

A strategy for restoring confidence and economic growth through green investment and innovation

Dimitri Zenghelis

Policy brief
April 2012



Grantham Research Institute on
Climate Change and
the Environment



Centre for
Climate Change
Economics and Policy



Grantham Research Institute on
Climate Change and
the Environment

The Grantham Research Institute in Climate Change and the Environment was established in 2008 at the London School of Economics and Political Science. The Institute brings together international expertise on economics, as well as finance, geography, the environment, international development and political economy to establish a world-leading centre for policy-relevant research, teaching and training in climate change and the environment. It is funded by the Grantham Foundation for the Protection of the Environment, which also funds the Grantham Institute for Climate Change at Imperial College London. More information about the Grantham Research Institute can be found at www.lse.ac.uk/grantham



Centre for
Climate Change
Economics and Policy

The Centre for Climate Change Economics and Policy was established in 2008 to advance public and private action on climate change through rigorous, innovative research. The Centre is hosted jointly by the University of Leeds and the London School of Economics and Political Science. It is funded by the UK Economic and Social Research Council and Munich Re. More information about the Centre can be found at: www.cccep.ac.uk



Contents

Executive summary	2
1. Introduction	4
2. The global investment slump	5
3. Fear and saving in the rich world	9
4. The macroeconomic opportunity from utilising saving	12
5. Correcting market failures and creating new market opportunities	14
6. Why economies cannot afford <i>not</i> to pay short-term investment costs	15
7. Entrenching credibility by guarding against policy failures	16
8. The green race offers scale and long-term credibility	18
9. Credibility requires some public ‘skin in the game’	20
10. Conclusion	22
Annex 1	23
References	24

The Author

Dimitri Zenghelis is a Senior Visiting Fellow at the Grantham Research Institute at the London School of Economics and Political Science (LSE) and an Associate Fellow at Chatham House. He is also a Senior Economic Advisor to Cisco’s long term innovation group. Previously, he headed the Stern Review Team at the Office of Climate Change, London, and was a senior economist working with Nicholas Stern on the Review of the Economics of Climate Change, commissioned by the then Chancellor Gordon Brown. Before working on climate change, Dimitri worked at HM Treasury, where he was Head of Economic Forecasting and headed the European Monetary Union (EMU) analysis team. He provided regular briefings to the then Chancellor and Prime Minister. He has also worked at Oxford Economic Forecasting, the Institute of International Finance, Washington DC, and Tokai Bank Europe, London.

Acknowledgements

The author is grateful to Alex Bowen, Lucas Chancel, Baran Doda, Chris Duffy, Tim Foxon, Emmanuel Guerin, Cameron Hepburn, Michael Jacobs, Nick Robins, James Rydger, Michael Spackman, Thomas Spencer, Nick Stern and Bob Ward, although the views and arguments outlined in this brief are the sole responsibility of the author.

Executive summary

Most advanced economies need to stimulate economic growth to reduce deficits and debt, but growth requires investment, and investment levels have slumped to record lows relative to output. The longer recovery is delayed and capital sits idle, the more skills are lost and the higher the misallocation of resources, making it harder to restore growth.

Fiscal policy is generally constrained by the need to build or restore confidence in the sustainability of public debt and, with short-term interest rates close to zero, the effectiveness of monetary policy to stimulate growth is reaching its limits. So the question arises: can policy-makers do anything to improve the short-term economic outlook? Some have argued that deregulation will help stimulate business activity. Though this is likely to be correct in the long run, it may not have much effect in a severely demand-deficient environment. This paper argues that a powerful instrument to restore growth is clear and credible policy to encourage investment in welfare-enhancing activities that need public support to be commercially viable. The low-carbon and wider 'green' sector is taken as an exemplar field for this.

Standard macroeconomics and the economics of market failure tell us that the best time to support investment in such activities is during a protracted economic slowdown. Resource costs are low and the potential to crowd out alternative investment and employment is small. In addition, although public budgets are stretched, there is no shortage either of private capital available for investment, or of investment opportunities with potential for profitable returns. Investment has slumped mainly because households, businesses and banks are nervous about future demand, and have responded by forgoing more risky investment in physical capital. Instead, private agents are squirreling away record levels of private saving into 'risk-free' assets such as solvent sovereign bonds.

Desired saving has exceeded desired investment to such a degree that global real risk-free interest rates have been pushed to zero and below. These savings are losing value by the day as pension funds and financial institutions pay real interest to (rather than receive interest from) governments; a truly perverse state of affairs given the need for productive investment. These low rates do not reflect a collapse in the underlying returns to capital; they reflect desperately depleted confidence.

We are witnessing a classic case of the 'paradox of thrift', in which greater saving and cost-cutting in order to rebuild balance sheets is the rational response to economic gloom at the level of an individual business (which also sheds labour), bank (which restricts credit) and household. But when everyone retrenches simultaneously, fear of recession becomes a self-fulfilling prophecy, sustaining a vicious circle of low demand and low investment that affects the whole economy. Governments are currently limited in their ability to offset private saving by extra borrowing, but they do still have the power to restore confidence by using carefully chosen instruments to stimulate private investment.

The most appropriate area for government to target is investment that the private sector would otherwise under-provide or not provide at all. That is, sectors prone to so-called market failures, missing markets and externalities. It is argued in this policy brief that policies to encourage low-carbon investment offer broad and effective opportunities to restore confidence and to leverage additional, rather than displaced, investment. These policies would generate income for investors and would have credibility in the long term because they address growing externalities and market failures, while tapping into a fast-growing global market for resource-efficient activities. Infrastructure – for instance for energy generation, transmission grids and energy efficiency – offers particular opportunities for long-term returns to investors, while also promoting growth. Activities which make use of the rapid development of networked information and communications technologies – the main source of cross-sector productivity gains – offer particular opportunities to stimulate growth-inducing innovation.

The private sector is not heavily investing in green innovation and infrastructure because of a lack of confidence in future returns. The lack of confidence in this policy-driven sector is due to uncertainties surrounding current energy and environment policy. It is argued here that governments should incentivise such investment by themselves taking on elements of this policy risk. Because the public sector ‘controls’ this risk, there is a lot it can do to encourage investment. This should be seen as an opportunity. By backing their own low-carbon policies, governments can stimulate additional net private sector investment, and thereby make a significant contribution to economic growth and employment.

1. Introduction

Most advanced economies are still experiencing very weak growth following the downturn in the global economy in 2009-10. A note prepared by the International Monetary Fund, for a meeting in February 2012 of G20 Finance Ministers and Central Bank Governors, pointed out:¹

“The global recovery suffered a setback and despite recent improvements remains subject to major downside risks. Global activity will slow in 2012. The euro area is still expected to enter a mild recession, and other *advanced economies* are likely to experience weak and bumpy growth. In *emerging economies*, growth is expected to continue moderating, reflecting past policy tightening and adverse spillovers from advanced economies.”

Outlining its priorities for its Presidency of the G20 in 2012, the Mexican Government noted:²

“Several economies around the world are experiencing a deceleration of economic activity and the confidence of consumers and producers has deteriorated. A prerequisite for the restoration of growth is a recovery of private sector confidence, for which economic stabilization is crucial. At the same time, this must be complemented by structural reforms that lead to higher growth and employment in a sustainable manner.”

Hence, most advanced economies need to stimulate growth to reduce deficits and debt. But growth requires investment, and investment levels have slumped to record lows relative to output. The longer recovery is delayed and capital sits idle, the more skills are lost, and the higher the misallocation of resources, making it harder to restore growth. Fiscal policy is generally constrained by the need to build or restore confidence in the sustainability of public debt and, with short-term interest rates close to zero, the effectiveness of monetary policy to stimulate growth is reaching its limits.³ So the question arises: can policy-makers do anything to improve the short-term economic outlook?

But just how viable are green policies in the present economically-challenged environment?

The G20 has throughout the global financial crisis and economic downturn continued to emphasise the importance of growth being sustainable and ‘green’.

