



ELSEVIER

Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist

Productivity and work in the ‘green economy’ Some theoretical reflections and empirical tests

Tim Jackson^{a,*}, Peter Victor^b^a University of Surrey, Guildford, UK^b York University, Toronto, Canada

ARTICLE INFO

Article history:

Received 19 November 2010

Received in revised form 17 April 2011

Accepted 18 April 2011

Keywords:

Post-growth economics

Productivity

Green technology

Ecological services

Employment

Carbon targets

ABSTRACT

This paper explores the concept of productivity in post-growth economies. It defines the ‘productivity trap’ that arises from the systematic pursuit of labour productivity and describes two solutions to this trap, each of which has some precedence in economic theory. The first is to reduce working hours – the most frequently cited avenue to combat unemployment in non-growing economies. The second is to engage in structural shifts towards low productivity growth sectors. Using a simple simulation model of the UK economy we illustrate how these two strategies might combine to achieve ‘deep’ carbon emission reduction targets while maintaining high employment.

© 2011 Elsevier B.V. All rights reserved.

1. Introduction

The transition to a sustainable society poses considerable challenges for conventional economics. Institutional structures, accounting frameworks and macro-economic relationships all require significant reform. Central to a new macro-economics for sustainability lies the relationship between growth, productivity and work (Jackson, 2009; Victor, 2008). In particular, a low-growth or slow-growth economy must reconcile labour productivity changes with the maintenance of full employment. This paper explores that challenge.

Productivity is highly prized in economics. In simple terms, productivity is defined by the ratio of outputs to inputs. Labour productivity, for example, is one of the most fundamental measures of economic success. Output is cast in terms of economic value, usually measured at the macro-economic

* Corresponding author.

E-mail addresses: t.jackson@surrey.ac.uk (T. Jackson), pvector@yorku.ca (P. Victor).

level in terms of Gross Domestic Product (GDP). Input is measured as the time spent by workers in employed labour. Labour productivity is the ratio of these two factors.

Rising productivity means that outputs increase relative to inputs. And it is generally assumed that this is a good thing. But any normative assessment of the value of productivity depends heavily on appropriate measurement. Are we measuring the right inputs? Are we measuring the right outputs? Does an increasing ratio of outputs to inputs really represent an improvement in our lives?

The aim of this paper is to explore the role of labour productivity in a low or no-growth economy. In the sections that follow, we first explore in more detail how the dynamics of productivity work and present what we call the 'productivity trap' inherent in modern growth-based economies. Next we discuss two distinct strategies for escaping this trap in non-growing economies. Finally, we offer some illustrative scenarios to show how these two strategies could transform the structure of the UK economy and help meet the nation's carbon targets.

2. The productivity trap

Capitalist economies place a high emphasis on the efficiency with which the so-called factors of production are utilised as inputs to the production process. In the conventional neo-classical growth model, the main dependencies are taken to be on labour, capital and technological innovation. Capital productivities are largely sought in terms of conventional financial returns on investment. And these investments are often themselves mainly focussed on improvements in labour productivity.

The underlying drivers of productivity growth are complex and contested. Clearly a strong endogenous incentive to seek productivity improvements is provided by the profit motive, since productivity improvements reduce the ratio of inputs (costs) to outputs (revenues). A further endogenous incentive highlighted last century by Schumpeter (1942) amongst others is the 'creative destruction' inherent in the entrepreneurial activity: the search for new and expanded consumer markets through continual and sometimes disruptive processes of technological innovation. This tendency can also be related to the profit motive and in particular for the competition for profits in capital markets (Booth, 2004; Jackson, 2009).

Some have also suggested that technological innovation is an inherent dimension of human activity, driven by a 'natural' human creativity and an exogenous desire for social progress (e.g. Beinhooker, 2005). To those who espouse this view, the economic system – with its strong institutionalisation of the profit motive – is simply a reflection of underlying human tendencies. For a partial critique of this naturalistic view see for example Jackson (2010).

A further dimension to the increase in overall productivity lies in expanded access to material resources. Technological innovation has been fuelled (almost literally) by an unprecedented and still increasing consumption of high-quality (low entropy) energy and material resources, principally fossil fuels. To the extent that these have been plentiful in supply, relatively easy to access, and exempt from paying the social costs of extraction and use, they have encouraged technological innovation designed to replace expensive labour inputs with cheap material and capital inputs.

