

Energy investments under the financial crisis

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Abstract

In early 2009 human society is facing two big challenges, climate change and the global financial crisis. These challenges are considered as contradictory, especially when examined under the widely-applied equilibrium-based modelling approach. In this paper the global post-Keynesian econometric E3MG model has been applied to assess the impact of the financial crisis on energy investment. It examines firstly the impact of the financial crisis and secondly the implementation of a medium term emissions-reduction target under the framework of the global financial and economic crisis. Results show that pathways exist for meeting those targets and, at the same time, boosting the economy and increasing the employment, thus turning the financial crisis into an opportunity for a green new deal.

The E3MG model

The E3MG model (An Energy-Environment-Economy Model at the Global level) is the latest in a succession of models developed for energy-economy and, later, E3 (energy-economy-environment) interactions at global level. It is very similar in structure to the E3ME model (see www.e3me.com), which follows from EXPLOR, built in the 1970s, then HERMES in the 1980s. Each model has required substantial resources from international teams and each model has learned from earlier problems and developed new techniques. The model manual for E3MG is currently under development. However, the manual for the European E3ME model, which is similar in structure and econometric method, is freely available online (Cambridge Econometrics, 2007).

E3MG is designed to address the issues of energy security and climate stabilisation both in the medium and long terms, with particular emphasis on dynamics, uncertainty and the design and use of economic instruments, such as emission allowance trading schemes (Barker et al. 2006; Stretton et al. 2008). It is a disequilibrium model with an open structure such that labour, foreign exchange and public financial markets are not necessarily closed. A key feature of the E3MG model is its detailed disaggregation of macro-economic series. The main model classifications are:

- 20 world regions, including 13 countries treated explicitly (the US, Japan, Germany, the UK, France, Italy, Canada, Australia, Russia, China, India, Mexico and Brazil)
- 42 economic sectors, based on NACE (rev 1.1) 2-digit classifications, including 16 service sectors and disaggregation of the energy sectors
- 28 consumer spending categories
- 12 fuels and 19 fuel user groups

The E3MG model combines economic analysis at the sectoral level with a top-down approach for modelling energy demand and with a bottom-up approach (the ETM submodel) for simulating the power generation sector. The model includes two-way feedbacks between the energy system and the wider economy. The ETM submodel, which is built to generalize an earlier work (Anderson and Winne, 2004), uses a probabilistic approach and historical data for estimating the penetration levels of different generation technologies, considering also their economic, technical and environmental characteristics.

As investment is made in 'new' technologies, learning takes place and the cost of the new technology lowers so that it becomes competitive with the 'old' technologies. For each type of energy demanded there is usually a technology or fuel 'of choice'—what might be termed a 'marker' technology—against which the alternatives will have to compete. In the ETM, the capital, operating and maintenance costs are being used to estimate the net present value of the different technologies, which is used for expressing the relative costs of the alternatives. Operating costs consider fuel and carbon prices. Those relative costs are readjusted based on the incentives or taxes that are applied to the different technologies. Even though the numeraire technology may comprise the majority of the market, there are always so-called

niche markets and opportunities where the non-carbon technology is cheaper than then numeraire. Photovoltaics, although their relative costs were several times higher compared to a marker technology, took a small share in the market, even without the presence of a favourable policy e.g. feed-in tariff. This can be justified, concerning cost-effectiveness, in case of off-grid installations, but this is not always the case. Historical data show that several energy investments can not be justified by using cost optimization techniques, adopted by most energy system models. On the other hand, energy investments consider a number of critical issues, sometimes contradicting with each other. Such factors are political decisions (nuclear in France), volatility in prices, energy security issues, technology transfer agreements being part of intergovernmental agreements for wider economic cooperation, social issues (public opposition), technical and environmental issues that create a high uncertainty in investing to a single technology, based on its cost-effectiveness compared to the others. This reason has led to an examination of the penetration capability of different technologies (Anderson and Winne, 2004), by estimating their substitution elasticities.

Figure 1 shows the Market Share of marker technology and technology i and the Rate of Change of Market Share vs Relative Prices of marker technology to alternative technology i. The left scale shows the market share of the technologies (marker and technology i) based on their relatives prices. If they cost the same (considering their capital, operating and maintenance costs and also any incentives or taxes), they take the same share of the new investments. The right scale shows the substitution elasticity α between the technologies (marker and technology i), based on the frequency distribution of relative prices. Narrow distribution means small standard deviation and large value of the parameter α . The distribution presented in this table is symmetrical, but historical data lead in several cases to unsymmetrical distribution figures.

