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Uncertainty Markets and Carbon Markets: Variations on Polanyian Themes

LARRY LOHMANN

Enormous new markets in uncertainty and in carbon have been created recently, ostensibly to enhance the cost-effectiveness of both finance and climate action. In both cases, however, creating the abstract commodity framework necessary to make sense of the notion of 'cost-effectiveness' has entailed losing touch with what was supposedly being costed, helping to engender systemic crisis. The new financial markets expanded credit and multiplied leverage by isolating, quantifying, slicing, dicing and circulating diverse types of uncertainty; the resulting unchecked pursuit of liquidity led to a catastrophic drying up of liquidity. The carbon markets, meanwhile, by identifying global warming solutions with reductions in an abstract pool of tradable pollution rights and linking them with 'offsets' manufactured through quantitative techniques, ended up blocking prospective historical pathways toward less fossil fuel dependence and thus exacerbated the climate problem. Unsurprisingly, both markets have provoked strong, if diverse and confused, movements of societal self-defence. This pattern of action and reaction constitutes a chapter in the political history of commodification as significant in some ways as that describing the movements to commodify land and labour analysed by Karl Polanyi.

Keywords: Cap and trade, climate policy, offsets, financial crisis, derivatives, carbon trading

Introduction

> 'We built a system that was much more dangerous than anyone thought.'
> (Simon Johnson 2008, former IMF Chief Economist)
>
> 'What, exactly, are we trading in?'
> (*Environmental Data Services Report* 2004)

This article proposes parallels between the financial innovations that have contributed to the credit crisis and the innovations feeding carbon trading, currently the main official approach to climate change worldwide. The first section suggests that the enormous growth in the derivatives markets since the 1970s constitutes

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a wave of commodification of certainty/uncertainty met by a Polanyian 'counter-movement' of societal self-defence. New commensuration practices transforming this 'fictitious commodity' into a target for expanded investment, developed by 'quants', financial institutions and regulators, helped make possible a huge expansion, then a catastrophic collapse, of credit, in the process creating vast if temporary opportunities for profit taking by financial firms. After reviewing some of the basics of carbon markets, a second section then explores parallels between carbon and uncertainty markets: both markets have seen the construction of similar abstract commodities, largely by centralised corps of quants and traders; both have faced contradictions, 'overflows' and movements of societal self-protection owing to the hazards connected with the ways that they 'disembed' various survival goods from one context and 're-embed' them in another; both involve the destruction of crucial knowledge and regressive redistribution; both are vulnerable to bubbles and crashes; both erode transparency; and both call into question the assumption that all markets can be successfully regulated. A concluding section draws some of the threads together in reiterating the value of comparative study of the two new markets.

Uncertainty markets

Taking as inspiration Karl Polanyi's (2001 [1944]) treatment of the 'fictitious commodities' of land and labour, this section looks at the political dynamics and attempts at regulation following on from the formation of a related 'fictitious commodity': the cluster of phenomena referred to by such terms as security and risk, certainty and uncertainty, safety and danger, and determinacy and indeterminacy. Like the commodification of land and labour, it will argue, the 'framing' – to borrow Michel Callon's (1998) term – of a wide range of uncertainties as commodities leads to 'overflows' and a dynamic of resistance, retrenchment and more or less fumbling attempts at societal self-defence that Polanyi called the 'double movement'.

Before the 1970s, perhaps the most important examples of the commodification of uncertainties were insurance and gambling. Traditional insurers commodified uncertainty by accepting bets that their policy holders would not die or their houses burn down over the next, say, 10 years. Traditional gambling or lottery establishments provided liquidity to an uncertainty market that they themselves helped create by taking one side of a range of transactions designed to tempt clients into speculating. Both tended to limit their commodification of uncertainty to artificially landscaped, highly constrained environments. Traditional insurance typically commodified uncertainty only where it could attach calculable, independent probabilities to the possible outcomes. It recruited law enforcement to help prevent or deter policy holders from activating payouts by killing themselves or burning down their own houses – that is, it stopped them from treating lives and homes as if they were fully commensurable with monetary payouts.[1] Casinos emphasised games (roulette, slots, blackjack) whose odds were independent and could be precisely calculated, placed limits on amounts staked, deployed state-of-the-art surveillance technology, frowned on customers betting other people's money without their knowledge, and generally did their best to ensure that, in the long term, the house always won.[2] In addition, casinos, like traditional gambling generally, were hemmed in by legal, geographical and moral restrictions aimed at discouraging vulnerable punters from addictively gambling their possessions and lives away – limitations parallel to those placed throughout the world on the commodification of land, food and labour to help shield households, livelihoods and nations from catastrophe.[3]