As incomes rise, this pressure to reduce labour costs has increased. This is why labour productivity assumes such a dominant role in the modern economy. Improving the efficiency of the economy with respect to labour inputs stimulates demand by driving down costs and contributes to a positive cycle of expansion. But crucially it also means that fewer people are needed to produce the same goods from one year to the next.

As long as the economy grows fast enough to offset this increase in labour productivity, things go well. But if it does not, then increased labour productivity means that there is less work available in the economy. In other words, if other things do not change, labour productivity improvements mean that someone somewhere loses their job.

If the economy slows for any reason – whether through a decline in consumer confidence, through commodity price shocks, or through a managed attempt to reduce consumption – then the systemic trend towards improved labour productivity leads to unemployment. This in its turn leads to diminished spending power, a loss of consumer confidence and further reduces demand for consumer goods.

From an environmental point of view this may be desirable because it leads to lower resource use and fewer polluting emissions (Victor, 2008; Jackson, 2009). But it also means that retail sales falter and business revenues suffer. Incomes fall. Investment is cut back. Unemployment rises further and the economy begins to fall into a spiral of recession.

In the short run, some countervailing economic trends (negative feedbacks) may dampen the worst case collapse scenario. For example, as economies falter, investment slows down, reducing the capability further to increase labour productivity. But the long-run tendency towards increased labour productivity remains undiminished.

In short, labour productivity appears to offer us a means to higher efficiencies in delivering economic output, but by the same token it requires us to grow our economies if we are to maintain full employment. In the language of over-anxious politicians, growth equals jobs. And any attempt to stabilise or reduce economic output – as a means of reducing resource throughput or environmental impact, for example – is viewed as a direct threat to people's livelihoods.

3. Escaping the productivity trap

In mathematical terms, the key relationship is illustrated by the following simple 'production function' in which the annual economic output, GDP, is calculated as the product of the annual labour input L , and the productivity of labour P_L . Explicitly we have:

$$\text{GDP} = P_L \times L \quad (1)$$

Labour input L can itself be further broken down (Victor, 2008) as:

$$L = h \times e \times F \quad (2)$$

where h is the average number of hours worked by each employee in a year, F is the total number of people in the labour force, and e is the employment rate (expressed as a percentage of the total labour force). The production function Eq. (1) then becomes:

$$\text{GDP} = P_L \times h \times e \times F \quad (3)$$

where P_L is defined as the average output generated by an hour of work. For the sake of argument here, let's assume that the labour force F remains constant, in which case:

$$e \propto \frac{\text{GDP}}{P_L \times h} \quad (4)$$

Or in other words, as P_L increases, we can only maintain full employment by increasing GDP or by reducing working hours h . Conversely, if we want to slow down (or constrain) economic growth, then to maintain full employment we must either (a) reduce working hours h or (b) slow down (constrain) growth in the labour productivity P_L .

These now define the two avenues of intervention through which it might be possible to escape the productivity trap. Either we reduce the average hours worked per employee or else we shift the structural composition of the economy to sectors which have lower labour productivity and lower (possibly even negative) labour productivity growth. Interestingly, as we shall see, both these avenues have some precedence in economic thought.

3.1. Sharing the work

The concept of 'sharing the work and sparing the planet' (Hayden, 1999) is perhaps the most familiar of these two options. Interestingly, this is how some prominent early economists thought things would play out in the future. In an essay on the 'economic possibilities for our grandchildren', written in 1932, John Maynard Keynes foresaw a time when we would all work fewer hours, abandon the endless attempt to increase incomes and spend more time with family, with friends and in the community.

In practice, some at least of the labour productivity gains witnessed in the OECD nations have been taken as increased leisure time. For instance working hours in the UK declined by 15% between 1970

and 2005 (OECD, 2010). The possibility of reducing working hours is the simplest and most often cited solution to the challenge of maintaining full employment with non-increasing output. And there is clear precedent for such policies within certain European nations (Golden and Figart, 2002). The lessons from these policies are not always positive. But the point here is that the goal of decoupling jobs from growth is not entirely outside the experience of western economies, or the purview of economists.