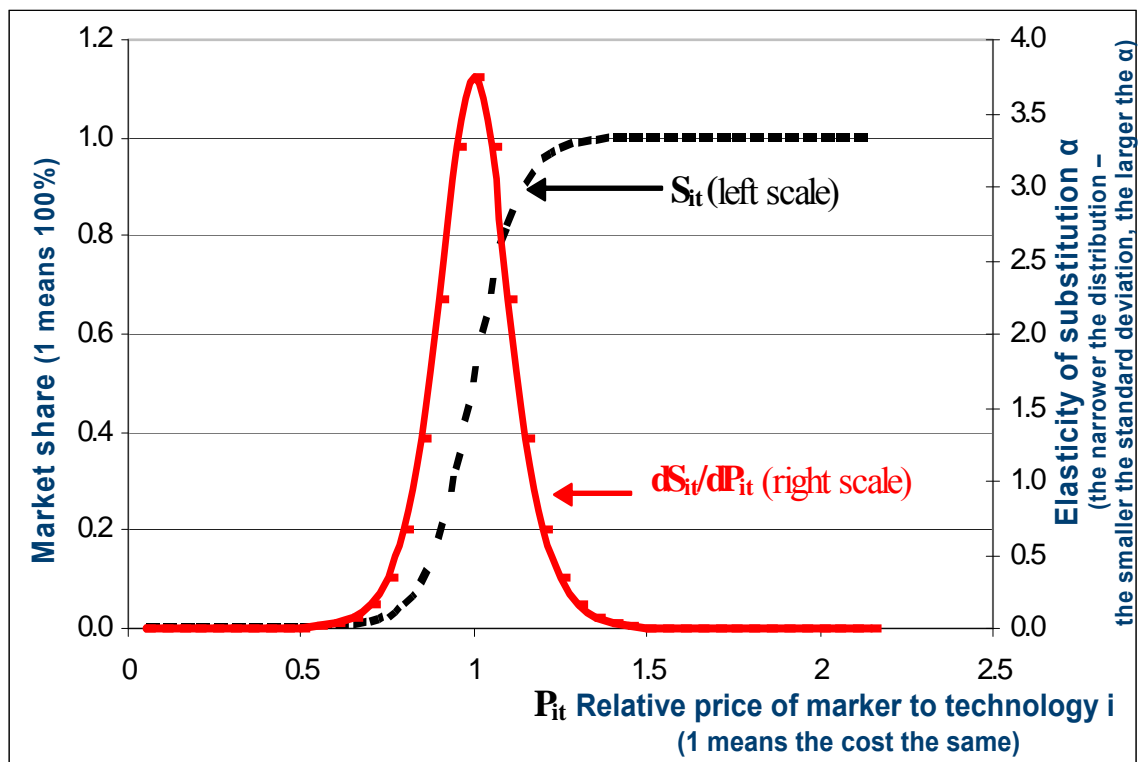


Figure 1. Market share & Frequency distribution of relative prices

Modelling the Financial Crisis

This paper is a continuation of a paper (Pollitt and Barker, 2009) examining the financial crisis, under the theoretical analysis presented in Barker (2009), which outlines some of the causes of the current crisis and suggests policy responses in the shape of a “seven-point-plan”. Different scenarios were set up to model the impacts of the crisis sequentially, where each one demonstrates a specific aspect of observable behaviour caused by the crisis. Changes in

patterns in banks' own behaviour (defined as NACE categories 65+67), through reducing their own expenditure, encouraging higher savings rates and reducing access to credit, are implemented firstly. Banks behaviour results in returning to historical normal saving rates for the households, ending the period of intense consumption due to the low interest rates, and in reduction in investments from business due to difficulties in getting loans and to the uncertainty caused by volatility in prices. Each of the scenarios includes the inputs, which are spread over the period 2009-11, to the previous scenario. The shape of the resulting loss in activity is designed to mimic that of previous financial crises, as reported in Reinhart and Rogoff (2009). The model inputs for the crisis were determined by a combination of economic theory, historical precedent and judgement by the modelling team.

More specifically a baseline scenario, which excluded the effects of the financial crisis, was examined firstly. The baseline projections roughly show a continuation of growth rates from before the financial crisis. Then the financial crisis was modelled through a baseline plus series of scenarios, which fall into three groups: aspects of the crisis, current policy, and policies recommended in the seven-point plan presented in Barker (2009). Each scenario was designed to demonstrate a specific aspect of observable behaviour caused by the crisis. The model results indicate the direct plus indirect impacts of these behavioural shifts. Each of the scenarios includes the inputs to the previous scenario plus the changes outlined below.

I. Aspects of the crisis

a. Banks cut back on expenditure

In an attempt to protect their own businesses, the banks reduce their own expenditure, both on capital (eg buildings) and on labour. In market economies, investment by the banking sector was assumed to fall by 25% over 2009-11 compared to baseline, and employment by 12.5%.

b. Banks encourage higher savings rates

Another result of the crisis is that banks try to protect their balance sheets through encouraging higher rates of savings. The net impact of this is a 0.5pp increase in household savings ratios in 2009.

c. Reduced access to credit

Another way for the banks to protect their balance sheets is through reduced lending to business. The macro-economic impact is a reduction in investment by businesses. On its own this was expected to lead to a permanent reduction in investment of 5% in 2009-11.

d. A return to "normal" savings rates

The availability of cheap credit, through very low interest rates proved to be unsustainable. With the banks no longer lending to such an extent, we consider that savings ratios should return to historical averages. We have taken the year 2000 as a rough proxy for this average and increased savings rates in the US, Japan and Western to 7-9%. Historical savings rates for three of the countries that were most affected (US, UK and Italy) are shown in Figure 2.

e. Uncertainty creates a disincentive to invest

The final behavioural change is that companies reduce investment to protect their own businesses, resulting from reduced access to credit and uncertainty on future profitability, which is attributed to high volatility in asset and commodity prices. In this scenario private-sector business investment was permanently cut by 38% over 2009-11. It should be noted that this reduction is roughly comparable to the 30-40% reduction in GDP seen in the US during the Great Depression.

f. Reaction of global commodity prices

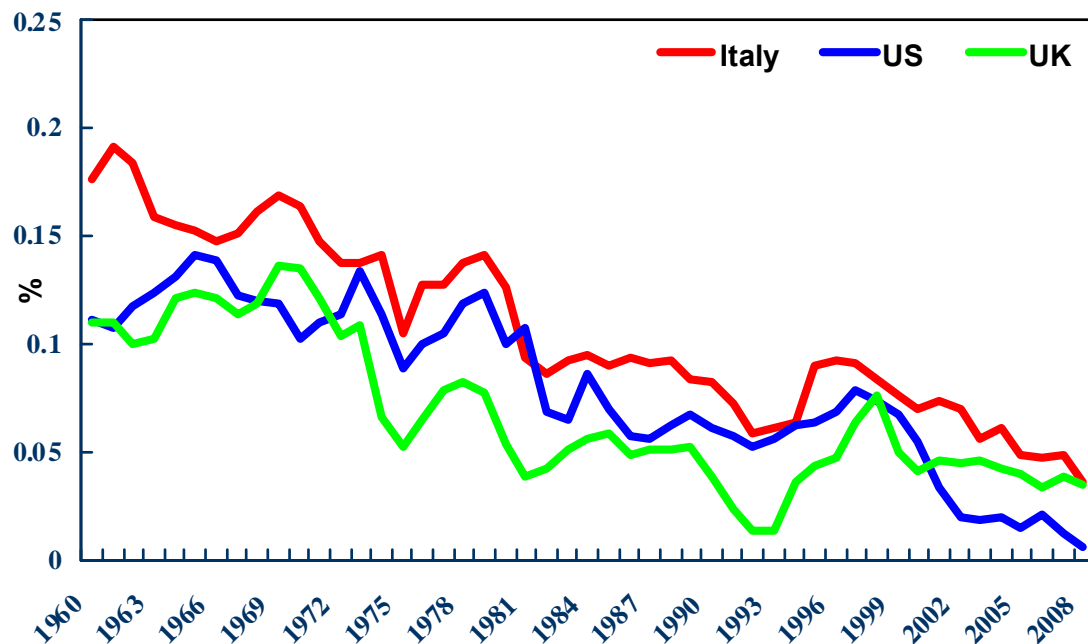
The final aspect of the crisis is that the reduced demand for raw materials causes commodity prices to fall. The oil price, considering that energy supplies and prices are an exogenous input to E3MG, is assumed to be at \$60/pb in 2009. Oil-producing countries cut back on investment as a result.