After the 1970s, the commodification of uncertainty and indeterminacy expanded far outside these traditional limits. As the US abandoned its commitment to redeem debts in gold, allowing its deficits to swell endlessly and the Bretton Woods agreements collapsed under the pressure of increasing international capital flows, industrialised-country states withdrew from the task of 'securing the present to the future' (Bryan and Rafferty 2007: 140) using fixed exchange rates, stable interest rates, commodity price stabilisation and the like. To handle these and other uncertainties of a globalised, deregulated business environment, derivatives rode to the rescue. Interest rate options were a privatised 'insurance' solution to the interest rate uncertainties opened up by liberalisation. Credit derivatives could be used to lay off and manage exposure to supplier default, and so on. But the new derivatives involved social transformations undreamed of by conventional insurers. New ranges of uncertainties had to be commodified, and the resulting markets needed to be liquid, with interested parties able to buy and sell securities as their needs demanded (LiPuma and Lee 2004: 21). Capital and credit controls were challenged as 'inefficient', a block to the growth of the liquidity that traders assembling diversified international portfolios needed if they were to provide a privatised solution to privatised uncertainty. Default risk was detached from loans so that it could be bought and sold separately. Price uncertainties were separated from their underlying assets and from the political aspects of commerce, repackaged, made commensurable with new things, mathematised, 'liquified' and sent through global commodity circuits. Disembedded from local contexts, uncertainties were simplified and re-differentiated along various numerical scales to help create thing-like products tailored to the degree of risk-averseness of every investor. Just as objectified, abstracted 'land' and 'labour' had emerged with the early modern European transformation of agriculture and gathering, so an objectified, abstracted, commodified 'risk' emerged as a new reality as well as a new term of economic and financial art.[4]

Speculation and credit creation

Like other financial innovations, the derivatives that at first appeared merely to be new forms of insurance quickly began to 'succumb to rampant speculation, as investors tr[ied] to exploit them' (*The Economist* 2008). Whereas in the 1970s most currency exchange was for financing international purchases of goods and services, by the 2000s the figure was less than 0.1 per cent (Hart 2001: 161–2); the rest comprised a new, gigantic form of gambling. Derivatives investors could buy exposure to movements in the value of oil without having to lay out any money for oil themselves. They could make money betting on the volatility of stock prices or the solvency of companies with which they had no connection. Interest rate swaps were transformed into barely comprehensible instruments that greatly increased profits if wagers came off and led to skyrocketing losses if they did not. In a treadmill effect, speculators' provision of market liquidity amplified volatility, which in turn increased the need to hedge and, again, 'the profit opportunities for speculatively driven capital' (LiPuma and Lee 2004: 21–2).

In giving rise to this 'modern machinery of speculation' (Eatwell and Taylor 2000: 2) the derivatives revolution also provided what George Soros called 'ever more sophisticated means of credit creation' (Saber 2007: 41) through the agency of a swelling menagerie of alpha-hungry hedge funds, index funds, capital management firms, brokerages, private equity firms, financial products divisions, and so forth, together with various new trading floors. 'Thingifed' uncertainties could be packaged up and sold off to investors who were 'not subject to supervision and persuasion by the regulatory authorities' (Soros 2008: 115) or insurers with lighter capital reserve requirements. Using structured investment vehicles, investment banks could park commodified uncertainties off their balance sheets, again bypassing reserve requirements and enabling more lending. As calculation began to supplant collateral as means for handling uncertainty, and low default correlation figures were substituted for the principle of diversification, leverage expanded enormously.