3.2. Resisting labour productivity growth

A second avenue for escaping the productivity trap is to question the continued pursuit of labour productivity growth. In fact, there is already some evidence of a slowing down of productivity growth in mature economies. Average annual productivity growth between 1970 and 1995 across the EU 15 nations was 2.7% per annum. But this rate of growth had fallen by almost a half in the period from 1995 to 2005 (Timmer et al., 2007). Economists began to speak of an inevitable decline in labour productivities across western nations as economies matured and changed.

Sometimes referred to as Baumol's disease, this trend towards declining labour productivity growth in mature economies is supposed to arise naturally because of the changing composition of developed economies. In particular, the shift from a manufacturing basis to a service basis is supposed to offer fewer opportunities for productivity growth.

As with many general theorems, there are some clear exceptions to the general statement. For instance, labour productivity growth in the financial services sector in the UK in the decade between 1995 and 2005 was faster than in any other sector in the economy aside from the electronics and communications sector (Van Ark et al., 2007). In retrospect, of course, it is possible to see that this growth was unsustainable even in economic terms and clearly implicated in the 2008 financial crisis and subsequent recession (Jackson, 2009).

Nonetheless, the 'natural' slowing down of productivity growth in developed economies suggests interesting possibilities for structural change to avoid or offset the productivity trap. Particularly, since the concept of services has itself been suggested as the basis for a more sustainable economy (Ayres, 2008; Jackson, 1996): services are – potentially at least – less material-intensive and less-energy-intensive than products.

Much depends, of course, on what exactly we mean by services. In the UK, aside from financial services, the service-based economy has largely meant the expansion of retail distribution a fast-moving leisure sector, which is itself rather carbon intensive. These developments have stimulated rather than depressed the tendency towards material consumption patterns. Particularly once imported goods are taken into account, material and ecological dependencies (e.g. carbon emissions) are still rising in the UK rather than falling (Druckman and Jackson, 2009).

In spite of these counterexamples, there are numerous possibilities service-based economy activities which are less materials-intensive and intrinsically more labour intensive than conventional activities. Selling 'energy services' rather than energy supplies, for example. Selling mobility rather than cars. Recycling, re-using, leasing, maybe.

In fact, the seeds for such an economy may already exist in thriving local or community-based social enterprises: community energy projects, local farmers markets, slow food cooperatives, sports clubs, libraries, community health and fitness centres, gardening, local repair, maintenance and refurbishment services, craft workshops, writing centres, community music and drama, local training and skills, hairdressing, gardening and conservation (McKibben, 2007).

In formal terms, these enterprises represent a kind of Cinderella economy (Jackson, 2009) that often sits neglected at the margins of consumer society. Some of them scarcely even register in conventional economic accounts. Labour productivities are low – and the potential for labour productivity growth is low – because the activities themselves are often labour intensive. For instance between 1995 and 2005, labour productivity in the personal and social services sector (where many of these activities would be classified) declined by 3% across the EU 15 nations; the only sector to show negative productivity growth (Timmer et al., 2007).

From a conventional economic perspective this is seen as problematic. And yet this sector offers us an alternative way of resisting the downward pressure on employment in a non-growing economy.

Specifically, we can potentially maintain employment and reduce environmental impacts by shifting some of the focus of economic activities towards a 'green services' sector with lower environmental impact and slower (or even negative) productivity growth.

Of course, there will still be sectors where the pursuit of labour productivity growth continues to make sense. Some tasks are just not very pleasant. And to remain competitive in international markets, we would still need to ensure that labour productivity does not fall too far in key export (and import) sectors. All the same, there is a clear opportunity here for a relatively local 'green services sector' in which lower labour productivities and slower productivity growth relieve the pressure on jobs and provide forms of meaningful work that support community and sustain people's livelihoods.

4. An illustrative model for a low-carbon UK

To illustrate the combination of these two strategies for maintaining employment in a carbon-constrained economy, we constructed a simple simulation model of the UK economy, based on the production function equations set out in the previous section.¹ The model takes 2008 as its base year and projects the growth rates, carbon reduction and shares of the employment market in three distinct sectors of the UK economy:

- a conventional sector defined by labour productivity growth (1% p.a.) typical of the UK economy over the last ten years;
- a green infrastructure sector, characterised by the same (1% p.a.) labour productivity growth as the conventional sector but based on renewable, low-carbon technologies and infrastructures;
- a 'green services' sector with slightly negative (−0.3% p.a.) labour productivity growth based on the expansion of community based, resource light, low-carbon, service-based activities.