The Mexican Government emphasised that the economic priorities in 2012 for the G20 “have to be enclosed by a renewed political commitment to sustainable development and green growth”. The Communiqué from the meeting of Finance Ministers and Central Bank Governors in February 2012 recognised “the importance of ‘green growth’” and called for the Organisation for Economic Cooperation and Development, the World Bank and the United Nations to “provide options for G20 countries on inserting green growth and sustainable development policies into structural reform agendas, tailored to specific country conditions and level of development”.⁴

But just how viable are green policies in the present economically-challenged environment? This policy brief is intended to contribute to this discussion of policy options. It is argued here that a clear and credible policy to encourage investment in welfare-enhancing activities that need public support to be commercially viable would be a powerful instrument to restore growth. The low-carbon and wider ‘green’ sector is taken as an exemplar field for this.

1. See: <http://www.imf.org/external/np/g20/pdf/022512.pdf>

2. See: <http://g20mexico.org/images/pdfs/disceng.pdf>

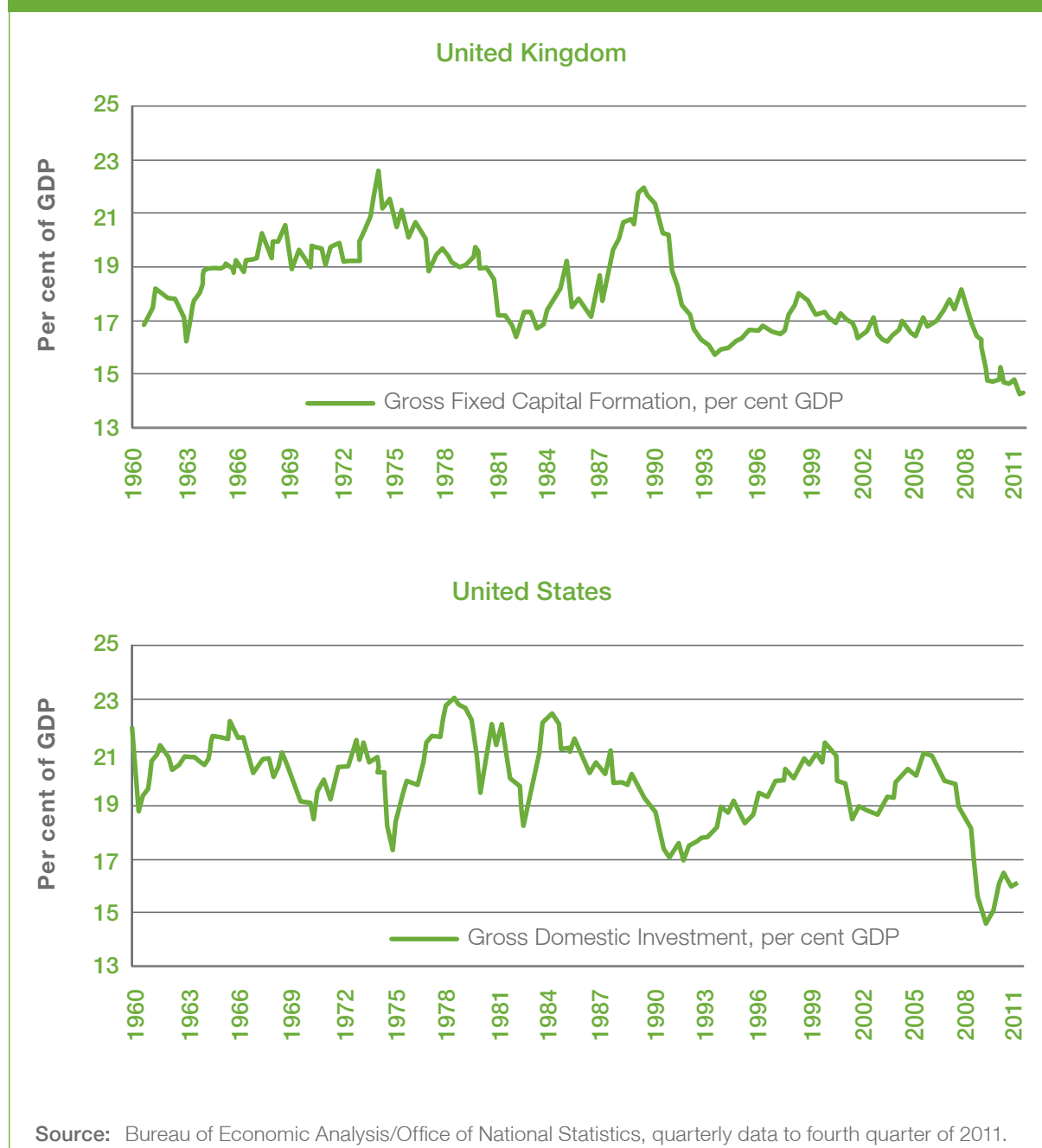
3. Though money creation through quantitative easing is still having an impact generally believed to be positive, if of uncertain scale, in many countries (Joyce *et al.*, 2011).

4. See: <http://g20mexico.org/en/news-room/press-releases/235-communiqué-meeting-of-finance-ministers-and-central-bank-governors>

2. The global investment slump

Growth requires investment, but investment levels are close to record post-war lows in most OECD countries. Figure 1 shows a sharp fall in investment as a percentage of GDP in the United States and United Kingdom, a picture common to most the developed economies including those in the Eurozone.⁵

