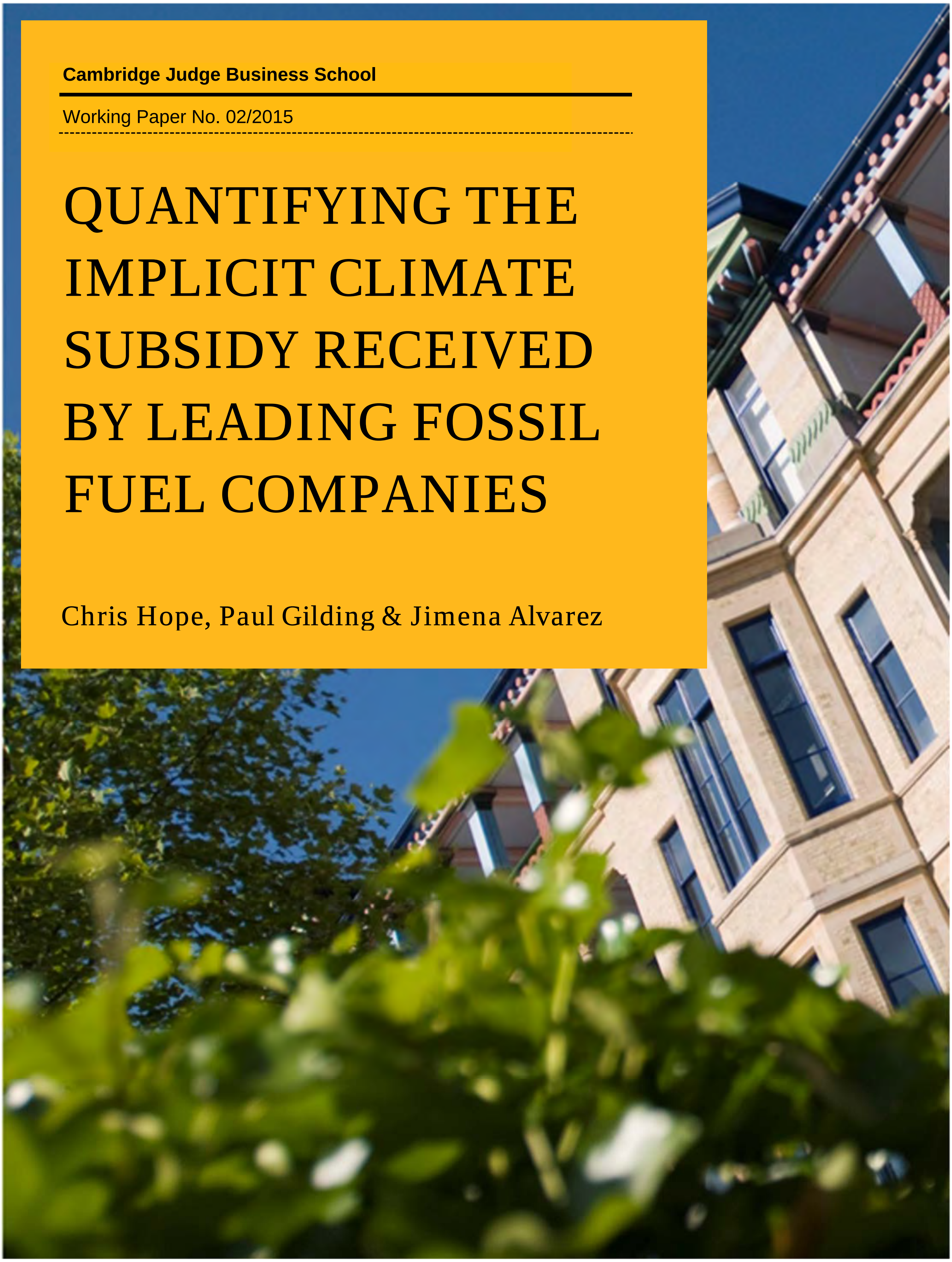

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QUANTIFYING THE IMPLICIT CLIMATE SUBSIDY RECEIVED BY LEADING FOSSIL FUEL COMPANIES

