting greenhouse gas emissions).

65. Promoting active labour market policies and developing strategies to facilitate structural change across industries are necessary complements to green growth policies. The scale of change induced in labour markets in the short to medium term is unlikely to be large relative to the normal flux in a dynamic economy. It does not appear, for example, that green growth policies are currently changing radically the relative demands for skilled and unskilled labour. In this respect, the transition to green growth is not as problematic as the ICT revolution and its consequences for routinised tasks or as globalisation and its consequences for unskilled workers in developed countries. In the long term, however, the scale of change will be much greater to the extent that green growth will ultimately require ever greater reliance on knowledge-based outputs and human capital and less reliance on the use of material resources and environmental services. The costs of structural change may also be reduced if policy-makers take steps to ensure the credibility of their policies over the long term, provide the appropriate frameworks for infrastructure provision and planning and give clear signals about the overall direction of travel – towards green growth.

66. The research priorities suggested by this review include:

- The application of more sophisticated models of how labour markets function in macroeconomic studies of net job creation and the use of 'stress tests' to investigate the robustness of investigators' conclusions in the face of uncertainty about how labour markets work in practice.
- The choice of models more tailored to the endowments, income levels and labour market characteristics and institutions of the particular country under investigation.
- More modelling of how green growth policies may affect wages relative to other factor returns and the relative pay associated with particular skills.
- More empirical study of the interaction of tax-benefit systems, labour markets and green growth policies to complement the theoretical literature on the 'double dividend' and taxation in a second-best world.
- More rigorous microeconomic studies of the impact of both particular projects (e.g. setting up and running a wind farm) and particular policies (e.g. subsidies for home insulation) on employment and wages over different time horizons. This could include explicit policy experiments designed to make ex post evaluation easier.
- More study of the implications for labour markets of the transition to green growth outside the energy sector and specific high-pollution industries (e.g. in transport, urban design, construction and, especially in the least developed countries, rural land use).

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