II. Analysis of current policy

A summarised version of current policy towards the end of May 2009 (including the measures outlined by the Obama administration, the European Union and the Chinese government) was collected as inputs to the model. We look at the effects on the real economy so do not include

the large sums of money injected into the global financial system. Central bank interest rates were updated with the latest available information.

There is no central database of measures, as they are constantly changing, so a variety of sources have been used, including the national and international press. In Europe, the European Economic Recovery Plan (European Commission, 2008) was used for the aggregate regions. For the other aggregate regions, government investment was set to increase by an arbitrary 1% of GDP. In many cases the time period of implementation has not been given explicitly so measures are assumed to cover the period 2009-11. It is assumed that the fiscal measures have been financed by increasing national debts, and that governments have not made any attempt to recoup these debts by 2012. An outline of the fiscal measures that were included is given in Pollitt and Barker (2009) and Cambridge Econometrics (2009).



Source: AMECO database.

Figure 2. Savings ratios for selected countries for the period 1960-2008

III. Analysis of the seven-point plan

Barker (2009) suggests policy responses to the financial crisis in the shape of a “seven-point-plan”. Some of them have already been adopted by different countries, while the other policy measures are assumed to be in addition to current policy. The focus is on restoring trust to the global financial system so that lending may resume and long-term investments necessary for growth may be made. It should be noted that here we are only modelling four of the seven points outlined in Barker (2009), the remaining steps (consolidating bad debts into regional banks, reforming global regulatory authorities and reforming international company law) cannot be modelled quantitatively but play an important role in restoring trust to the system.

- a. Allow the markets to work without more interference; let the banks with bad debt go bankrupt

The first measure in the seven-point plan will cause further short-term losses as struggling banks are wound down. However, it is seen as an essential step for restoring the trust in the system that is required for a return to investment. It is assumed that investment in the banking sector will fall by an additional 20%.

- b. Set global interest rates to near-zero

The second measure aims to boost short-term liquidity and allow the remaining banks to start lending. The measure is assumed to be only a temporary boost to the global economy, otherwise there are major risks of both hyperinflation and entering the liquidity trap. For this reason it is assumed that in 2010 interest rates return to a minimum level of 1% or, if higher, the same levels seen in early 2009.

c. Temporarily fix global prices to remove uncertainty from the system

Large swings in the value of commodities and national currencies have formed part of the disincentive to invest. By removing some of the uncertainty from the system, investment could be expected to increase. Global oil prices are fixed at \$80pb.

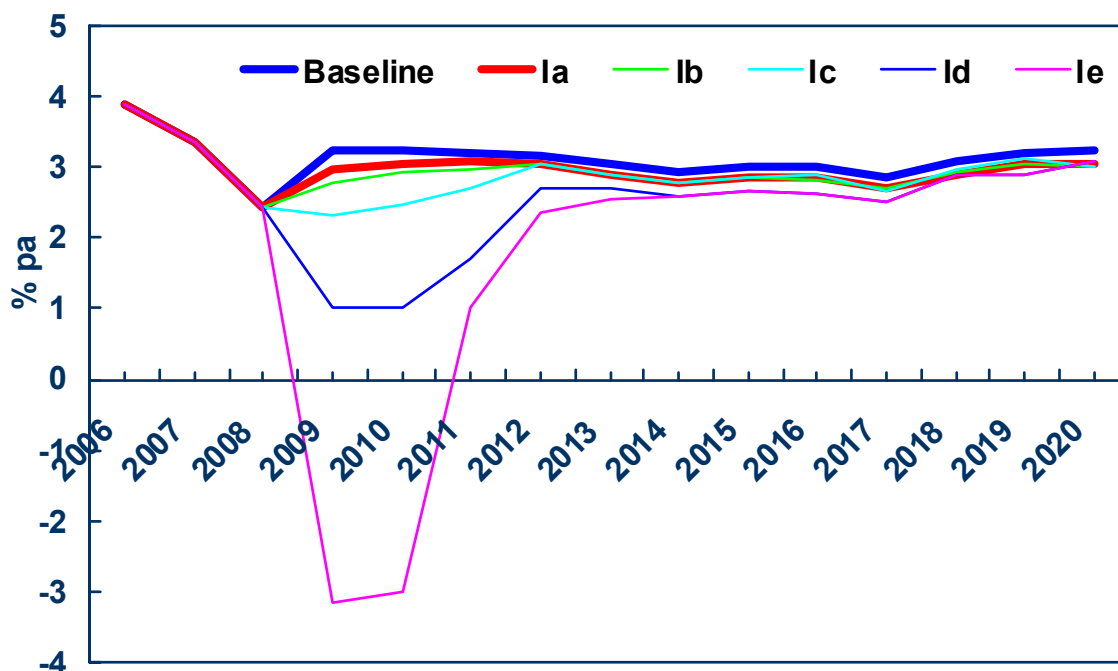
d. A return to investment

The resulting return to investment is the main outcome of the seven-point plan. It is induced by the return of trust in the system, less uncertainty and availability of credit. It is assumed that the scale of this effect is large enough to counter the effects of the loss of confidence from banks and, more importantly, from businesses.