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Quantifying the implicit climate subsidy received by leading fossil fuel companies

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Abstract

Fossil fuel companies sell the products that cause the vast majority of anthropogenic climate change[1]. These companies don't pay for the economic damage these products cause to society. The IMF calculated that in 2011 this implicit subsidy amounted to about $800 billion globally[2]. This implicit subsidy represents a risk to individual companies because as society seeks to reduce or recover the economic costs fossil fuels create, company profits could be lost and assets stranded by the resulting shift to low carbon energy. As a result attempts are being made to identify companies most at risk[3]. However, no company-level model exists to compare present-day implicit subsidies and therefore risk level. Here we calculate these subsidies, by company, for the years 2008 to 2012. For all companies the implicit subsidy exceeded their post-tax profit (averaged over five years). For all pure coal companies, the implicit subsidy exceeded total revenues. There is substantial variation between companies within the same fuel type. We anticipate that these results will be a useful starting point for investors seeking to manage their exposure to climate change risk, and for policy makers interested in fossil fuel companies' net contribution to society.

Introduction

While climate change is accepted as an economic issue, most of the focus and analysis has been on the economic impacts at the national and global level. In recent years this has started to shift, with increasing attention on the risk to individual companies as exposure to "carbon risk" grows as a concern for managers and investors.

However, with the high level of uncertainty on future policy action it is difficult for managers and investors to judge the materiality of carbon risk at the company level, or for investors to compare that risk between companies or across investment portfolios.

This paper proposes a simple and transparent tool to understand and thereby help manage the risk. It applies this tool to most of the leading global fossil fuel extraction companies to show how it could work. The results show it has considerable potential to help managers and investors judge the risk. As an ancillary outcome, it provides a tool that could be useful for society and policy makers as they seek to measure the net economic value added by individual companies and sectors within the fossil fuel industry.

The burning of fossil fuel led to the global emission of 29.5 Gt of CO_2 to the atmosphere in 2008[4,] rising to 31.6 Gt in 2012[5], the last year for which complete records are available.

We analyse 20 of the largest coal, oil and gas companies which were collectively responsible for producing fossil fuels that emitted 7.16 Gt of CO_2 in 2008 (25% of the total), and 7.23 Gt of CO_2 in 2012 (23% of the total). We concentrate on those companies in this analysis, as they represent the great majority of fossil fuel production from companies which have publicly available emission data and financial results.

These 20 companies had revenues of $ 3,032 bn in 2008 and $3,181 bn in 2012, and posted after-tax profits of $ 248 bn in 2008 and $ 275 bn in 2012. All financial figures in current dollars (2008 values in 2008 dollars and 2012 values in 2012 dollars).

It would seem from these figures that the 20 companies as a group are highly profitable, with after-tax profits of about 8.2 % of revenues in 2008 and 8.6 % in 2012. However this does not take account of the hidden economic cost to society that is caused when their products are burned and CO_2 is emitted to the atmosphere. This hidden or externalised cost is an implicit subsidy and accordingly represents a risk to those companies. There is a reasonable chance that society will act to either reduce this societal cost by regulating against fossil fuel use or recover it by imposing carbon prices. Investors are increasingly focused on this risk and seeking to understand and manage it[6].

Calculating the implicit subsidy

The measure that best captures this economic cost to society and therefore quantifies the risk to the companies involved is to multiply the emissions of CO_2 by the social cost of CO_2 ($SCCO_2$), which is the increase in the net present value of global climate change impacts when one more tonne of CO_2 is emitted into the atmosphere[7].

Several estimates of the $SCCO_2$ have been made over the last decade or so[8,9]. The US Environmental Protection Agency (EPA) uses a central value of $39 per tonne of CO2 (in $2011) at a 3% discount rate[8]. A recent study which tried to include the effects of climate change on economic growth as well as consumption estimated a value of $220 per tonne of CO2 in 2015[10]. Here we use the mean estimate from business-as-usual emissions in the default PAGE09 model, one of the three models used by the EPA, of $105 per tonne of CO_2 in 2008[7]. The $SCCO_2$ increases in real terms as the world gets richer, and as the emission date gets closer to the time at which the most severe impacts of climate change are expected to occur. We assume it rises at 2.3% per year in real terms[11] to $122 per tonne in 2012.