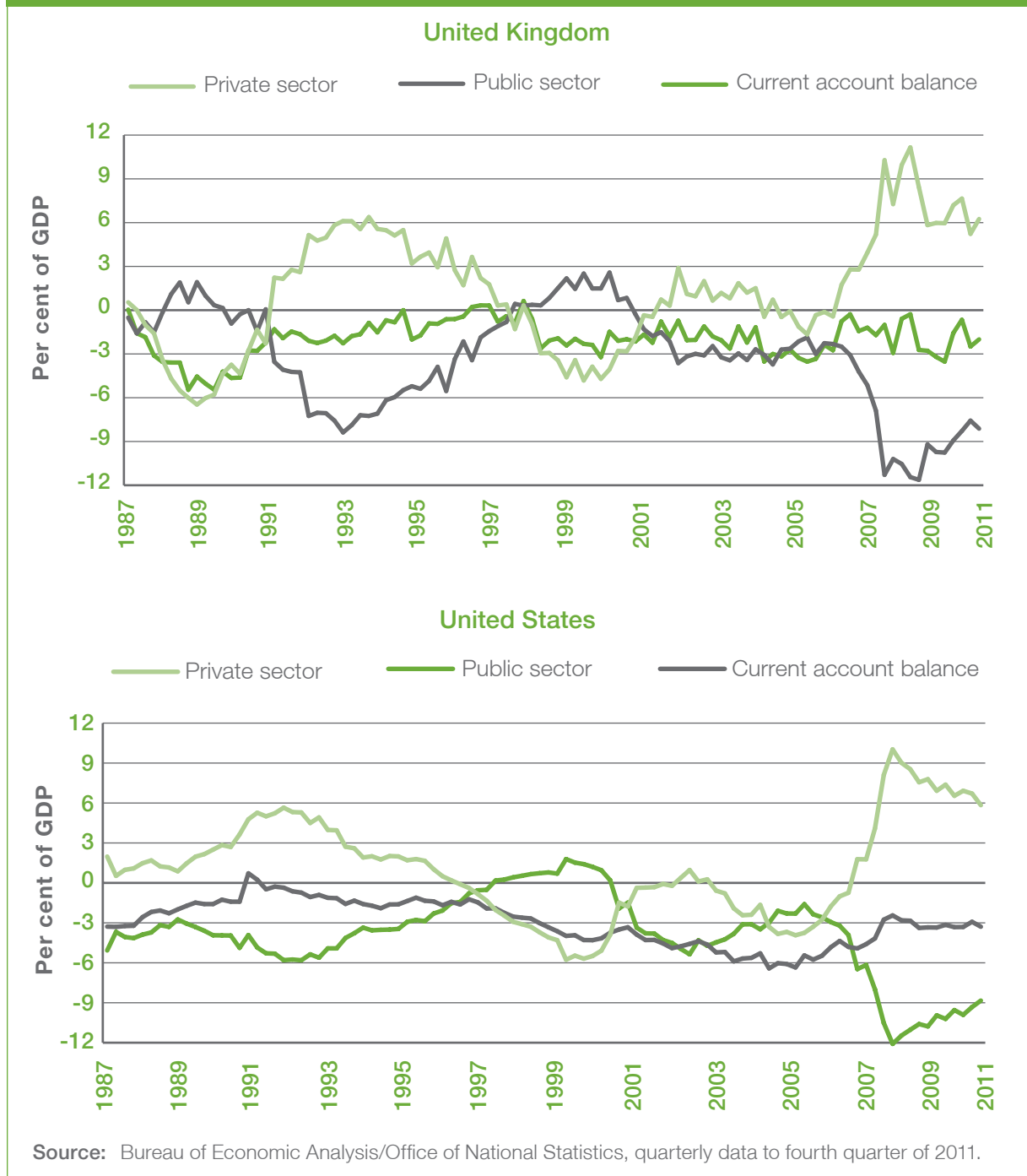
Figure 1 Fixed investment



5. Figure 1 shows total fixed investment, but private non-residential investment and 'business investment' are also at record lows. In the United States, private non-residential investment is at its lowest level as a proportion of GDP since the early 1960s while in the United Kingdom, business investment is at its lowest level since the series began in 1997.

Instead of investing, households, institutional investors and many businesses in most advanced economies are struggling to restore their net worth following the global downturn. Many are choosing to hoard savings in assets earning zero or negative real interest rates in 'risk-free' securities.⁶ They simply do not feel confident enough to invest in more risky productive assets because of continuing doubts about the resilience of future demand.

Figure 2 Sector financial balances (net lending)



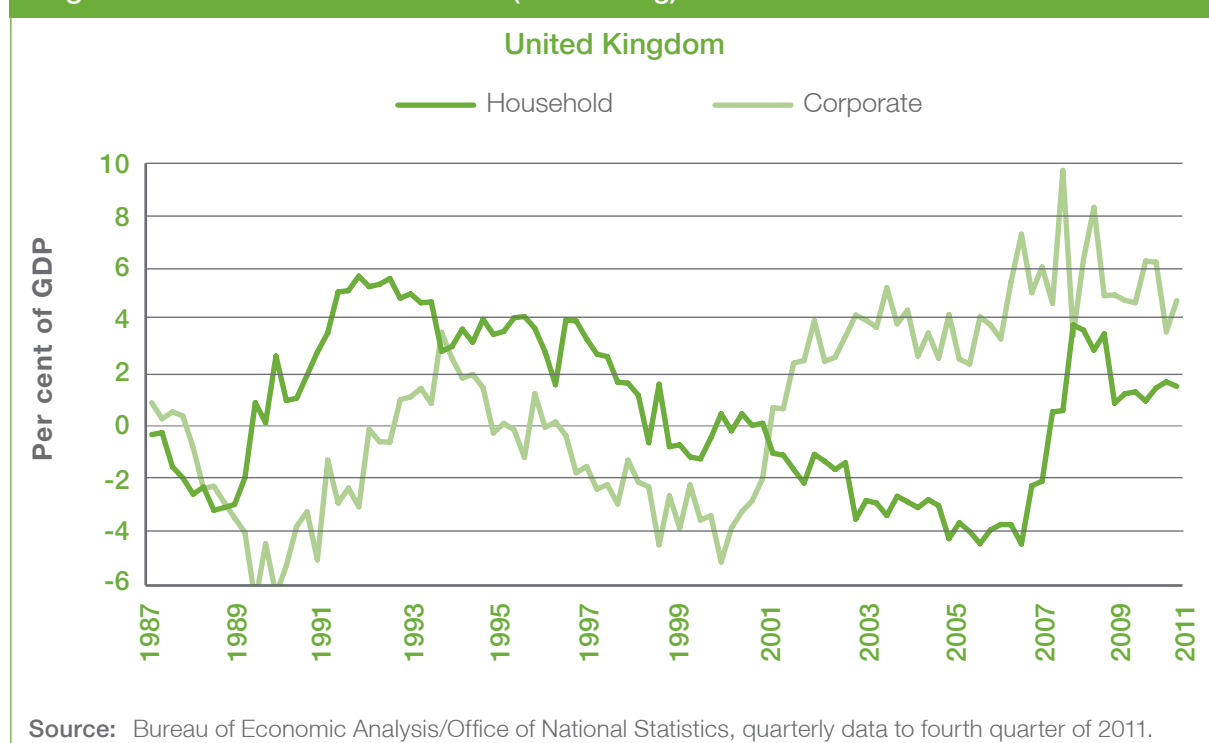
6. For example, with UK inflation close to 3 per cent, real yields on short-dated HM Treasury paper remain negative: see: <http://markets.ft.com/research/Markets/Bonds>.

Figure 2 shows net lending/borrowing positions (the excess of saving less investment or, equivalently, income less expenditure) of the private and public sectors.⁷ These are at close to record levels. Just as the public sector is borrowing like never before, the private sector is saving like never before. The private sector in the United States alone generated a record post-war surplus of \$1.2 trillion in 2009, falling to \$1.1 trillion in 2010 and \$1.0 trillion in 2011; while in the United Kingdom, the private sector surplus was £135 billion in 2009, falling to £95 billion in 2010 and £99 billion in 2011 respectively (Figure 2).

Just as the public sector is borrowing like never before, the private sector is saving like never before.

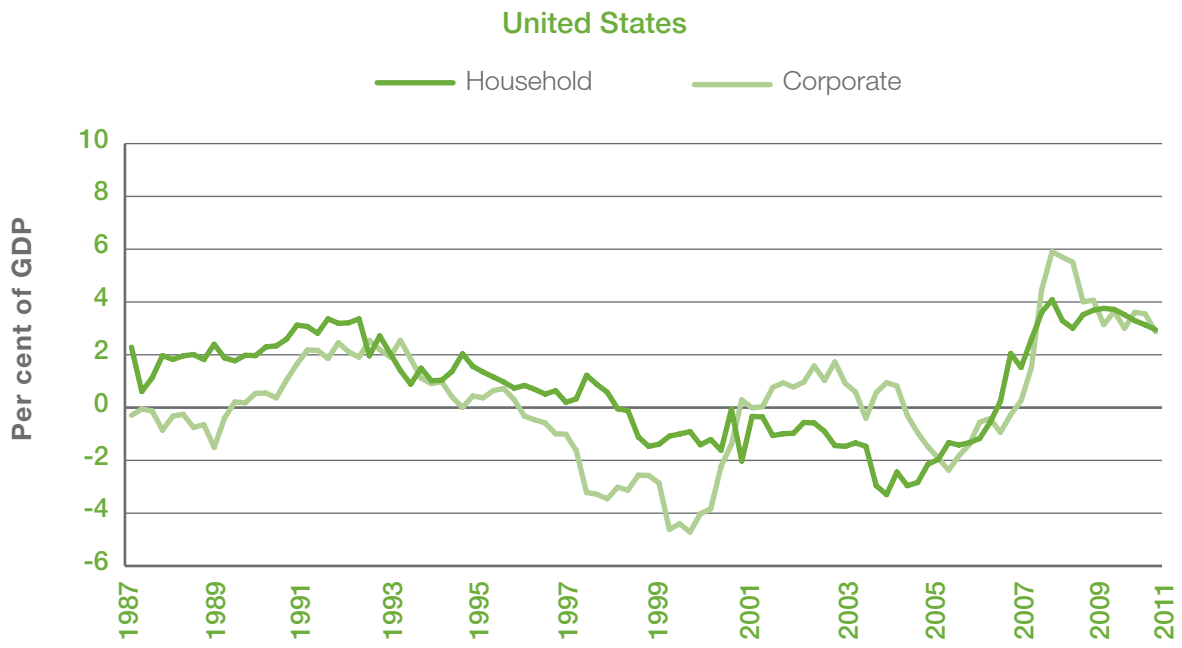
The symmetry between the private and public sector net lending positions is immediately obvious and is no coincidence. The sharp swing over the last four years reflects the fact that as spending, income and profit growth fell after the financial crisis, so too did tax revenues, while welfare-related spending rose.⁸ Figure 3 breaks down private sector net lending into businesses and households. The most notable feature is the level of financial surpluses within the business sector. This reflects the collapse in investment as businesses chose to save cash rather than to reinvest earnings.