The model results showed that, given this judgement, 2009-11 could be exceptionally difficult years for the global economy in the absence of policy intervention. Global GDP growth is expected to be decreased by 3.4% in 2009, while some recovery is predicted in 2011-12, but it is 2013 before growth rates return closer to trend values. One very critical impact of the financial crisis, is that the global economy, when recovered, will get growth rates lower than the pre-2008 forecast by 0.2-0.3% p.a.

Figure 3 shows the effect of each component (aspect) of the financial crisis. If the reduction in global commodity prices is taken into account (Scenario If, not shown in Figure 3), this does increase the global growth rate by up to 0.5pp each year over 2009-11 compared to Scenario Ie (which has all the other components of the financial crisis), but this still represents a large actual fall in world output. In other countries, the loss of output is less, and at or below 5% in much of the developing world. The variation between the regions is dependent on a number of factors, some of which are illustrated quite clearly in the results for the different scenarios. Table 1 summarises the most important factors behind the fall in output.

Figure 4 shows that the global impacts of policies that have been announced so far are limited. In 2009, current policies are expected to add three-quarters of a percentage point on to world growth, and just a quarter in 2010. In most countries, the total effect on GDP is less than 1%. Tax cuts in the UK and Japan have more immediate effects, as public investment is assumed to take longer to take effect. The one country where national policy does have a large impact is China, where investment is assumed to increase until GDP matches more recent growth rates. This represents a much larger stimulus and by 2012 adds 4% on to GDP.



Source: E3MG.

Figure 3. World GDP growth rates, considering sequentially the different aspects of the financial crisis (Scenarios Ia-Ie)

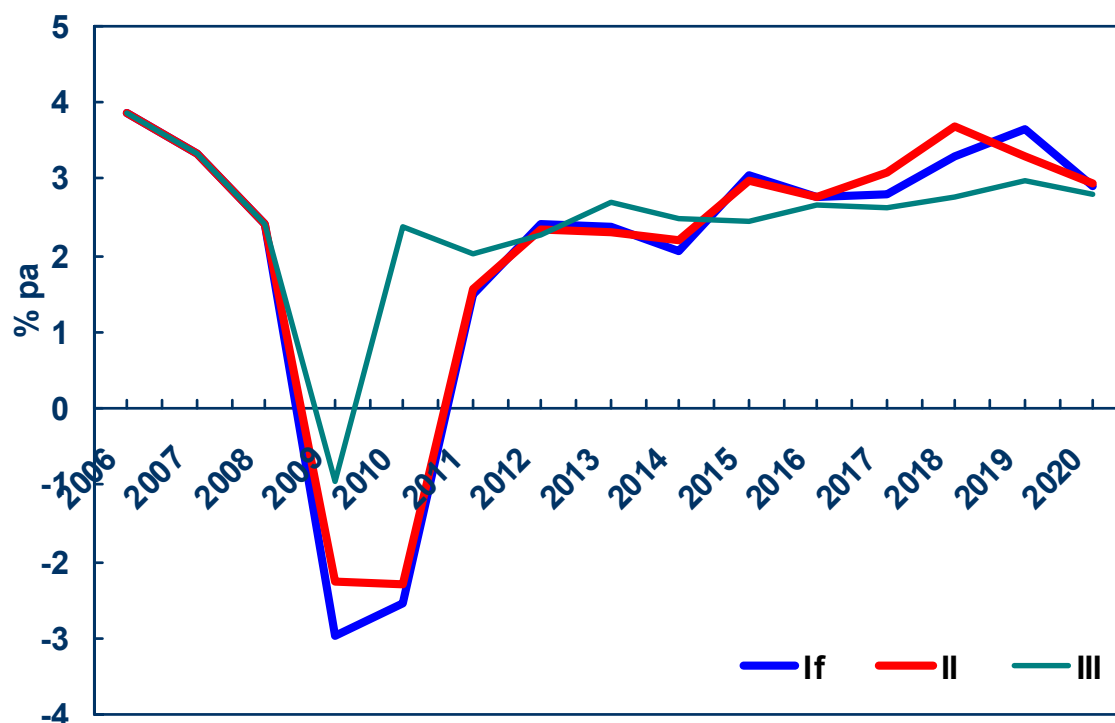
Further policies are needed for an earlier recovery, which could be found on those proposed by Barker (2009) and could lead to positive global GDP growth from 2010. The seven-point plan was broken down into four scenarios. Of these, two had negative global impacts, reducing banking investment and increasing and stabilising commodity prices (although this does benefit commodity producers). Temporarily setting interest rates close to zero will have some positive impact, but not much as the world's two largest economies already have near-zero rates. The main positive outcome arises from the increase in investment associated with the return of confidence and trust in the global financial system (near-zero interest rates of course provide the means for lending to resume).

Figure 4 shows that implementing the plan successfully could have a considerable effect, limiting the loss of output in 2009 to 1% and returning rates of growth close to normal in 2010. In total, by 2012 the measures reduce the loss in annual output by half. Furthermore, as the measures are aimed directly at the part of the economy that will suffer the most from the crisis, ie investment, the relative gains in III match the areas where larger losses are expected in Scenario If.

| Economic factor | Example countries |
|---|----------------------|
| Private sector investment accounts for a large share of GDP | China, NICs |
| Savings ratios have deviated a long way from long-term averages | US, UK, Italy, Japan |
| Large banking sectors | US, UK |
| Produce investment goods or components of these goods | Germany, Japan |

Source: E3MG, Cambridge Econometrics.

Table 1. Main factors influencing loss of output



Source: E3MG.