Using these values for the $SCCO_2$, the hidden economic cost to society of the 20 companies amounts to $ 755 bn in 2008 and $ 883 bn in 2012. Comparing this to the after-tax profit figures of the companies confirms the findings of the IMF that this economic cost is not trivial. All results are linear in the SCCO2, so finding the implications of using different values is straightforward.

We chose the 20 leading oil, gas and coal producers, based on their production levels and emissions with some geographical spread, constrained by the availability of reliable data. We looked at the five years 2008 to 2012 to even out any unusual market conditions.

After-tax profits and revenue were taken from publically available financial information [17]. The majority of the information on the oil & gas companies contained in our database comes from the Oil & Gas Journal (OGJ) reports (with the exception of part of Pertamina's information which was not available in some OGJ reports) [17 to 24]. The information on the coal companies contained in our database comes from each company's annual reports. Some of the largest oil & gas companies (Saudi Aramco, National Iranian Oil Co., Kuwait Petroleum Corp., Abu Dhabi National Oil Co., Sonatrach, Iraqi Oil Ministry, Qatar Petroleum, Petroleos de Venezuela, Nigerian National Petroleum) were not included in our analysis due to the lack of publicly available financial information.

We estimated emissions using production values from OGJ reports and companies' annual reports. Conversion factors for each fossil fuel are based on Heede, 2013[25]. Impacts are quantified by valuing each ton of emissions at the $SCCO_2$.

$SCCO_2$ values are the mean results from the default PAGE09 integrated assessment model, using business as usual greenhouse gas emissions from the IPCC's A1B scenario[26]. PAGE09 values the impacts of climate change and the costs of policies to abate and adapt to it. All results reported are from 100,000 runs of the model. The probabilistic structure of the model enables consideration of the full spectrum of risks from climate change.

PAGE09 is an updated version of the PAGE2002 integrated assessment model that has been used to value the impacts and calculate the social cost of CO_2[28,29], and value the impacts and costs in the Eliasch review of deforestation[30]. PAGE09 accounts for recent scientific and economic information, primarily in the 4th Assessment Report of the IPCC[31]. A full description of the updated treatment of the science, impact, abatement and adaptation costs in the latest default version of the model, PAGE09 v1.7, and the full set of model equations and default inputs to the model are given in the supplementary material to Hope, 2013[7].

PAGE09 uses simple equations to simulate the results from more complex specialised scientific and economic models, accounting for the profound uncertainty that exists around climate change. Calculations are made for eight world regions, ten time periods to the year 2200, and four impact sectors (sea level, economic, non-economic and discontinuities). All calculations are performed probabilistically, using Latin Hypercube Sampling to build up probability distributions of the results.

Company-level results

Figure 1 shows the hidden economic cost versus after-tax profit for the 20 companies for the five years 2008 to 2012. For each company, the smallest circle is for 2008, with the years connected in order to the largest circle in 2012. Coal companies are shown in black or dark brown, and oil and gas companies in lighter shades of red, brown and orange. Equality of hidden economic cost with after-tax profit is shown by the dashed line in the figure.