Labour force and unemployment (5.6%) are assumed to remain unchanged at their pre-crisis (2008) levels over the scenario period. The aim of the model is to show how progressive structural shifts towards the two green sectors might contribute to maintaining high employment while achieving the UK's carbon targets.

The expansion of both green sectors is linked to the rate of reduction of carbon emissions in the economy. The green infrastructure sector lowers carbon emissions across the economy as a whole by reducing the carbon intensity of energy supply infrastructures. The green services sector lowers carbon emissions in two ways: firstly by activities (renovation and refurbishment) which improve the carbon performance of buildings and secondly by shifting the basis of the economy towards low-carbon, resource-light, service-based activities.

In this paper, we present three scenarios from the model. In Scenario 1, there is a vigorous (5% per year) expansion of the green infrastructure sector, but no expansion of the green services sector and no reduction in working hours across the economy. In Scenario 2, the expansion of the green infrastructure sector is accompanied by a substantial (1.5%) year on year reduction in working hours across the economy. In Scenario 3, working hours are reduced at a more realistic rate (1% per annum) but the expansion of the green infrastructure sector is accompanied by a slightly higher (6% per year) expansion of the green services sector, sufficient finally to achieve the UK's carbon target (Fig. 1).

Economic output in Scenario 1 is consistent with a traditional growth-based model – though growing somewhat less rapidly than conventionally assumed, because we have assumed no growth in the labour force. Scenarios 2 and 3 both demonstrate 'de-growth' – negative growth rates in GDP during certain periods. However, the structure of economic activity (and of work) differs substantially between Scenario 2 and Scenario 3. In the former, degrowth is achieved only by reducing working hours substantially. The working week in 2050 is around half what it is today and the service sector remains undeveloped. In the latter, working time is reduced by about a third and there is a rapid expansion of the green services sector.

¹ The model was built using a dynamic simulation software platform known as STELLA.

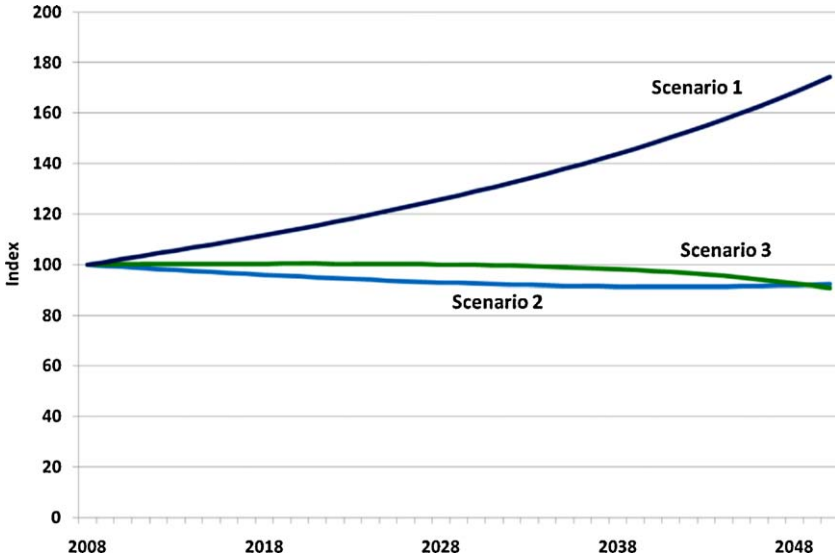


Fig. 1. Illustrative scenarios – UK GDP from 2008 to 2050.

In short, these scenarios illustrate the importance of both the mechanisms identified in the earlier section of this paper for escaping the productivity trap. They show how a vigorous policy aimed at expanding green technologies and supporting the Cinderella economy can protect employment and achieve the UK’s ambitious carbon targets, without relying on substantial year on year growth rates.