Figure 4. World GDP growth rates for the scenario which considers all aspects of the financial crisis (Scenario If), the scenario which considers the current policy to tackle the financial crisis (Scenario II) and the scenario with the seven points plan (scenario III)

Impact of the Financial Crisis on Investments

The results for sectoral output are broadly consistent with the conclusions above and are not unexpected. The sectors that suffer the most are those that produce investment goods and the more basic manufacturing sectors that produce inputs to these industries. However, hotels and catering is also notably affected from lower levels of household spending. On the other hand, sectors that produce basic requirements, such as agriculture, and those whose demand comes from the public sector are affected less.

Table 2 shows a selection of sectors with the largest and smallest changes in output in Scenario 1f, compared to the baseline.

| Sector | NACE codes | Change in output | Main drivers |
|--------------------------|------------|------------------|---|
| Electrical engineering | 31+33 | -37.2 | Lower demand for investment goods |
| Electronics | 30+32 | -32.5 | Lower demand for investment goods |
| Mech. Engineering | 29 | -25.4 | Fall in investment |
| Motor vehicles | 34 | -23.6 | Fall in investment and consumption |
| Metal goods | 28 | -22.6 | Lower demand for investment goods |
| Basic metals | 27 | -18.2 | Lower demand for investment goods |
| Construction | 45 | -14.3 | Fall in investment |
| Hotels and catering | 55 | -13.9 | Reduction in household spending |
| ... | | | |
| Pharmaceuticals | 24.4 | -5.2 | Demand from health services largely unchanged |
| Health and social work | 85 | -5.0 | Public services unchanged |
| Gas distribution | 40.2+40.3 | -3.8 | Low elasticity of demand |
| Agriculture etc | 01+02+05 | -2.2 | Low elasticity of demand |
| Public admin and Defence | 75 | -1.5 | Public services unchanged |
| Education | 80 | -1.1 | Public services unchanged |

Note: Change in output in 2012 between Scenario 1f, representing the Financial Crisis and the baseline, representing the trend without the Financial Crisis.
Source: E3MG.

Table 2: Loss of output due to the Financial Crisis in selected sectors, 2012

Modelling emission reduction targets under the financial crisis

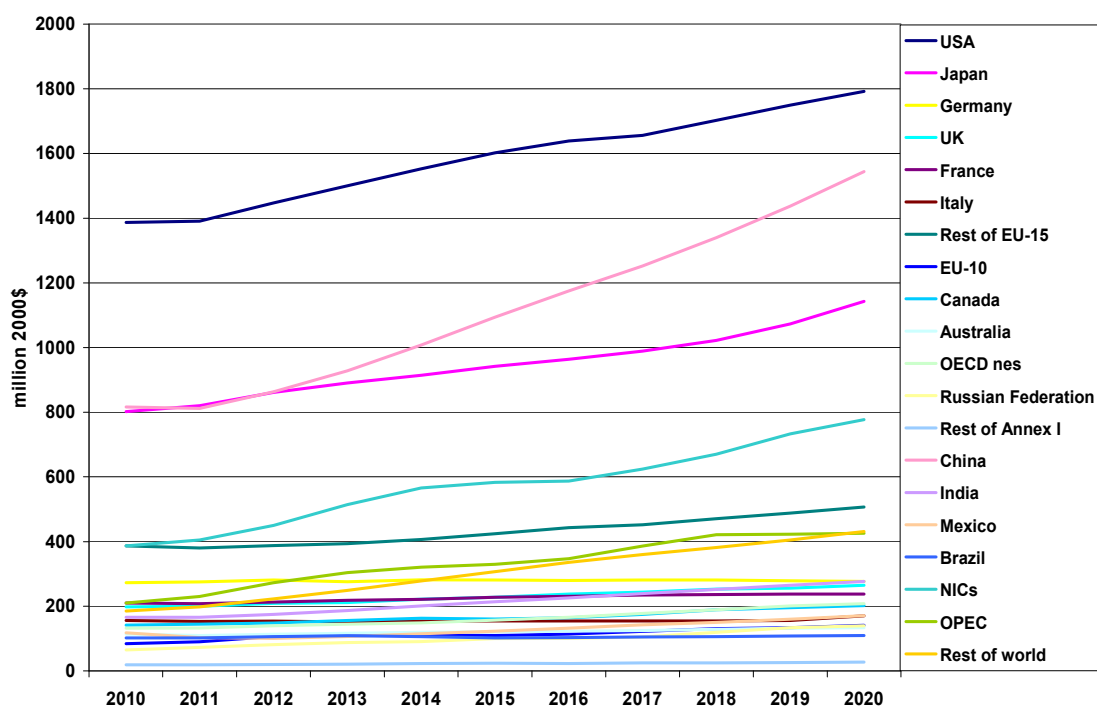
The second big challenge is to implement deep reduction targets. There is an expectation that a global agreement towards tackling climate change will be met at the UNFCCC COP15 conference in Copenhagen in December 2009, where both developed and developing countries will undertake specific commitments. But irrelevant of the outcomes of those negotiations, developed countries have already announced their commitment towards reduction targets in the medium or long term e.g EU commitment to reduce emissions by 20% or even 30% by 2020, UK and G8 80% emissions reduction by 2050. The examination of the influence of the financial crisis on meeting those targets is very important, as there is a high scepticism that those issues are conflicting. This scepticism arrives also from the way the climate change targets and the financial crisis are modelled, and becomes more intense especially when the modelling is based on the neoclassical economic approach.

Under the framework of the financial crisis, a portfolio of policies is applied in E3MG to meet deep carbon-reduction targets. This comes in contrast with most energy-system models or general/partial equilibrium models which impose reduction targets exogenously and allow the model to estimate the marginal abatement cost for achieving this target, under the consideration of several debatable assumptions such as market perfection, full employment, equilibrium etc.

The portfolio of policies, analysed in Barker et al. (2008), focuses on recycling revenues from the implementation of carbon pricing (either through auctioning carbon permits or through carbon taxes), providing the energy sector with incentives to invest in low-carbon electro-production technologies, implementing energy-efficiency measures in buildings and industries, accelerating the diffusion of electric plug-in vehicles and other measures, implemented at different timing and different extent through the examined period.