The implicit social contract justifying this transformation held that it would make possible more productive and 'efficient' cultivation of the future. Apologists for the new markets (like apologists for the European enclosures of the eighteenth and nineteenth centuries or apologists for industrial agriculture), tried, especially when talking to relative outsiders, to characterise the new arrangements as an 'efficient', politically neutral, technical rearrangement of pre-existing materials rather than as the outcome of politically interested demands for radical commensuration. For example, a 1999 JP Morgan *Guide to Credit Derivatives* discoursed complacently about how credit derivatives 'allow even the most illiquid credit exposures to be transferred to the most efficient holders of that risk' by 'separating specific aspects of credit risk from other risks' (Tett 2009: 81). Such forms of 'unbundling', elaborated Alan Greenspan, then Chairman of the US Federal Reserve,

> improves the ability of the market to engender a set of product and asset prices far more calibrated to the value preferences of consumers ... and enable entrepreneurs to finely allocate real capital facilities to produce those goods and services most valued by consumers, a process that has undoubtedly improved national productivity growth and standards of living. (Tett 2009: 8)

Such glib statements were based on a tacit inference nearly identical to one that later came to underpin carbon trading:

(1) If the feat of disentangling, isolating, commensurating and quantifying a new range of uncertainties could be accomplished, it would help maximise efficiency and resilience; *therefore*,
(2) It must be the case that this feat can be (or already has been) accomplished.

In reality, what securitised debt most visibly made possible, in addition to huge profits for financial institutions, was an explosion in lending for houses, cars and individual consumption: lenders went wild as soon as they began believing that they could 'sell off' any risk they accrued to manufacturers of collateralised debt obligations or credit default swaps, which had become all the rage among investors. In Margaret Atwood's (2009: 8) memorable summation, banks 'peddled mortgages to people who could not possibly pay the monthly rates and then put this snake-oil debt into cardboard boxes with impressive labels on them and sold them to institutions and hedge funds that thought they were worth something'. A special attraction of such practices for both the US and UK governments was that they looked to be a 'technical fix' for potential popular discontent over stagnant incomes, worsening maldistribution of wealth and the growth in power of the super-rich (Funnell 2009). The value of securitisation issues grew more than five times in the US, Europe, Australia and Japan in the decade to 2006 alone. In 2005, US households raised $4.75 trillion against the value of their homes, compared with only $106 billion ten years earlier. Two-thirds went to personal consumption, home improvements and credit card debt, helping maintain (over)production of export consumer goods by countries such as China.

The hard work of commodification

In reality, too, instead of being a fundamentally unproblematic technical procedure, the task of disentangling, isolating, commensurating and 'thingifying' uncertainties involved painstaking, innovative, contingent political work by a variety of interested actors, including regulators. Polanyi's famous dictum '*laissez faire* was planned; planning was not' holds as good for the finance of the turn of the twenty-first century as it did for the labour and land markets of the turn of the nineteenth.

This planning – or, perhaps more accurately, this *bricolage* – was problematic at every point. As in the eighteenth and nineteenth centuries, the mechanisms of commodification, by virtue of the very simplifications that allowed them to function, became time bombs of ignorance. First, essential to making a wide new range of unknowns market-friendly (sliceable, diceable, sellable, buyable) was, roughly, the 'mystification of uncertainty or contingency as if it were measurable as probability' (Gudeman 2008: 141).[5] Integrating this mystification into uncertainty commodities was largely the job of computers and quantitative experts ('quants') steeped in the efficient markets hypothesis. The Black–Scholes equation published in 1973 helped expand the options market by offering a streamlined, academically sanctioned way of calculating prices for uncertainty using reference sheets, calculators and computers. David Li's Gaussian copula model, devised in 1999, similarly became the 'combustion engine of the collateralized debt obligation world' (Tett 2009: 121), making the mass production of structured finance deals possible by displaying how corporate or mortgage defaults might correlate, thus helping to mechanise the production of confidence in ways that made the provision of credit vastly more 'cost-effective'. One result, as financial journalist Sam Jones (2009: 35) recounts, was that

> [t]he CDO market exploded. In 2000, the total number of CDOs issued were worth somewhere in the tens of billions of dollars.

> By 2007, two trillion dollars of CDO bonds had been issued. And with so many investors looking to put their money in debt, that debt became incredibly cheap, fuelling a massive boom in house prices and turbo-charging the world's economies.

Value-at-risk methodologies seeming to display in a single number how much a financial institution could lose in an unfavourable scenario, meanwhile reassured executives that they were not accumulating unmanageable uncertainties in their ever more complex trading positions. 'Pricing tools that purported to be able to summarize überly complex trades into one neat number', explains trader Pablo Triana (2009: 99), 'convinced bank executives and trading floor honchos that restraint would be a wasteful course of action.'