There are even more important differences between the scenarios in terms of carbon emissions, as Fig. 2 illustrates. While each scenario offers some reduction potential, only Scenario 3 meets the UK target of 80% reduction over 1990 levels by 2050.

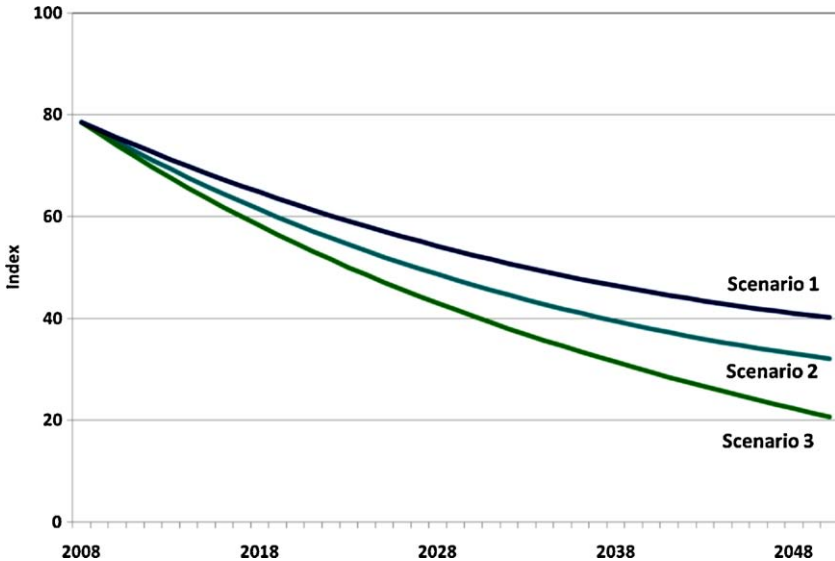


Fig. 2. Illustrative scenarios – UK carbon emissions from 2008 to 2050.

5. Concluding remarks

The aim of this paper has been to show how a twin-fold strategy – comprised of work-time reduction and a sectoral shift to ‘green services’ – might contribute to achieving carbon targets in the UK. The illustrative model described above shows how such a strategy might maintain full employment even while there is degrowth in the formal economy.

Several elements of our strategy remain unexplored at the present time. For instance, we have not addressed in detail the policy demands of such a scenario. Clearly, for instance, careful attention would have to be paid to wages policy in an economy with differential rates of productivity growth. Conventionally, wage increases tend to follow productivity growth. In a green economy of this kind, some income equalising mechanisms – including perhaps the idea of a basic citizen’s income – would be needed to prevent wage disparities from distorting social conditions.

Additional policies might be needed to incentivise the expansion of the Cinderella economy. Such policies could include tax deductions or preferential investment conditions for green services. New legal forms for Cinderella enterprises, building for instance on the 2005 Community Interest Company legislation in the UK, could strengthen the resilience of such activities against capital flight. Wider conditions, restricting moral hazard in capital markets, could reduce the unfair competition for capital created by destructive investments in material or energy intensive activities with high social costs.

This paper has focused on the question of labour (and labour productivity) in the transition to a sustainable economy. But there is another key area to address in a coherent ecological macroeconomics, namely the question of capital and capital productivity.

Capital investment is clearly a vital input to production. Investment maintains and improves production facilities. It provides for radical innovation that can revolutionise the productive capacity of the economy. And in particular it stimulates the continual increases in labour productivity.

The transition to a sustainable, low-carbon economy represents an enormous challenge. Above all, this challenge is about investment. It is about allocating sufficient resources to transform our economies fast enough that they do not completely undermine the prospects for prosperity in the future.

But clearly the target of investment would need to change. The traditional function of investment, framed around increasing labour productivity, is likely to diminish in importance. Innovation will still be vital, but it will need to be targeted more carefully towards sustainability goals. Specifically, investments will need to focus on resource productivity, renewable energy, clean technology, green business, climate adaptation and ecosystem protection.

It is not immediately clear what the impact of these investments might be on the growth potential of the economy as a whole, as conventionally measured. Investments in resource productivity are likely to have a positive impact on overall productivity. But they will not necessarily bring preferential returns over conventional investments unless the relative prices of labour and materials change substantially.