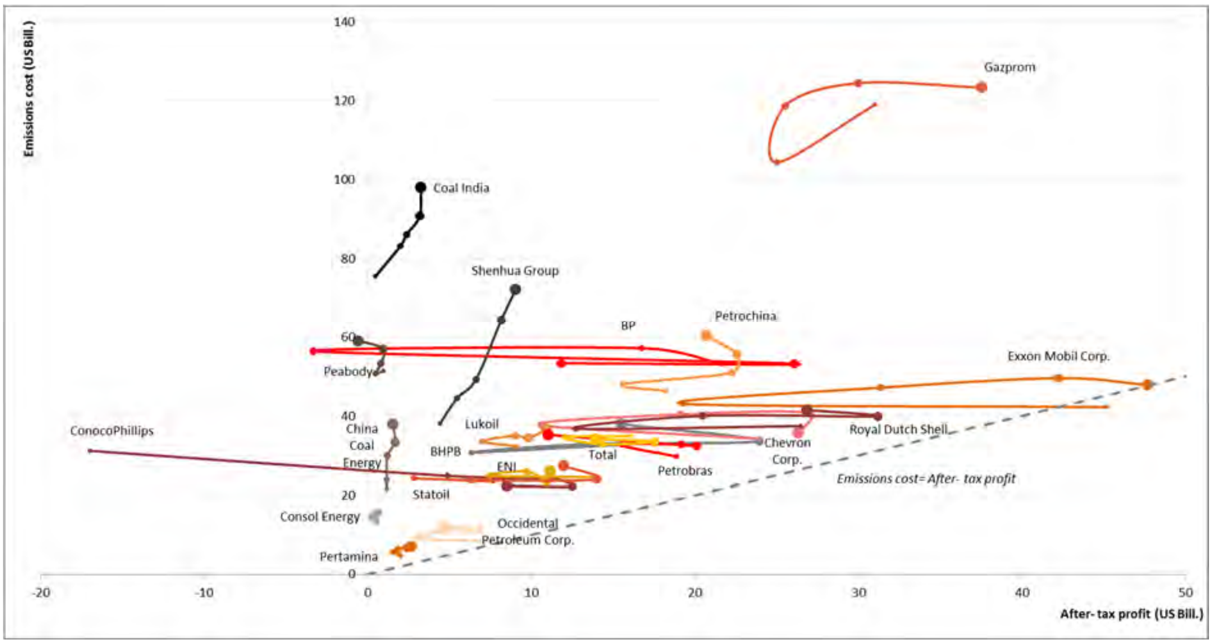

Figure 1: Hidden economic cost versus after-tax profit, by company, 2008 to 2012

For all companies and all years, the economic cost to society of their CO_2 emissions was greater than their after-tax profit, with the single exception of Exxon Mobil in 2008. Three companies had negative after-tax profits for one year.

For companies predominantly in oil and gas, the economic cost to society ranged from around $1 to over $8 for each dollar of company after-tax profit, with a cluster of values around $1.5 - $3. It is only the size of Gazprom that makes it appear an outlier.

For companies predominantly in coal (Coal India, Peabody, Shenhua Group, and China Coal), the economic cost to society ranged from $7 to over $150 for each dollar of company after-tax profit.

Figure 2 shows the hidden economic cost of CO_2 emissions relative to the total revenue for the same 20 companies to provide an alternative reference for those focused on overall societal impact. We include this reference because total revenue captures all societal contributions including employment, taxes, supply purchases, and indirect employment, which might be of interest to policy makers. The three dashed lines show hidden economic costs equal to 10%, 50% and 100% of revenue for reference purposes.