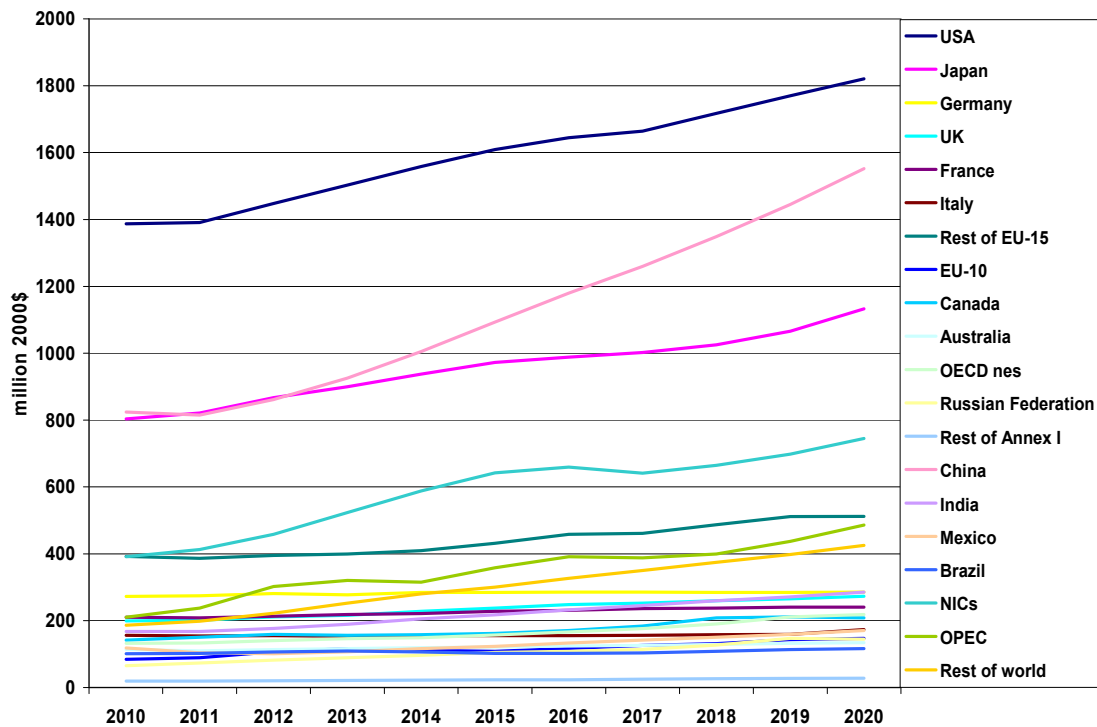
Those policies are applied to meet a possible global agreement on medium reductions, representing the “Mitigation scenario” in this paper. Such a scenario considers that the Annex I countries are committed to 30% reduction in CO₂ emissions by 2020 compared to 1990 levels, while the developing countries join the developed world in combating climate change by committing to stabilize their emissions at 2010 levels by 2020. This scenario is applied on the Scenario If, representing the Financial Crisis. The participation of developing in a global reduction effort leads to a low carbon price, at the level or even below 10\$/tCO₂. The carbon price, considered to result from an auctioning process or from the implementation of carbon tax for the non-Emission trading Scheme sectors, provide the revenues for extra energy investments.

Figures 5 & 6 show the investments in million US\$ for the Scenario If, representing the Financial Crisis, and the “Mitigation Scenario” respectively. Those figures together with Table 5, show that the extra investments required for meeting such targets are almost 1% more per year. This comes from the fact that already in the Financial Crisis, a fall in energy demand and emissions is happening, attributed mainly to the decrease in the economic activity. However for a higher reduction target in the medium term or for a very deep reduction target in the long term, the extra energy investments would be much more, as there would be required extra capacity and a wider implementation of energy efficiency measures. The recent report from IEA (2009) on the impact of the financial and economic crisis on global energy investment, mentions that energy demand and emissions reductions are expected for year 2009 at least. This fact combined with the high uncertainty in profitability on energy investments due to the volatility of the energy prices and the difficulties in financing new projects, lead to a sharp decrease in energy investments. Such decrease can be at the level of 40% for year 2009, and so comes in agreement with our assumptions on modelling the different aspects of the financial crisis.



Source: E3MG

Figure 5. Investment in million 2000\$ for the Scenario If, representing the Financial Crisis.



Source: E3MG

Figure 6. Investment in million 2000\$ for the “Mitigation Scenario”, under the Financial crisis .

However, the cancelling or delay in energy investments may lead to higher emissions, depending on the time of recovery from the crisis and the evolution of critical factors such as the energy prices. This can affect not only the global effort towards tackling climate change, but also the global economy, as the energy investments provide a credible option for boosting the economy and preventing national economies from energy security issues. Therefore, a political framework is needed to guarantee new investments. This framework demands the active roles of the governments towards regulation and fiscal measures to support the real economy. Those conditions are considered in modelling the Mitigation Scenario, as the carbon pricing through the auctioning of the carbon permits and the carbon taxation, can provide the funds for enhancing investments in energy efficiency measures, low or zero carbon energy supply technologies and on electrification of the transport sector.

The results, presented in Tables 3-8, show that the Mitigation scenario can lead to an economic growth and to an even higher increase in employment. This comes mainly from the extra investments, that lead to an increase in the consumption, and from the implementation of policies that face energy inefficiencies in the current system (in contradiction to the neoclassical approach, that considers that the system is in optimum stage), through mainly investments in energy efficiency polices or new energy technologies.