The executives and honchos were clearly ready to be convinced. The nominal value of markets in derivatives including futures and options on interest rates, currencies and commodities, credit default swaps and so on grew from virtually zero in 1970 to nearly US$100 trillion in 2000 and $680 trillion in 2008, many times the economic value of global output (Bank of International Settlements 2008: A103). Between 1998 and 2007, the number of quantitative-based equity funds relying principally on computer programmes increased from around 130 to about 800, as mechanical computation multiplied in importance across the financial world (Cooper 2008: 28; Triana 2009: 84). Hedge funds increased in number from 3,000 in 1996 to 8,900 in 2006, their assets growing more than 10 times (Ertürk et al. 2008: 12). Taking on a life of its own, derivatives trading helped smudge and eventually almost obliterate the distinctions among insurance, portfolio capital, speculative capital, investment banking and retail banking (Prins 2008: 50; Soros 2008: 115; Kay 2009: 217–25; Luce 2009: 1; Tett 2009: 143). In the words of trader-physicist J.P. Bouchaud (2008: 1181) of Capital Fund Management, models that priced structured financial products involving subprime mortgage risk provided the 'credit mongers of the financial industry' with ways 'to smuggle their products worldwide'. By 2008, brokers, hedge funds and special investment vehicles controlled US$8 trillion in assets, compared with $10 trillion on the balance sheets of banks. Unregulated shadow banks and brokers were so closely connected with commercial banks that they were not only '"too big to fail", they were too interconnected to ignore' (Tett 2009: 263). Credit ratings agencies – which drew their fees from the companies whose offerings they were rating and thus had a vested interest in making favourable judgements – also put their faith in the mathematical models that legitimated the assembly lines. In 2004, both Moody's and Standard & Poor's began to rate collateralised debt obligations using a type of mathematical formula that financial firms themselves used in the production of derivatives (Jones 2009: 35). By 2005, Moody's was drawing nearly half of its revenues from the structured finance sector (Partnoy 2003: 119). Regulators, who since the 1970s had been deferring to the agencies when promulgating rules, also became more model-dependent, as did risk officers (Partnoy 2003: 66, 387–8; Soros 2008: 116–17). International financial regulations formulated in the late 1980s allowed banks to use their own models to calculate risk and judge how much capital to set aside (Tett 2009: 162). By 2000, even some acute critics of the financial sector saw it as regulators' fate always to be ‘running several paces behind the market’ (Eatwell and Taylor 2000: 191). As the commodification of uncertainty and the provision of credit exploded, in other words, institutional boundaries were obscured while remaining checks and balances themselves became entwined with the ‘commodified’ ways of thinking (Taleb 2007b: 147) that the mathematical models encouraged.

A second aspect of the ignorance generated by the uncertainty products emerging from the new assembly lines was that, as a part of their ‘added value’, they distanced their buyers from the context of the ‘underlying’ – for example, the mortgages and the houses they were written on. What counted as trust was progressively disentangled from one context (for example, the ‘thick’ sets of information and varied non-calculative, often personalised social practices that had previously defined it) and re-embedded in another (for example, the innovative commensuration methodologies deployed by transnational financiers and quants, and the networks of mutual back-scratching that issued in the spectrally ‘thin’ codes of credit ratings) (Lapavitsas 2007: 416). To adapt a phrase of Mervyn King, Governor of the Bank of England, ‘my word is my bond’ was transformed, through commodification, into ‘my word is my collateralised debt obligation squared’ (Wolf 2009). Value chains became so long that few could guess how, say, defaults in the housing market might affect the cash flows of investors.

Yet what the models communicated to customers, governments and the public was that the disentanglement of trust from judgement, lending from capital reserves and so forth constituted an objective improvement in managing risk. By the same token, the Black–Scholes option pricing equation helped make long-standing suspicions that derivatives trading involved gambling ‘fall away’. ‘It wasn’t speculation or gambling, it was efficient pricing’ (MacKenzie 2005: 18). Such reassurances were as crucial to commensuration in modern finance as they were to the emergence of significant global food prices several centuries ago. Even now, many pundits on both right and left prefer to repeat simplistic, boilerplate explanations for the credit crunch (‘greed’, ‘lack of regulation’, ‘the internal dynamics of capitalism’, ‘too much lending during a property boom’) rather than question a narrative charting the inexorable progress of financial technology.