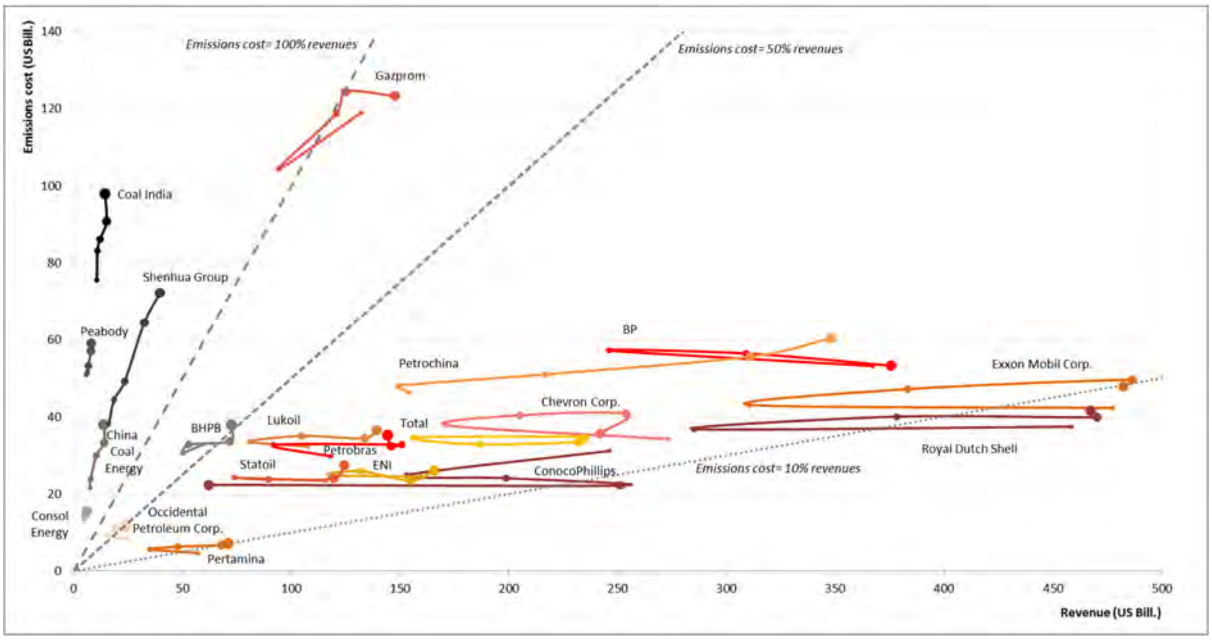

Figure 2: Hidden economic cost versus revenue, by company, 2008 to 2012

For the majority of oil and gas companies, the economic cost to society lies between 10% and 50% of revenues in most years.

Gazprom is the main exception to this pattern, with economic costs to society around 100% of revenues. At the other end of the spectrum, Royal Dutch Shell and Exxon Mobil have hidden economic costs below 10% of revenues in more than one year.

For pure coal companies (Coal India, Peabody, Shenhua Group, and China Coal) the economic cost to society exceeds total revenue in all years, with this cost varying between nearly $2 and nearly $9 per $1 of revenue.

Interpretation

The focus of this paper is on a way to quantify the comparative level of climate change risk for those companies most exposed to it - producers of coal, oil and gas. Our purpose in doing so is to assist managers and investors to understand and manage that risk, by providing

- a simple measure of the materiality of the risk - its size relative to profits and revenue;
- a tool to compare the relative risk between companies and investment portfolios, by measuring risk against profits and revenue in a consistent way.

Given that there is an economic cost to society of not acting on climate change and that climate change is largely caused by fossil fuel use, economic theory would argue that fossil fuel companies are externalising this economic cost of their product’s use to society. That externalised cost is effectively a measure of the risk because at some point the expectation is that society will act to either recover or avoid that cost through regulation, taxes or carbon pricing. This has happened before with other socially and economically damaging products such as asbestos or tobacco.[12]

Fossil fuel producers, as the key economic actors at the point where these products enter the market, are the ones most exposed to this risk. This is because users of the fuel have the option to pursue other options for energy, which are increasingly competitive especially with a carbon price and so may not bear much cost. Fossil fuel companies however simply lose sales and this loss of sales across the economy would also lower the price of the commodity concerned, thus these companies would lose both volume and margin, thereby bearing the brunt of the risk.

As a tool for measuring economic risk to fossil fuel companies, our approach is worthy of further testing and investigation. It warrants comparison with other approaches.

The data shows what intuitively makes sense but with greater precision and therefore sharper differentiation between companies and investment portfolios. This includes that:

- the higher the specific CO_2 emissions from burning the fuel, the greater the risk;
- companies vary significantly in their level of risk proportional to value creation, by factors other than fuel type.

These points would be of particular interest to investors and company managers, because while the data shows the overall risk of investing in fossil fuels, it also shows that the difference between companies is considerable. This could be a useful guide for investors to manage their exposure to climate change risk in ways that are more subtle and defined than simply reducing exposure by fuel type. It would therefore be more useful as an investment tool.

The broader implications relate to this tool's utility for policy makers. For decades a key aspect of the debate over climate policy has been the argument that acting on climate change would cause damage to the economy, that there was an implicit choice between climate protection and the creation of economic value. Our analysis provides data that helps policy makers judge this more accurately and to differentiate between companies and fuel types.

In almost all cases, it shows that fossil fuel companies are costing society more than they contribute in profits, even those producing lower carbon fuels. There is already concern amongst policy makers about direct subsidies for fossil fuels. [13] The analysis in this paper suggests the subsidy is actually much greater than perceived.