Results show that there is also high potential for the developing countries to increase their economic growth and create new jobs, standing an important argument of joining a global reduction effort. Considering that the non-linear nature of the E3MG model, and ofcourse of the energy system and of the global economy, there does not exist an optimum way fro meeting reduction targets. There exist complex interactions between different factors that have to be considered when directing new policies. The policies should be considered as complementary, rather than as independent/competitive, which is a critical drawback in most modelling approaches, and thus leading to high costs for emission reduction targets. Therefore there exist several pathways for meeting deep reduction targets and, at the same time, boosting the economy, providing evidence for the decision makers to implement policies supporting energy investments. Results show that the financial crisis can be turned into an opportunity for a green new deal.

| | 2010 | 2015 | 2020 |
|-----------------------|------|------|------|
| 1 USA | -0.2 | 0.5 | -0.1 |
| 2 Japan | 0 | 0.5 | -0.5 |
| 3 Germany | 0.1 | 1.1 | 1.5 |
| 4 UK | 0.1 | 0.6 | 0.6 |
| 5 France | 0 | -0.2 | 0.4 |
| 6 Italy | 0 | -0.5 | -0.5 |
| 7 Rest of EU-15 | 0 | 0.4 | 1.3 |
| 8 EU-10 | -0.1 | -0.4 | -0.8 |
| 9 Canada | 0 | 1.7 | 6 |
| 10 Australia | 0 | -0.2 | 0.1 |
| 11 OECD nes | 0 | 0.3 | 9.5 |
| 12 Russian Federation | -0.1 | 1.1 | -0.5 |
| 13 Rest of Annex I | -0.4 | -0.7 | 4.1 |
| 14 China | 0.2 | 0.6 | 0.5 |
| 15 India | 0.5 | 0.6 | 0.4 |
| 16 Mexico | -0.1 | 0.1 | -1.2 |
| 17 Brazil | -0.1 | -0.5 | 1 |
| 18 NICs | 0.2 | 3.2 | -0.2 |
| 19 OPEC | 0.1 | 0.8 | -0.9 |
| 20 Rest of world | -0.5 | 3 | 5 |
| Total | 0 | 0.6 | 0.7 |
| Source: E3MG | | | |

Table 3. % Difference in GDP between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

| | 2010 | 2015 | 2020 |
|-----------------------|------|------|------|
| 1 USA | -0.2 | 1.3 | 2.6 |
| 2 Japan | 0 | 0.2 | 0.2 |
| 3 Germany | 0 | -0.1 | 0.4 |
| 4 UK | 0.4 | 2.4 | 5.2 |
| 5 France | 0 | -0.1 | 0.2 |
| 6 Italy | -0.2 | -0.2 | 0.5 |
| 7 Rest of EU-15 | 0.1 | 0.2 | 0.5 |
| 8 EU-10 | 0.4 | -0.8 | 0.4 |
| 9 Canada | 0 | -0.2 | 1.8 |
| 10 Australia | 0 | 0.8 | 2.9 |
| 11 OECD nes | 0.4 | 1.3 | 4.7 |
| 12 Russian Federation | 0.7 | 0.2 | 2.3 |
| 13 Rest of Annex I | -0.1 | 0.4 | 1.1 |
| 14 China | -0.1 | 2.4 | 3.6 |
| 15 India | 0.2 | 0.5 | 0.7 |
| 16 Mexico | 0 | 0.1 | -0.2 |
| 17 Brazil | -0.3 | -0.1 | 2.5 |
| 18 NICs | 0.4 | 1.1 | 1.8 |
| 19 OPEC | 0.7 | 3.3 | 12.5 |
| 20 Rest of world | -0.4 | 1 | 2.3 |
| Total | 0 | 1.3 | 2.9 |
| Source: E3MG | | | |

Table 4. % Difference in Employment between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

| | 2010 | 2015 | 2020 |
|-----------------------|-------------|-------------|-------------|
| 1 USA | 0 | 0.4 | 1.6 |
| 2 Japan | 0 | 3.2 | -0.8 |
| 3 Germany | -0.2 | 1.1 | 2.8 |
| 4 UK | 0.3 | 3.8 | 3.1 |
| 5 France | 0.1 | 0 | 1 |
| 6 Italy | 0.4 | 0.2 | 2.2 |
| 7 Rest of EU-15 | 1.3 | 1.6 | 1.1 |
| 8 EU-12 | -0.2 | -2 | 4.2 |
| 9 Canada | 0 | 0.3 | 3 |
| 10 Australia | 0.1 | 0.3 | -0.4 |
| 11 OECD nes | 0 | 0 | 4.8 |
| 12 Russian Federation | 0.1 | 5.1 | 3.7 |
| 13 Rest of Annex I | 0 | -2 | 3.9 |
| 14 China | 1 | -0.1 | 0.5 |
| 15 India | 0.7 | 1.5 | 2.9 |
| 16 Mexico | -0.1 | 0.1 | -0.1 |
| 17 Brazil | -0.1 | -0.5 | 5.7 |
| 18 NICs | 1.1 | 10 | -4.2 |
| 19 OPEC | 0 | 8.5 | 14 |
| 20 Rest of world | 0.1 | -2.2 | -1.3 |
| Total | 0.3 | 1.9 | 1.3 |
| Source: E3MG | | | |

Table 5. % Difference in Investment between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

| | 2010 | 2015 | 2020 |
|-----------------------|-------------|-------------|-------------|
| 1 USA | -0.3 | 0.4 | -0.7 |
| 2 Japan | -0.1 | -0.2 | -0.7 |
| 3 Germany | 0.2 | 1.2 | 2.1 |
| 4 UK | 0.1 | 0.4 | -0.6 |
| 5 France | -0.1 | -0.6 | -0.2 |
| 6 Italy | -0.1 | -0.7 | 1.4 |
| 7 Rest of EU-15 | 0 | 0.6 | 3 |
| 8 EU-12 | -0.1 | -1.1 | -1.3 |
| 9 Canada | 0.1 | 3.5 | 14.3 |
| 10 Australia | -0.1 | -0.5 | 0.2 |
| 11 OECD nes | 0 | 0.4 | 12.9 |
| 12 Russian Federation | -0.2 | 0.5 | -1.6 |
| 13 Rest of Annex I | -0.7 | -1.2 | 4.6 |
| 14 China | 0 | 0.5 | -2.4 |
| 15 India | 0 | -0.7 | -0.8 |
| 16 Mexico | -0.2 | 0.1 | -1.8 |
| 17 Brazil | -0.1 | -0.4 | 1.5 |
| 18 NICs | 0.2 | -0.5 | -0.4 |
| 19 OPEC | -0.3 | -4 | -11.1 |
| 20 Rest of world | -2.2 | 1.9 | 4.7 |
| Total | -0.2 | 0.2 | 0.5 |
| Source: E3MG | | | |