Figure 3 Sector financial balances (net lending)



7. The current account aggregates both balances and measures the excess of saving over investment (income over spending) at the level of the whole economy i.e. the balance that needs to be lent to, or borrowed from, abroad.
8. Additional discretionary borrowing to stimulate the economy also helped swell global public deficits, though most estimates suggest that the fiscal deterioration has been 'automatic' or 'cyclical' rather than 'structural' or 'underlying' (Krugman and Wells, 2010). Estimates of structural fiscal balances before and after the crisis have subsequently been revised towards deficit in line with downward adjustments to estimates of trend output, but the swing in the balances remains mostly cyclical (OECD World Economic Outlook, tables 2008-2011).

Figure 3 Sector financial balances (net lending) (continued)



Source: Bureau of Economic Analysis/Office of National Statistics, quarterly data to fourth quarter of 2011.

3. Fear and saving in the rich world

Macroeconomic policy now threatens to prolong the recession unnecessarily. The world is currently experiencing the so-called ‘paradox of thrift’. This describes how responding to economic uncertainty by focusing on austerity, cost-cutting and saving to rebuild balance sheets makes perfect sense in terms of good-housekeeping at the level of the individual. It also makes sense for a business, bank or the state. However, when everyone retrenches simultaneously, the collective macroeconomic impact can be disastrous. As spending is cut, businesses postpone investment and shed labour, and banks restrict credit for all but the safest activities. Fear of recession then becomes a self-fulfilling prophecy.⁹ This ‘multiplier’ erodes balance sheets and confidence further and prompts another round of retrenchment. The longer recovery is delayed and capital sits idle, the more skills are lost, and the higher the misallocation of resources, which makes it harder to restore growth.¹⁰

Macroeconomic policy now threatens
to prolong the recession unnecessarily.

When the private sector is aggressively paying down debt, the best way to avoid a deep recession is for the government to move in the opposite direction and dissave. Indeed, with the public sector acting as ‘borrower of last resort’ as the private sector retrenched, the ballooning budget deficits of recent years were essential in avoiding a global depression.¹¹ But high public debt levels have raised questions over the willingness or ability of future governments to pay off the debt, with the consequent threat of default, rescheduling, or ‘monetisation’ of the debt through inflation. The cost of such uncertainty manifests itself in a loss of investor confidence and higher bond rates for vulnerable countries.¹²

9. For an interesting account of the application of the *paradox of thrift* in the banking sector in the recent downturn, see Martin (2010).

10. *ibid.*

11. The recent fiscal deterioration has been driven by the extended economic slowdown, which is itself a function of the private sector saving more at a time when there are not enough perceived opportunities for profitable risk-adjusted investment to attract borrowers. Had the public sector not automatically borrowed to offset this reduction in private spending out of income, demand in the economy would have fallen further with dire consequences for output and jobs.

12. This is notably evident in the recent experience of Greece, Ireland, Portugal and latterly Italy (although the inability of these countries to devalue their currencies within the Eurozone has heightened their vulnerability). Economists such as Taylor (2009, 2010b, 2010c) believe that discretionary, rather than ‘automatic’, public sector borrowing is misallocating capital in a way that will hinder real wealth creation, and crowd out private investment when the recovery begins. This is because distortionary taxes and interest rates will have to rise further and faster than would otherwise have been the case (see also Baxter and King, 1993; Bowen and Stern, 2010).

Part of the blame for the present situation rests with policy-makers across the world who failed to take sufficient action to reign-in the build-up of private debt during the preceding economic boom. Policy failed to offset excess confidence, indebtedness and asset price valuation during the boom, perhaps inevitably given institutional structures and short-term electoral incentives. Apart from lax levels of bank regulation and supervision, macroeconomic policy was generally too loose, with many governments running current budget deficits during the years when private saving ratios were falling sharply and asset prices were unsustainably inflated.¹³ As a result, underlying structural public sector deficits were, in many countries, largely ignored, masked by unsustainably high revenues and low public spending which were assumed to be structural when in fact they were cyclical. At the same time, central banks seemingly followed an asymmetric policy path of cutting interest rates aggressively when recession threatened, but raised them only tentatively when demand and asset values soared. When the bubble finally burst, over-leveraged positions were exposed, asset prices fell and ballooning private debt was transferred to the public sector. This happened directly, as governments bailed out banks, and indirectly as individual and corporate tax revenues collapsed and welfare spending soared.¹⁴ This legacy of excess debt is the reason governments are limited in their ability to borrow to offset private saving in a way that might have been possible had underlying structural balances been more sustainable (Baxter and King, 1993; Bowen and Stern, 2010). But this does not mean that policy-makers are powerless today.¹⁵

When the bubble finally burst, over-leveraged positions were exposed, asset prices fell and ballooning private debt was transferred to the public sector.

Despite the demand for billions of dollars to fund high public sector deficits in many rich countries over recent years, real ‘risk-free’ interest rates have tumbled and are negative over a 10-year horizon (Table 1). The world is awash with liquidity and in real terms, with inflation positive, the governments in the United States, United Kingdom and other advanced economies are being paid interest on their lending for 10 years! This is because a lack of appetite for investment means growing public sector demand for funds is more than matched by an even faster growing pool of desired net private saving.

-
13. Household saving ratios in the United States and United Kingdom fell to record lows prior to the crash: in the United States it was 1.5 per cent of total resources in 2005 compared to a 7.2 per cent average since 1952; a low of 3.1 per cent in 2006 and 2008 in the United Kingdom, compared to an average of 7.6 per cent since 1963). This was directly associated with the rise in asset prices. Rising asset prices and lower saving reflected increased confidence in the future. Improved household net worth went hand-in-hand with lower saving. In some cases this took the form of mortgage equity withdrawal using rising house prices as collateral for extending loans for current consumption. Though it is commonly reported that economists did not see this coming—and many did not—many economists in government and businesses across the world did warn repeatedly of unsustainable macroeconomic pressures. Many economists, such as Nouriel Roubini, warned of unsustainable imbalances from early in the new millennium.
 14. Having seen their wealth eroded by asset price falls during the recent financial crisis, the private sector understandably postponed investment and began to repay debt to rebuild net worth. As spending, income and profit growth fell, so too did tax revenues, while welfare-related spending accelerated. Combined eventually with discretionary borrowing to stimulate the economy, this swelled global public deficits. As Martin Wolf (2012) sets out, Spain’s fiscal difficulties are more a consequence of the crisis than a cause. The country experienced huge rises in private debt after 1990, particularly among non-financial corporations. The overhang of residential construction also rules out substantial household borrowing. The sharp rise in government debt represented a shift of imbalances from the private to the public sector. Attempts to reduce public indebtedness will, Wolf rightly argues, result in a far deeper recession, along with little progress in reducing actual fiscal deficits.
 15. Monetary policy is also running up against limits. Quantitative easing has been invoked with unknown effect. Objective estimates of the appropriate monetary policy stance as indicated by the ‘Taylor Rule’ suggest current policy rates constrained by the zero bound remain well above recommended levels (Zenghelis, 2011; and also Chancel *et al.*, 2012).

Table 1 Daily United States Treasury yield curve rates (March 2012)

Date	1 month	3 month	6 month	1 year	2 year	3 year	5 year	7 year	10 year	20 year
29 March 2012	0.02	0.07	0.14	0.18	0.33	0.50	1.01	1.57	2.18	2.93

Source: United States Treasury.

These low rates do not reflect an underlying multi-decade-long collapse in the return to global capital. Instead, they are the numerical manifestation of a lack of private confidence. This has driven the surge in desired saving and the collapse in desired investment. A further indirect but quantifiable measure of the current lack of confidence is the relationship between interest rates and asset prices. In normal circumstances, low real interest rates would push up demand for income-generating assets so that their price relative to projected earnings would rise. Yet the reverse has happened. The expected price earnings ratios in Standard and Poor's 500 have actually fallen to around 13 times earnings, compared to an average of 19 since December 1989 and peaks nearer 30 at the end of the booms that collapsed in 2001 and 2008 (Figure 4), reflecting underlying pessimism over future markets.