Some investments in renewable energy will bring competitive returns in some market conditions. Others will only bring returns over much longer time frames than traditional financial markets expect. Investments in eco-system enhancement and climate adaptation might not bring conventional financial returns at all, even though they are protecting vital ecosystem services for the future and may also be contributing to employment. But in the short-term, they appear to ‘soak up’ income without increasing economic output.

In short, we might say that ecological investment calls up a different ‘investment ecology’ or set of investment conditions. Capital productivity will probably fall. Returns will be lower and delivered over longer timeframes. Though vital for ecological integrity, some investments may not generate returns in conventional monetary terms. Profitability – in the traditional sense – will be diminished. In a growth-based economy, this is deeply problematic. For an economy concerned with a lasting sense of prosperity it need not matter at all.

These considerations point to the need for on-going work in a variety of areas. For instance, there is a need to understand the impacts on capital productivity, and to explore the relationship between capital productivity, resource productivity and labour productivity in more detail. The wider implications of these changes for capital markets will also need to be elucidated. More generally, this discussion raises

the challenge of building a genuinely ecological macroeconomics, in which economic stability can be achieved without relentless consumption growth.

In the long run, this new macroeconomics is likely to require capital markets which are configured around social and ecological returns, labour market policies (and wage policies) that shape sectoral transition, and public sector interventions to protect employment and nurture resilience in the Cinderella economy. It is legitimate to ask whether such an economy may still be construed as capitalist. It is beyond the scope of this paper to answer that question fully. Suffice it to point out that capitalism itself has many guises and forms; and that this new capitalism – if it may be called such – will look nothing like the insecure, debt-based consumer capitalism that led to the financial crisis. That may be no bad thing.

The broad conclusion of this paper is that the macro-economics of productivity is vital for understanding the transition to a sustainable economy. The modelling exercise here is highly exploratory, but it demonstrates that technology, work-time reduction and structural economic change all have a part to play in achieving carbon (and other environmental) targets. Further work is needed to explore the connotations of this finding in more detail.

References

- Ayres, R., 2008. Sustainability economics: where do we stand. *Ecological Economics* 67, 281–310.
- Beinhocker, E., 2005. *The Origin of Wealth: Evolution, Complexity, and the Radical Remaking of Economics*. Harvard Business School Press, Harvard.
- Booth, D., 2004. *Hooked on Growth – Economic Addictions and the Environment*. Rowman and Littlefield, New York.
- Druckman, A., Jackson, T., 2009. The carbon footprint of UK households 1990–2004: a socio-economically disaggregated, quasi-multiregional input–output model. *Ecological Economics* 68 (7), 2066–2077.
- Golden, L., Figart, D., 2002. *Working Time: International Trends, Theory and Policy Perspectives*. Routledge, London/New York.
- Hayden, A., 1999. *Sharing the Work, Sparing the Planet – Work Time, Consumption and Ecology*. Zed Books, London.
- Jackson, T., 1996. *Material Concerns: Pollution, Profit and Quality of Life*. Routledge, London.
- Jackson, T., 2009. *Prosperity Without Growth – Economics for a Finite Planet*. Earthscan, London.
- Jackson, T., 2010. Prosperity – An Economic Reality Check. TEDTalk, Oxford, http://www.ted.com/talks/tim_jackson.s.economic_reality_check.html.
- McKibben, B., 2007. *Deep Economy – The Wealth of Communities and the Durable Future*. Henry Holt & Co, New York.
- OECD, 2010. *OECD Factbook 2010: Economic, Environmental and Social Statistics*. Organization for Economic Cooperation and Development, Paris.
- Schumpeter, J., 1942. *Capitalism, Socialism and Democracy*. Harper, New York (reprinted 1975).
- Timmer, M., O'Mahony, M., Van Ark, B., 2007. EU KLEMS Growth and Productivity Accounts – Overview November 2007. University of Groningen, Groningen, p. 10, Table 1.
- Van Ark, B., O'Mahony, M., Ypma, G. (Eds.), 2007. *The EU KLEMS Productivity Report. Issue 1*. University of Groningen and University of Birmingham, p. 57, Table 1.
- Victor, P., 2008. *Managing Without Growth – Slower by Design not Disaster*. Edward Elgar, Cheltenham.