Blowback

The new derivatives plays were far more dangerous than either traditional gambling or traditional insurance. The new models and the institutions that surrounded them were no substitute for the institutions that had held in check the threats posed by traditional gambling, and that had provided the needed social context for traditional insurance. Taking advantage of a legal and moral imprimateur that had, ironically, always been denied to the less threatening activity of traditional gambling, the models helped spread a gigantically expanded range of esoteric betting practices around a vast, untended landscape ill-prepared to control them, magnifying existing dangers and creating ones where there had been none before. Many of the new financial practices misleadingly pilloried as ‘casino capitalism’ (Cassidy 2009: 10–13) are in fact so hazardous that no casino could get away with them and stay in business and no Gambling Board hope to regulate. For example, unlike casino bosses who are generally able to construct a near-sterile world in which the models crucial to sustained profitability work, traders using Li's correlation model found that their world was constantly being contaminated by new uncertainties and dangers deriving from the model itself:

> [T]he more that banks all relied on the Gaussian copula approach, the more they were creating a new form of correlation risk. Because everyone was using the same statistical method of devising their collateralized debt obligations to contain risk, in the event of economic conditions that defied that modelling, huge numbers of CDOs would suffer losses all at once. (Jones 2009: 35)

Model-influenced trading magnified adverse market movements and correlated hitherto relatively uncorrelated markets, helping bring about events that the models suggested could only happen once in millions of years (MacKenzie 2000; Holzer and Millo 2005; Tett 2007; Blackburn 2008). Instead of making a portfolio safer, trading away foreign exchange or interest rate risk involved 'swapping everyday risk for the exceptional risk that the worst will happen and your insurer will fail' (*The Economist* 2009: 14).

By the same token, the more efficient 'insurance' supposedly facilitated by the new, liquid uncertainty commodities was in some ways the opposite of insurance, creating and exacerbating risks instead of protecting against them. As John Meriwether, the legendary trader associated with the ill-fated firm Long Term Capital Management, noted, while insurance policies are not supposed to affect the likelihood of the events insured against, 'in financial markets this is not true. The more people write financial insurance, the more likely it is that disaster will happen because the people who know you have sold the insurance can make it happen' (Bookstaber 2007: 112).

Similarly, American International Group (AIG) continued to call itself an insurance company when, in the 1990s, it began to insure not only houses but also the mortgages on those houses by issuing derivatives, selling billions of dollars in guarantees against the default of tranches of super-senior debt in collateralised debt obligations manufactured by banks such as Merrill Lynch. But in fact, by attempting to apply what financial journalist Matthew Philips (2008) calls 'traditional insurance methods to the credit default swap market', AIG was venturing into a jungle far outside the manicured turf on which insurance usually operates:

> There is no correlation between traditional insurance events; if your neighbour gets into a car wreck, it doesn't necessarily increase your risk of getting into one. But with bonds, it's a different story: when one defaults, it starts a chain reaction that increases the risk of others going bust. Investors . . . start to bail, the markets freak out and lenders pull back credit.

The stock in trade of 'hedge' funds, by the same token, is a long way from what the prudential farmer of yesteryear would have understood as a hedge – that is, an insurance policy against losing the costs of production. As Nick Hildyard (2009) explains, hedge fund clients

> are after 'alpha' – the higher-than-market returns that (supposedly) come from active management. Their target is returns – typically 15–20 per cent – that are uncorrelated to movements in the market. This is achieved by betting not only on the price of assets going up but also on them going down.

Hedge fund activity is so far removed from the safety-first 'peasant goal' of minimising the risk of losing money through a declining market that it might be said to lie at the other end of the prudential spectrum entirely.