In normal circumstances low real interest rates would push up demand for income-generating assets so that their price relative to projected earnings would rise. Yet the reverse has happened.

Figure 4 Low interest, low confidence in productive assets

Standard & Poor's 500 Price Earnings Ratio



Source: Standard & Poor's. Data of spot prices taken at the end of every month.¹⁶

16. www.marketattributes.standardandpoors.com. Forward estimates reported from 31 December each year based on Capital IQ consensus estimate for specific share issue, building from the bottom up to the index level estimate.

4. The macroeconomic opportunity from utilising saving

The presence of spare capacity and a pool of private saving means now is a particularly cost-effective time to invest in growth. Factor resources, especially labour, are underemployed and global capital is available to solvent governments on extremely favourable terms.¹⁷ So the primary task for policy-makers seeking to arrest the current economic malaise and incentivise private capital to invest in productive growth-inducing investments must be to restore confidence in specific sectors and the economy as a whole.¹⁸

As the scope for effective counter-cyclical fiscal policy based on tax cuts or spending increases is limited by such concerns about the sustainability of debt, it is vital that policy-makers use other instruments designed to stimulate demand and leverage private investment. Governments are not powerless when it comes to creating new markets, even when public borrowing is constrained. They can still steer spending and investment through a mix of policies including pricing, regulation and institutional reform.¹⁹ But which policies, and targeting which sectors?

The presence of spare capacity and a pool of private saving means now is a particularly cost-effective time to invest in growth.

-
17. Capital may not be available on favourable terms to many businesses, especially smaller ones, precisely because the current economic environment means lenders demand a higher risk premium, or apply outright credit rationing, to provide cover for general economic uncertainty.
 18. In an open letter to United States President Franklin Roosevelt 75 years ago, John Maynard Keynes wrote: “the business world must be induced, either by increased confidence in the prospects or by a lower rate of interest, to create additional current incomes in the hands of their employees, which is what happens when either the working or the fixed capital of the country is being increased; or public authority must be called in aid to create additional current incomes through the expenditure of borrowed or printed money”. This policy brief focuses on the first option, recognising growing limitations in the second.
 19. To understand the potential returns to public intervention in an environment characterised by uncertainty and depressed confidence, take the following example. The classical Keynesian story describes one route out of demand-deficient recession by employing people to dig up holes and fill them in again. From an individual level this makes no sense. How is it that people are to become wealthier in an activity which is clearly wealth-destroying? The answer is that it could raise activity by helping unwind the paradox of thrift. Of course Keynes did not actually favour pointless hole-digging. He merely made the point that the multiplier works even if the form of spending that sparks off a ‘multiplier episode’ is entirely pointless. In the first instance, those paying workers to dig up roads, through taxes or road tolls or utility prices, might offset this by reducing their spending elsewhere, but the offset is unlikely to be full. And as the ‘hole-diggers’ spend their wages on other goods and services, workers and business owners elsewhere would witness a rise in spending on their goods and services. They too are likely to respond to this by hiring more labour (or keeping on labour), paying extra wages (or not cutting them), and investing in new capital. The consequences of a policy which most people would consider to be utterly mad, could be collectively advantageous, just as the collective consequence of an action which most people would consider to be entirely rational (saving more when times get tough) has been collectively disastrous.

- First, the most appropriate target for government is activities for which financial viability is dependent on public sector involvement. That is, activities prone to **market failures and externalities**. These are usually within sectors where the private sector would otherwise under-invest or not invest at all. The financial returns derived from a credible public commitment to such activities are, by definition, highest because policy risk is often the key deterrent to investors. Policy credibility can effectively ‘make or break’ confidence about whether the activity is commercially viable.
- Second, targeted activities should be **large enough in scale** to create significant employment and boost collective confidence. An obvious field on which policy should be focused is infrastructure. Infrastructure investment has three advantages: it tends to create largely domestic jobs relatively quickly; it is growth-stimulating in the medium and long-term; and it offers low risk, long-term returns for institutional investors. Income-generating infrastructure includes energy, water, waste, high-speed internet, housing, rail and tolled roads.
- Third, policy should be targeted at fields that are credible in the long-term so that **investors can be confident of sustained market growth**. Ideally, it should seek to stimulate innovation and productivity growth which can contribute to long-term growth. For example, sectors which can make use of the new ‘smart’ distributed networks, enabled by the revolution in information and communications technology and biotechnology, offer particular opportunities – this is where the largest cross-sector productivity gains and cost reductions continue to arise (Zenghelis, 2011b).

5. Correcting market failures and creating new market opportunities

Policies designed to build a green economy address different externalities and market failures. These have been outlined in detail in previous analyses and a shortlist is summarised in Annex 1 (Romani *et al.*, 2011; Zenghelis, 2011b). But they provide a firm underpinning for long-term public policy intervention in this fast-growing field. Almost all sectors are involved and the potential impact of policy is global and very large. Different market failures point to different policy instruments, so long as the collection of policies is mutually reinforcing.

Most climate policies will straddle a number of imperfections – for example feed-in tariffs and carbon floor prices help to price greenhouse gas emissions, support deployment and innovation and reduce policy risk. Mandatory efficiency or emissions standards, building regulations, and investment banks also straddle many market failures including information asymmetries, the external costs of local and global pollution, and energy security. Physical standards can provide clarity, promote scale and reduce uncertainty (King, 2008). Carbon floor prices can reduce uncertainty, price greenhouse gases and raise public revenue. Experience of environmental and low-carbon policy over the last two decades provides strong evidence that a coordinated policy mix to address a variety of market failures, if well directed by stable and strong institutions, can deliver significant investment in environmental improvement and induce investment in new technologies (Otto and Reilly, 2008; Aghion *et al.*, 2009; Fischer and Newell, 2008).

Different market failures point to different policy instruments, so long as the collection of policies is mutually reinforcing.

Policy should be consistent and coherent in its application with a minimum of overlapping instruments.²⁰ Effective policy should harness the dynamics of change and learning in order to stimulate innovation and productivity growth, through an understanding of the process of 'endogenous growth' and creative destruction (Peres, 2002; Stern, 2012). Finally, policies should build on existing frameworks, not least because this opens up policy options that could be quickly operated. For example, in the European Union this could start with tightening the Emissions Trading Scheme and raising the overall target for 2020 to an emissions reduction of 30 per cent, as well as implementing new mandatory energy efficiency standards and policies to hit the target of a 20 per cent improvement by 2020.

20. For example, adding supplementary measures to countries or sectors within a regional cap-and-trade scheme may require measures such as tightening the overall cap (or broadening its reach) to preserve scarcity of certificates in sectors within the scheme, but not subject to the supplementary measures (see: Fankhauser and Hepburn, 2010).

6. Why economies cannot afford *not* to pay short-term investment costs

But the question will surely be asked, is this the best time to introduce stronger environmental policies? Surely loading higher costs on the economy in the depths of an economic slowdown is exactly the wrong goal? Of course, environmental interventions will change relative prices and the structure of demand. Many green solutions are financially more expensive than conventional alternatives, especially in terms of early capital costs. And most investments, even those which clearly cut costs in the long run, such as energy efficiency, require some additional up-front investment. Indeed, all policies designed to boost demand when the economy is operating below capacity incur costs. This is standard macroeconomics. In the past, building dams, expanding electrification, or military rearmament have arguably helped advanced economies out of recession.²¹ Many have increased costs such as energy bills to pay for the investment. Debt-financed or equity-financed capital had to come from someone's net saving.²²

But the question will surely be asked, is this the best time to introduce stronger environmental policies?