Table 6. % Difference in Consumer Spending between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

| | 2010 | 2015 | 2020 |
|-----------------------|-------------|-------------|-------------|
| 1 USA | -6.2 | -12.7 | -26.9 |
| 2 Japan | -3.5 | -3.7 | -8.9 |
| 3 Germany | -1.3 | -4.5 | -18.2 |
| 4 UK | -0.9 | -2.6 | -15.9 |
| 5 France | -0.6 | 0.3 | 2.6 |
| 6 Italy | -0.5 | -0.7 | -2.5 |
| 7 Rest of EU-15 | -0.3 | -2.6 | -6.8 |
| 8 EU-12 | -0.3 | -9.3 | -13.2 |
| 9 Canada | -5.6 | -7 | -16.5 |
| 10 Australia | -2.9 | -9.3 | -1.2 |
| 11 OECD nes | 0 | 0 | -2.6 |
| 12 Russian Federation | -0.2 | -38.3 | -31.8 |
| 13 Rest of Annex I | -0.1 | -18.8 | -30.7 |
| 14 China | -7.9 | -17.3 | -36.8 |
| 15 India | -2.9 | -7.5 | -22.7 |
| 16 Mexico | -3.6 | -0.1 | -16.4 |
| 17 Brazil | 0 | -4.9 | -19 |
| 18 NICs | -3.3 | -3.5 | -6.6 |
| 19 OPEC | 2.7 | -15.6 | -39.9 |
| 20 Rest of world | -4.4 | -22.2 | -28 |
| Total | -3.4 | -13 | -25.5 |
| Source: E3MG | | | |

Table 7. % Difference in Fuel Demand between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

| | 2010 | 2015 | 2020 |
|-----------------------|-------------|-------------|-------------|
| 1 USA | -5.9 | -4.2 | -29.7 |
| 2 Japan | -2.4 | 0.9 | -14.5 |
| 3 Germany | -0.4 | -4.6 | -19.9 |
| 4 UK | -0.5 | 4.4 | -9.1 |
| 5 France | -0.1 | -3.3 | -20.2 |
| 6 Italy | -0.3 | -2.4 | -11.9 |
| 7 Rest of EU-15 | -0.3 | -2.4 | -11.4 |
| 8 EU-12 | -0.3 | -8.5 | -4 |
| 9 Canada | -4.3 | -3.7 | -23.3 |
| 10 Australia | -0.8 | -3 | -7.6 |
| 11 OECD nes | 1.7 | -7.3 | -29.7 |
| 12 Russian Federation | -0.8 | -34.5 | -41.3 |
| 13 Rest of Annex I | 0.7 | -19.6 | -28.1 |
| 14 China | -6.2 | -28.2 | -34.1 |
| 15 India | -1.7 | -4.7 | -15.9 |
| 16 Mexico | -2.1 | -8.9 | -19.7 |
| 17 Brazil | -0.1 | -5.2 | -14.2 |
| 18 NICs | -1.3 | -3.1 | 4.8 |
| 19 OPEC | -0.3 | -10.4 | -26.1 |
| 20 Rest of world | -2.5 | -5.6 | -19.6 |
| Total | -3.1 | -13.6 | -25 |
| Source: E3MG | | | |

Table 8. % Difference in CO₂ emissions between the “Mitigation Scenario” and the If Scenario, representing the Financial Crisis.

Conclusions and policy considerations

This paper assesses the impacts of the financial crisis using a global econometric model with detailed sectoral disaggregation, E3MG. The model inputs for the crisis were determined by a combination of economic theory, historical precedent, recent evidence and judgement by the modelling team. The model results showed that, given this judgement, 2009-11 could be exceptionally difficult years for the global economy in the absence of policy intervention. Some recovery is predicted in 2011-12, but it is 2013 before growth rates return closer to trend values. The most important outcome is that after the recovery from the financial and economic crisis, the economic growth will be less than the trend, based on pre-2008 condition, unless there is a global commitment to energy investment towards emissions reduction targets.

Of particular interest is the variation in potential impacts across countries. It is not unexpected that countries with the large banking sectors and high levels of personal debt are the most affected; however, the model results show that impacts continue down the value chain to affect countries that supply basic materials. In particular, countries with a high concentration of industries that supply investment goods and materials used to produce investment goods are affected.

The current policy measures in place have been shown to be too small in scale to have more than a minor impact on the scale of the depression, adding around only 1% back on to global output. The fiscal stimuli proposed in most countries are too small to have much effect at all, although China is an exception to this. Restoring confidence to invest at the global level is a key element to successfully handling the crisis. The four main criteria that have been identified are:

- Restore trust in the global financial system
- Reduce the level of volatility and uncertainty over future prices
- Provide remaining banks with the ability to resume lending
- Stimuli connected with the real economy and especially with the energy investments, so as to face also the climate change and energy security issues

Assuming these conditions are met, a more rapid return to growth is possible, although there may be additional short-term costs. But in the medium term (by 2020), the implementation of a global mitigation effort, the macroeconomic effects will be small but beneficial. Mitigation policies seem likely to increase employment, especially in developing countries, but the scale is small (about 1% more employment for a 25% reduction in CO₂ below baseline by 2020). With employment falling in many investment sectors that would benefit from substantial mitigation action (construction, vehicles, low-carbon technologies), reflationary packages aimed at reducing pollution and increasing employment, as adopted by China in response to the 2008 crisis, would accelerate the transition to a low-carbon economy and provide more employment over the next few years.

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