Neither the contingent and precarious nature of the *bricolage* that made the new commodification possible, nor the larger dangers that it entailed, was ever a secret on Wall Street. Realising that quantist formulas for cultivating the future both oversimplified it and destabilised it in dangerous ways, brainy, experienced traders working close to the coal face had pointed out early on that while heavily model-driven commodification of uncertainty might temporarily expand profit opportunities, it made crashes inevitable. The billionaire speculator George Soros (2008: 71), for example, joined followers of the Keynesian economist Hyman Minsky in pointing out that the inherently unstable, anti-equilibrium tendencies of financial markets made them resistant to quantist modelling (Eatwell and Taylor 2000: 208–9; Kindleberger and Aliber 2005: 43). The options trader Nassim Nicholas Taleb (2007a) became notorious for warning model-dependent financial institutions that they were, in effect, 'picking up pennies in front of a steamroller'. Even mainstream manuals for financial practitioners pointed out that the increased leverage made possible by the new commodification of uncertainties tended both to expand bubbles and to deepen crashes when calls were made on reserve capital, turning 'efficient market' theories upside down (Wiseman 2001: 101). Noting that quantist risk management increased confidence 'to inappropriate levels', George Cooper (2008: 147) of Alignment Investors likened it to the 'proverbial chocolate teapot; it works only while not in use'. The derivatives veteran Satyajit Das (2006: 177) contributed satires on the logic that drives risk management toward the status of 'pure entertainment,' with quants pushed into the absurdity of pretending to be able to model every eventuality including road accidents involving bankers on bicycles. Even bank executives eager to defend quantism acknowledged that 'a model is inherently wrong, because a model only looks backwards' (Fink 2009); Fischer Black (1988, 1989), one of the most famous of all quants, was himself well aware of 'The Holes in Black–Scholes'. It was common knowledge, too, that the models' self-defeating tendencies were bound up with the scale, speed, complexity and tight integration of modern financial transactions that they helped make possible (Bookstaber 2007: 188; Tett 2009: 86). By 2005, Timothy Geithner, then of the Federal Reserve, was quietly admitting that credit derivatives, if they made the system more stable in places, seemed to do so 'at the price of making the system more unstable at the tail' (Tett 2009: 185). As the hedge fund practitioner Richard Bookstaber (2007: 240) put it, 'in the instances where it really matters the liquidity that is supposed to justify the leverage will disappear with a resulting spiral into crisis'. In vivid contrast to the academic economist Kenneth Arrow, who had envisaged a security for every condition in the world, with every uncertainty becoming a commodity that could be transferred to someone else (Stix 1998: 97), Bookstaber (2007: 259) insisted that 'just because you can turn some cash flow into a tradable asset doesn't mean you should' and that 'limitless trading possibilities might cause more harm than good'. He cautioned that a coarser, less 'sophisticated', more resilient approach was needed:

> Rather than adding complexity and then trying to manage its consequences with regulation, we should rein in the sources of complexity at the outset . . . reduce the speed of market activity [and] the amount of leverage that comes as a result of the liquidity. (Bookstaber 2007: 260)

However, a number of factors discouraged any such move toward decommodification. First, traders who actually understood the models compensated for their unworkability by relying on the 'dark twin' (Scott 1999: 331) of older 'heuristics and tricks' and a vernacular understanding of possible scenarios that they had acquired through long, everyday practice (Haug and Taleb 2009). This had the effect, intended or not, of hiding the shortcomings of the prominently displayed model engines from technically inexperienced higher-ups, clients, governments and the public. Second, many traders used the failures of the models as money-making opportunities, thus ironically shoring up the dominance of the models by becoming trading partners of more gullible quantist true-believers (Tett 2009: 155). Third, the simplifications required for commodification paradoxically led to enormous complexity partly due to unrelenting pressures on quants to come up with one technical fix after another in an attempt to try to meet the resistance of the uncertainties involved to being probabilistically framed – an obscurity-generating perpetual motion machine that also played a part in concealing the underlying hazards of the trades being made. Risk managers and regulators stoked a similar machine when, ignoring the fact that 'if risk management can fail in unanticipated ways, then adding more controls can't address the issue' (Bookstaber 2007: 240), they tried to deal with the dangers thrown up by commodification by adding new levels of commodification. Sisyphean though this task was, it could be relied upon to provide lucrative employment for many. Fourth, and most obvious and most important, the acronym-rich complexity generated by commodification was a useful smokescreen behind which non-systemic dangers could be lucratively passed on to customers and systemic dangers passed on to governments and taxpayers. If quants kept wheeling out new derivatives 'combustion engines', it was not because no one saw the pollution they gave off or failed to spot their tendency to break down or get into motorway pileups. More plausibly, it was because, beset by irresistible competitive pressures to maintain or ramp up production of profitable uncertainty commodities, quants, traders, bankers and politicians alike found themselves unable to answer their own question, 'what is the alternative?' (Tett 2009: 154). Whatever promised productivity, however temporary, had to be treated as, in principle, perfectible. Among quants, traders, executives, risk managers, journalists, governments and the interested public alike, obligatory admissions that models were 'inherently wrong' were typically interpreted as implying that they were 'approximately right', or, in line with Milton Friedman's famous doctrine of positive economics, 'heuristically useful' (Friedman 1953).