This is most extreme in the case of coal where the companies we analysed imposed economic costs on society that were 2 to 9 times their total revenue. Even with the most generous interpretation of economic value created by a company (considering jobs, taxes, royalties, supply chain purchases, indirect employment etc) their net economic contribution to society is negative, in some cases dramatically so.

The implicit subsidy to fossil fuel companies is linear in the $SCCO_2$. The mean $SCCO_2$ value of a little over \$100 in 2008 applies to one more tonne of CO_2 emitted on top of the business as usual emissions from IPCC scenario A1B. But if climate change is recognised as a serious problem, it would be perverse to continue to allow emissions to rise like this, even though that is what seems to be happening at present. Suppose instead that global CO_2 emissions decline by about 50% by 2050, and 80% by 2100, giving peak CO_2 concentrations of slightly under 500 ppm, and a 50% chance of limiting the global mean temperature rise since pre-industrial times to 3 degC. The PAGE09 model estimates that an extra tonne of CO_2 emitted in 2010 on top of this lower emissions scenario would have a mean $SCCO_2$ of about $80 [27]. The reduced chance of a discontinuity in this scenario, and all that that implies, means that the extra impact from one more tonne of emissions is lower than if emissions are allowed to grow unchecked. If this lower emissions scenario were to come about, all the implicit subsidy results in this paper would be reduced by about one quarter. While this changes the implications in quantitative terms, particularly for policy makers, it doesn't change the usefulness of the approach for measuring comparative risk between companies and investment portfolios.

The mean $SCCO_2$ is the value as measured by someone with the mean GDP per capita in the EU. It will be higher for a richer person and lower for a poorer one. In future work it may be possible to adjust the economic cost according to the region in which the company primarily operates, but this is not without problems. For instance, should the region be where the fuel is produced, where the company is quoted, or where most of its shareholders live?

Our analysis only includes the externalised cost of CO_2 emissions. If the broader economic subsidy implied by other social costs were taken into account, such as health and air pollution, the costs to society would be even greater. Coal combustion releases sulphur and other particulates that are known to be hazardous to human health. According to a major review on the life cycle of coal cost in the US, the overall 'external' costs of coal amount to a " third to over one-half of a trillion dollars annually. Accounting for the damages conservatively doubles to triples the price [of electricity] from coal per kwh generated" [14] while "air pollution is about half the total in their central estimates, which focus on the Appalachian region" [14,15] . Another study on environmental accounting for pollution in the US estimated that the environmental cost of air pollution from coal power stations in the US is larger than their 'value added' with coal- fired electric generation damages ranging from 0.8 to 5.6 times its 'value added'.[15,16]

Conclusion

The idea that climate change has economic consequences and that this presents risks to companies extracting and selling fossil fuels is of course well understood. While accepted at least in principle by most company managers and investors, the challenge has been to define and measure that risk in ways that are more useful than just knowing it exists. Investor coalitions such as Ceres have examined the levels of climate change risk but do not suggest any available quantitative tools[32]. The Oxford Smith School Stranded Assets Programme explores these issues and concludes there is a need for more tools to assess the risk better.[33]

Applying the methodology in this paper goes some way to addressing this need. It provides a simple, freely available tool that allows a quantifiable metric for direct comparison between companies. This can help managers to understand the risk more precisely and investors to develop risk reduction strategies across portfolios, based on a solid foundation.

The economic cost to society per dollar of profit is a useful simple measure of carbon risk. It is not a literal measure of the future financial liabilities of a company, as society is unlikely to apply the full costs to the companies concerned, at least not retrospectively.

We accept the range of uncertainty in measuring the net cost to society of a tonne of carbon dioxide emissions but note that uncertainty goes both ways - the cost could be higher than our mean estimate as well as lower. However, these limitations do not undermine the usefulness of this approach to identifying:

- the level of materiality of the risk,
- the comparability between companies and fuel types, and
- the companies' net economic contribution to society.

Therefore we conclude it is a useful and timely addition to the tools needed by managers, investors and policy makers.

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