In a demand-deficient environment, businesses are not primarily constrained by excessive costs (indeed capital, labour and raw materials remain relatively cheap). They are constrained by a lack of perceived demand. In normal circumstances when the economy is operating close to capacity, rising costs would reduce factor efficiency and undermine productivity, green jobs would replace other jobs, and green investment would crowd out alternative productive investment. But when resources are underemployed, such activity can be largely additional and an important part of correcting the imbalance, generating positive returns and overcoming the vicious confidence cycle. More broadly, presenting challenges and targets to businesses can also help breed innovation when high-skilled labour is otherwise underutilised. Economic recessions are drivers of creative destruction in innovative sectors; genius is also found to be underemployed. Microsoft, Nokia and Research in Motion were all born, or reborn, during a downturn. Indeed, over half of the companies on the 2009 Fortune 500 list began during market downturns (Pilat and Wyckoff, 2010). Economic crises breed innovation and entrepreneurship, which in turn provides the spark for a subsequent resurgence in productivity and growth.

21. Krugman (2011) makes the same argument using the example of spending money on defending the world from an invasion by aliens from outer space which turns out to be a false alarm, but as a result of which the slump is over in 18 months (http://www.huffingtonpost.com/2011/08/15/paul-krugman-fake-alien-invasion_n_926995.html). Indeed, the 20th Century is replete with examples of wars ('hot' and 'cold') that have helped get economies out of a hole. After the Kobe earthquake in 1995, Japan's GDP rebounded strongly, bucking the trend in what was later dubbed Japan's 'lost decade'. GDP expanded by almost 1 per cent quarter-on-quarter in the nine months after the earthquake as the rebuilding effort gathered momentum. Of course digging holes and filling them in, or declaring war on your neighbours, would make for wasteful policy. Policy can be brought to bear in far more constructive ways, spurring spending and investment in useful areas while stimulating a stronger multiplier, backed by policies that are credible in the long term. Higher energy costs which are recycled as spending ought to have a net stimulatory effect through the 'balanced budget multiplier' effect. This describes spending funded by money withdrawn out of income, part of which would otherwise have been saved. In a demand-deficient environment, this lost saving is unlikely to be fully made up for by consumers.

22. A key issue that needs to be considered is the distributional impact of raising costs, for example the effect on safeguarding against fuel poverty for those on low incomes. Also, awareness of the realities of political economy is required – some of the potential losers in high-carbon sectors have political clout and will seek to delay or prevent policy that may be in the broader public interest.

7. Entrenching credibility by guarding against policy failures

Intervention is the opposite of distorting when applied to sectors in which, in principle, government intervention is pro-market; that is, where market failures are corrected. But the intervention needs to be well-designed in order to avoid replacing market failure with policy failure (Hepburn, 2010). Expectations play a crucial role in influencing investor behaviour and establishing credibility takes time, so it is critical that policy-makers think carefully about policy design.

Intervention is the opposite of distorting when applied to sectors in which, in principle, government intervention is pro-market...

Price signals to internalise resource externalities remain the most efficient means to ensure productive investment.²³ In particular they generally avoid discriminating between technologies and processes, while encouraging competition within sectors and offering little scope for rent-seeking.²⁴ Policy should be sufficiently stringent to change behaviour, and predictable in order to contain policy risk, yet simple and flexible in evolving to changing circumstances while limiting compliance costs (Bowen, 2011; Helm, 2010). Simple policy regimes with fewer overlapping instruments are harder to 'capture' and more likely to improve the transparency and effectiveness of policy (Fankhauser and Hepburn, 2010). The administrative burden of new regulations should be closely monitored. Standards should be designed carefully to avoid unintended consequences, for example where mandatory biofuel targets encourage undesirable land-use change (King, 2008).

Policies should be as neutral as possible, to allow a broad range of technologies to emerge and compete, and to avoid the problem of governments attempting to 'pick winners'. However, governments cannot avoid making some choices, given that there are a range of technological options that will be available over the coming decades and some technologies have specific barriers and opportunities that may require targeted assistance (Fisher, 2009). In addition, dispensing financial support for research, development and deployment is likely to be far more effective when combined with 'demand-pull' policy frameworks designed to create new markets in which private innovators can expect a secure future revenue stream, as discussed previously. Just as a space race or military-industrial commitment can induce innovation, so the setting of green challenges can be expected to create substantial knowledge-spillovers, boosting Schumpeterian innovation and productivity across a broad number of sectors (Mazzucato, 2011; Perez, 2009; Pearson and Foxon, 2012).

23. Policy-makers are unlikely to be very good at anticipating where and when the key technological breakthroughs are going to arrive, so the emphasis should be on policy instruments with broad application – another reason why carbon pricing is key because it provides a pervasive incentive to introduce low-carbon technologies (Aghion *et al.*, 2010).

24. Rent-seeking occurs where vested interests influence policy-makers in order to maximise the benefits (or minimise the loss) to them from policies. Such groups (industries with a market stake in proposed legislation) tend to be more politically influential and focused than the more diffuse potential gainers from public policy (consumers and citizens), spurring a costly process of 'capture'. The scope for vested interests to lobby government will consequently be enhanced in such circumstances and policy must be carefully designed to minimise the scope for a 'technology pork barrel', (Cohen and Noll, 1991). For a comprehensive discussion of the scope for policy failure and capture by vested interests, see Helm (2010). Moreover, among producers, lobbying is likely to be skewed towards 'losers' rather than 'winners' (see Baldwin and Robert-Nicoud, 2002).

Undermining official policy and institutions by not securing credibility among private investors is another example of policy failure. A credible carbon policy must provide a degree of security that commitments will be met (Helm *et al.*, 2003). Yet policy must be set in the face of known uncertainty (about technology costs, taste and preferences, climate science and political preferences). This requires policy based on clear rules for review and revision so that the private sector can operate against a known public sector reaction function (where the public sector responds to surprises in a predictable manner). The public sector will need the flexibility to learn from and revise policy accordingly, and to draw on experience in the design of utilities regulation. Most importantly, stable rules that are not changed retroactively are a necessary condition in order to provide an appropriate risk-adjusted return to induce private capital to flow to low-carbon investments. The government must convince businesses that it will not renege on its commitments once investment costs are sunk.

A credible carbon policy must provide a degree of security that commitments will be met. Yet policy must be set in the face of known uncertainty...

8. The green race offers scale and long-term credibility

It is precisely the overwhelming and growing long-term need to address numerous market failures through transformational investment and innovation that has the potential to make the opportunity from intervention so credible. 'Green' investment is also large-scale and offers potentially profitable markets for decades. It can therefore leverage in serious private money.²⁵ As a result, much of this private investment should be additive (rather than displaced from elsewhere), helping to break out of the deflationary confidence spiral, much as Roosevelt's New Deal did in the United States from 1933.²⁶

Investors recognise that huge opportunities are presenting themselves as the world strives to become resource-efficient and carbon-constrained. HSBC forecasts the global low-carbon energy market will triple to US\$2.2 trillion by 2020.²⁷ This is not science fiction. A highly competitive 'green race' has begun with South Korea, China, some parts of Europe, and California in the lead. Mainland China's share of the global low-carbon market is forecast to grow from 17 per cent today to 24 per cent by 2020, moving ahead of the United States (HSBC, 2010).²⁸ Competition for market share will be strong. South Korea is showing leadership with its five-year plan for green growth 2009-2013.²⁹ After being hit by the slowdown in 2008 and 2009, South Korea's economy expanded by 6 per cent in 2010 and was growing healthily into 2011. Even in the United States, the green stimulus packages implemented under the American Recovery and Reinvestment Act (2009) since 2008 brought significant employment, environmental and innovation benefits. Green investment accounted for 10 per cent of the overall Recovery Act's employment creation, according to Aldy (2012). But, crucially, Aldy argues that the stimulus effects of the United States green investment package under the American Recovery and Reinvestment Act were diminished by the absence of a stable, demand-side public policy framework to accompany the supply-side push and to create private confidence in the green sector.

25. Examples can be found across the world, from green measures in South Korea, to energy efficiency and carbon emissions targets in China, to urban planning in Barcelona, Portland and Stockholm, to feed-in tariffs in Germany, the United Kingdom and Spain.

26. It might be countered that in order to incentivise the private sector to spend, government action is likely to be more successful in pump-priming familiar activities that private investors can understand better and others where market failures are less rife (so that expected returns are less dependent on long-term consistency of government action). But if the private sector is not confident that private demand will support such familiar activities, it is not obvious how public involvement will help unless the public sector indefinitely commits to pumping large sums of taxpayer money into these markets. On the other hand, if the market depends on credible government action, then the private sector can at least invest with confidence in a secure market sheltered from fickle private sentiment.

27. It is hard to estimate the size of the green economy or to precisely delineate and define the green sector. A broad measure might include energy efficiency, energy generation, smart grids, transport networks and urban planning and any process or activity that reduces the carbon intensity of production and consumption. So the scope for transformative innovation is broad, especially if the innovation is aligned with advances in information and communications technology and policy generates a degree of creative destruction to meet new constraints.

28. See HSBC (2010). China has embraced high-tech, low-carbon growth, notably in its 2008-2009 stimulus package and in its outline for the 12th Five-Year Plan. Of the seven "magic growth sectors" identified in the Plan, three are low-carbon industries: clean energy, energy efficiency, and clean energy vehicles; other sectors include high-end manufacturing (see Stern, 2011).

29. It plans to allocate 2 per cent of GDP to reduce greenhouse gases, improve energy security, and promote new engines of economic growth. The target is to increase South Korea's share of global clean technology exports from 2 per cent to 8 per cent by 2012.

As well as providing a market opportunity in one of the world's fastest-growing and most durable markets, green energy-efficient infrastructure can help countries to meet climate targets (which are currently under threat due to low carbon prices and weak investment), to reduce long-run energy costs, and, in many cases, to improve energy security.³⁰ The final advantage is that such policy can be fiscally undemanding (even neutral). Green policies do not require significant public spending. Carbon pricing can raise revenues, while standards and regulations can change producer and consumer behaviour at little cost to the public purse.³¹

Green policies do not require significant public spending.

30. Renewable energy has high (though in many cases falling) capital costs, but its zero feedstock cost offers a hugely valuable insulation from commodity price risks, as well as from the political insecurity of oil and gas supply.
31. It is also worth noting that, in principle, the revenues raised from environmental taxes or auctioned permits can be used to reduce distortionary taxes elsewhere in the economy.

9. Credibility requires some public 'skin in the game'

The public sector will, however, have to commit some resources if it is to make a strong green investment policy credible. This is because in many countries, even where climate policy exists, a major barrier to private investment in the green economy is a lack of confidence in key policy frameworks, such as a long-term carbon price, and the longevity and stringency of emissions and renewable energy targets. But this 'policy risk' resides in the hands of policy-makers. Therefore, in order to secure additional (rather than merely displaced) private investment, the public sector should endorse its own policies, and take on risks it controls, whether through direct co-investment with the private sector or through guarantees. This is about instilling confidence, which is a process that will also benefit from progress on international agreements to curb emissions and to establish global policy frameworks.

Institutional frameworks also matter greatly. Institutions help bestow credibility on policy and draw private sector expertise. For example, an active and well-capitalised Green Investment Bank can help to reduce policy risk (governments are less likely to change policy if a public long-term investment bank is involved) as well as to take a long-term view using flexible finance. Such a bank can act as a one-stop-shop for banking and sectoral skills in new and important areas and can acquire special convening powers to put together networked sources of finance. The European Investment Bank within the European Union could create additional instruments to cover policy risk and to stand behind infrastructure investments through direct equity or debt finance, insurance policies, first-loss guarantees and other mechanisms.

Low-carbon infrastructure investments – in onshore and offshore wind farms, solar plants, biomass, hydropower and associated transmission grids – which can be expected to generate modest but predictable commercial returns over the medium term, are of the sort that many institutional investors are generally keen to have in their portfolios. At present, pension and insurance funds, sovereign wealth funds and banks are putting significant sums into gilts that are earning very little, or even negative, real returns. So, in principle, low-carbon investment offers an attractive prospect.

At present, pension and insurance funds, sovereign wealth funds and banks are putting significant sums into gilts that are earning very little, or even negative, real returns. So, in principle, low-carbon investment offers an attractive prospect.

Many infrastructure activities will require current public borrowing or contingent liabilities and could therefore increase debt.³² There will therefore be those who argue that it is impossible in current circumstances. But it is necessary to distinguish between borrowing for productive investment and borrowing for current expenditure. There are clear limits to the latter under current conditions, as it increases deficits and debt without contributing to growth. But borrowing (at near zero rates) to underwrite credibility and foster large sums of private investment and innovation can help to restore growth. By contributing to growth, it will help reduce deficit and debt ratios. Borrowed cash would be reinvested in productive assets that generate future returns. Making this distinction transparent requires comprehensive balance sheet accounting that appropriately scores any potential increase in net worth, recognising that the only route to debt-sustainability is sustainable growth. Financial markets would be assisted in making decisions on the sustainability of public debt if the accounting framework were more transparent.

...borrowing (at near zero rates) to underwrite credibility and foster large sums of private investment and innovation can help to restore growth. By contributing to growth, it will help reduce deficit and debt ratios.

32. Although statistics based on the National Accounts do not, by convention, include contingent obligations or provisions, some agencies do publish broader public sector balance sheets.

10. Conclusion

Low-carbon growth policies alone will not resolve the public debt crisis in advanced economies – but they offer an important part of a credible solution, alongside other measures, including, in particular, broader economic reorganisation, structural reform, promotion of competition and liberalisation.³³ In the short run, credible green policies can boost confidence and increase economic activity, provided policy risks are reduced to the point where green investment is seen as a better means to restoring net worth than sheltering saving in ‘risk free’ assets earning zero real interest. Lots of private money wants to see a successful ‘green’ economy, but it requires credible policy to kick-start investment in renewables and energy efficiency.

In an environment in which the private sector is undertaking a dramatic deleveraging, such public sector leveraging through credible policy design can increase economic activity. Crowding-in investment can generate income, create jobs and increase tax revenues which address public indebtedness. At the same time, countries can meet tough emissions targets and leave a long-lasting legacy through the transition to a resource-efficient green economy. There is no lack of private money in the current market. However, there is a widely perceived lack of private sector opportunity. There is a rare and multiple opportunity that should not be missed.

33. See the letter from British Prime Minister David Cameron and other European Union leaders to the President of the European Council calling for economic policies to become more growth-focused: <http://www.telegraph.co.uk/finance/financialcrisis/9093478/David-Cameron-and-EU-leaders-call-for-growth-plan-in-Europe-full-letter.html>

Annex 1 Non-exhaustive list of primary climate-policy-related ways of correcting market failures

- Pricing greenhouse gas emissions to reflect the damage they do and incentivise changed behaviour. Correcting the greenhouse gas externality involves a combination of carbon taxes, cap-and-trade and regulation.
- Encouraging the greater provision of research and development where knowledge is a free good and 'spill overs' are large.
- Supporting deployment of low-carbon and other green technologies.
- Supporting induced innovation of new technologies whose costs will only later come down as technology providers learn by trial and error.
- Overcoming network externalities where the value of joining a network depends on how many others are in it (e.g. electricity grids, public transport, broadband, community-based insulation schemes) and which require government frameworks to drive incentives to kick-start the network.
- Addressing imperfections in risk/capital markets through risk-sharing and risk reduction, including private capital markets failures that result in a lack of funding for projects of long-term value to the national economy and infrastructural investment where the benefits of a project to the broader economy are larger than the private financial return.
- Introducing labelling and information requirements on cars, domestic appliances and products more generally, together with measures to improve consumer awareness of substitution options.
- Countering information asymmetries and so-called agency problems, such as where a tenant and a landlord possess different incentives to improve energy efficiency and so fail to act in their mutual interests.
- Implementing competition policy, to encourage regulated utilities to be innovative.
- Factoring in further 'co-benefits' and social externalities that private providers will not take on board. These include reduction of the risks of climate change; improved efficiency and reduced waste; greater energy security; reduced local pollution and more 'liveable' urban environments; regulation of dirty and more dangerous technologies; valuing ecosystems and biodiversity; and valuing energy security.

References

- Acemoglu, D., Aghion, P., Bursztytn, L., and Hemous, D., 2010. *The environment and directed technological change*. [pdf] GRASP Working Paper 21, mimeo Harvard. Available at: <http://www.economics.harvard.edu/faculty/aghion/files/Environment%20and%20Directed.pdf>
- Aghion, P., Hemous, D., and Veugelers, R., 2009. *No green growth without innovation*. Brussels: Bruegel.
- Aldy, J., 2012. *A preliminary review of the American recovery and clean energy package*. Washington D.C. Resources for the Future.
- Baldwin, R. E., and Robert-Nicoud, F., 2002. *Entry and Asymmetric Lobbying: Why Governments Pick Losers*. NBER Working Papers 8756, National Bureau of Economic Research, Inc.
- Baxter, M., and King, R., 1993. Fiscal policy in general equilibrium. *American Economic Review*, 83(3), pp.315–334.
- Bowen, A., and Stern, N., 2010. Environmental policy and the economic downturn. *Oxford Review of Economic Policy*, 26(2), pp.137–163.
- Bowen, A., (in prep) *Fighting climate change: the case for using all the tools in the tool-box*. London: Grantham Research Institute for Climate Change and the Environment, London School of Economics and Political Science.
- Chancel, L., Guérin, E., and Thomas, T., (in prep) *The EU crises and the green economy*. Paris: IDDRI.
- Clover, R., Robbins, N., and Singh, C., 2009. *A climate for recovery: the colour of stimulus goes green*. London: HSBC Global Research, HSBC Bank plc.
- Clover, R., Robbins, N., and Singh, C., 2009. *A Global Green Recovery? Yes, but in 2010*. London: HSBC Global Research, HSBC Bank plc.
- Clover, R., Knight, Z., Magness, J., Robbins, N., and Singh, C., 2010. *Sizing the climate economy*. [pdf] London: HSBC Global Research, HSBC Bank plc. Available at: <http://www.research.hsbc.com/midas/Res/RDV?ao=20&key=wU4BbdyRmz&n=276049.PDF>
- Cohen, L. R., and Noll, R. G., 1991. *The technology pork barrel*. Washington D.C. The Brookings Institution.
- Fankhauser, S., and Hepburn, C., 2010. Designing carbon markets. Part I: carbon markets in time. *Energy Policy*, 38(8), pp.4363–4370.
- Fankhauser, S., and Hepburn, C., 2010. Designing carbon markets. Part II: carbon markets in space. *Energy Policy*, 38(8), pp.4381–4387.
- Fischer, C., 2009. *Issue Brief: The role of technology policies in climate mitigation*. Washington D.C. Resources for the Future.

- Fischer, C., and Newell, R.G., 2008. Environmental and technology policies for climate mitigation. *Journal of Environmental Economics and Management*, 55, pp.142-162.
- Hallegatte, S., Heal, G., Fay, M., and Treguer, D., 2012. *From growth to green growth: a framework*. Working paper 17841, World Bank.
- Helm, D., 2010. Government failure, rent-seeking, and capture: the design of climate change policy. *Oxford Review of Economic Policy*, 26(2), pp.182-196.
- Helm, D., Hepburn, C., and Mash, R., 2003. Credible carbon policy. *Oxford Review of Economic Policy*, 19(3), pp.438–450.
- Hepburn, C., 2010. Environmental policy, government, and the market. *Oxford Review of Economic Policy*, 26(2), pp.117-136.
- Holmes, I., and Mohanty, R., (in prep). *The Macroeconomic Benefits of Energy Efficiency: The case for public action*. London: E3G.
- International Monetary Fund, 2012. Restoring Confidence Crucial to Rebuilding World Recovery, *IMF Survey Magazine*, [online] 28 January. Available at: <http://www.imf.org/external/pubs/ft/survey/so/2012/NEW012812A.htm>
- Joyce, N., Tong, M., and Woods, R., 2011. The United Kingdom's quantitative easing policy: design, operation and impact. *Bank of England Quarterly Bulletin Q3*, pp.200-212.
- Keynes, J. M., 1936. *The General Theory of Employment, Interest and Money*. London: Palgrave Macmillan.
- King, J., 2008. *The King review of low-carbon cars*. London: HM Treasury.
- Krugman, P., and Wells, R., 2010. The way out of the slump. *New York Review of Books*, [online] 16 September. Available at: <http://www.nybooks.com/articles/archives/2010/oct/14/way-out-slump/?pagination=false>
- Martin, W., 2010. *Rebalancing in the dark*. Cambridge: Centre for Business Research, University of Cambridge.
- Mazzucato, M., 2011. *The Entrepreneurial State*. London: Demos.
- Pearson, J.G., and Foxon, T. J., (in prep) *A Low Carbon Industrial Revolution? Insights and Challenges from Past Technological and Economic Transformations*.
- Perez, C., 2002. *Technological revolutions and financial capital: the dynamics of bubbles and golden ages*. Cheltenham: Edward Elgar Publishing.
- Perez, C., 2009. The double bubble at the turn of the century: technological roots and structural implications. *Cambridge Journal of Economics*, 33(4), pp.779-805.
- Perez, C., 2012. Greening the Global Economy, *Green Alliance Inside Track*, [pdf] February.
- OECD, 2010. *Regulatory Policy and the Road to Sustainable Growth*. [pdf] Paris: OECD. Available at: <http://www.oecd.org/dataoecd/5/41/46270065.pdf>
- OECD, 2011. *OECD calls for urgent action to boost ailing global economy*. Press release, 28 November 2011. [online] Available at: http://www.oecd.org/document/47/0,3746,en_21571361_44315115_49095919_1_1_1_1,00.html

- Otto, V., and Reilly, J., 2008. Directed technical change and the adoption of CO₂ abatement technology: The case of CO₂ capture and storage. *Energy Economics*, 30, pp.2879-2898.
- Pilat, D., and Wyckoff, A., 2010. Innovation: Sensible Strategies for Sustainable Recoveries. *OECD Observer No. 279* [online] May. Available at: <http://www.oecdobserver.org/news/fullstory.php/aid/3252/>
- Romani, M., Stern, N., and Zenghelis, D., 2011. *The basic economics of low-carbon growth in the UK*. [pdf] London: Grantham Research Institute for Climate Change and the Environment, London School of Economics and Political Science. Available at: <http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/briefs.aspx>
- Stern, N., 2012. *Climate Change and the New Industrial Revolution*. Lionel Robbins Memorial Lectures, London School of Economics and Political Science. [online] Available at: http://cep.lse.ac.uk/_new/events/event.asp?id=140
- Stern, N., 2011. Raising consumption, maintaining growth and reducing emissions: The objectives and challenges of China's radical change in strategy and its implications for the world economy. *World Economics*, 12(4), pp.13-34.
- Taylor, J. B., 2009. The lack of an empirical rationale for a revival of discretionary fiscal policy. *American Economic Review: Papers and Proceedings*, 99(2), pp.550-555.
- Taylor, J. B., 2010. The Recovery is gaining momentum, but government is in the way. *The Motley Fool*, [online] 15 March. Available at: <http://www.fool.com/investing/general/2010/03/15/the-recovery-is-gaining-momentum-but-government-is.aspx>.
- Taylor, J. B., 2010. *Comment on: Global Effects of Fiscal Stimulus During the Crisis by Charles Freedman, Michael Kumhof, Douglas Laxton, Dick Muir, Susanna Mursula*. [pdf] Available at: <http://www.stanford.edu/~johntayl/JBT%20comment%20on%20FKLMM.pdf>
- Wolf, M., 2012. The pain in Spain will test the euro. *Financial Times*, [online] 6 March. Available at: <http://www.ft.com/cms/s/0/f54332d2-66dc-11e1-9e53-00144feabdc0.html#axzz1oY6yqPG7>
- Zenghelis, D., 2011. *A macroeconomic plan for a green recovery*. [pdf] London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics, London School of Economics and Political Science. Available at: http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PP_macro-economic-green-recovery_Jan11.pdf
- Zenghelis, D., 2011b. *The Economics of Network-Powered Growth*. [pdf] London: Cisco Internet Business Solutions Group. Available at: http://www.cisco.com/web/about/ac79/docs/Economics_NPG_FINALFINAL.pdf



Grantham Research Institute on
Climate Change and
the Environment



**Centre for
Climate Change
Economics and Policy**