Again, an analogy with land may be useful. Modern wood product manufacture tends to rely on 'framing' large tracts of land for maximum, relatively short-term, commercial production of uniform timber or pulpwood. Land is surveyed, examples of desirable species tagged, their 'fit' with existing machinery assessed, and return per hectare of various types estimated. Stands are thinned and biodiversity and human habitation that is 'extraneous' to the varieties selected is reduced or eliminated. Ultimately, serried, factory-friendly monocrops of species can be planted, perhaps followed by rows of clones or even trees engineered to be genetically identical. 'Wood' becomes a standardised, fungible, mobile product. State and market actors working through such processes often understand that they are drastically simplifying the landscape both in 'theory' and in 'reality'. What they 'see' when they look at the original landscape is largely a substrate for the maximal or optimal growth of the particular species appropriate for the machines available. Following through on this vision results in an even more reduced 'reality'. Relationships centring on the land that are 'extraneous' to maximum wood production are disentangled and separated out from it in the name of efficiency. Many wood industrialists may well understand that, far from applying a 'theory of sustainable maximal wood production' which, if false, will automatically and benignly correct itself through iterated encounters with distinct biological or social realities, they are in fact stoking the likelihood of long-term systemic 'blowups' resulting from soil depletion, pest infestations, disease, genetic erosion, farmer revolt, catastrophic fire, and other social and environmental consequences of extreme simplification (Carrere and Lohmann 1996; Scott 1999). As in the world of credit derivatives, overreaching attempts to maximise the system's 'productivity' by continuing to seek gains at the margin threaten to crash it altogether if things go wrong. Whether or not they grasp this, however, wood industrialists have incentives, when encountering precursors of crisis, merely to add technical fixes to the original package, and then additional technical fixes that attempt to fix the problems brought on by the fixes, and so on. The inevitability of a reckoning, unpredictable in its timing and damaging depending partly on how much land has been staked on the experiment and how extreme the simplification procedures deployed, does not entail that they are acting unreasonably given their interests and the market's requirements (compare Bebchuk and Spamann 2009). Like quants and the bankers that depended on them, wood industrialists and the foresters they work with find themselves subject to a social context in which they are typically unable to answer their own question: What is the alternative? Yet a narrative of progress through forestry expertise helps them defend their position both before and after crisis hits.

Carbon markets

The growth of uncertainty markets from the 1970s onwards was accompanied by another equally sweeping movement of commodification: the invention of pollution markets and, ultimately, carbon markets. As financialisation gained momentum, governments and financial and energy interests facing potential popular unrest due to a deepening climate crisis were encouraged to turn to quants for help in developing a 'commodity' or neoliberal solution to global warming, just as some of the same interests had earlier sought a commodity solution to new commercial uncertainties. A landmark date was December 1997, when the Bill Clinton administration, citing the precedent of a US programme to trade sulphur dioxide, successfully pressed for the United Nations' Kyoto Protocol to be turned into a set of global pollution trading instruments. Vice-president Al Gore, who carried the US ultimatum to Kyoto, became a carbon market actor himself; his Generation Investment Company has become the largest shareholder in Camco, holder of one of the world's largest carbon asset portfolios. In the 2000s, Europe picked up the initiative to become the host of what is today the world's largest carbon market, the EU Emissions Trading Scheme (EU ETS). Today, the project of building a single, liquid global carbon market worth many trillions of dollars – backed by the UN, national governments, economists, well-funded Washington green groups and many in the business sector – is the main official approach to the climate crisis worldwide.

Significantly, some of the same *bricoleurs* and theorists have helped nurture both the financial derivatives markets and the carbon markets. One example is Richard Sandor, a US economist and trader who was one of the originators of interest rate derivatives in the 1970s and who later made a fortune during the boom years of the 1980s at Drexel Burnham Lambert, the firm of the junk-bond innovator Michael Milken (Goodell 2006). Sandor also collaborated with Howard Sosin (Sandor and Sosin 1983), who subsequently helped set up and head the financial products division that ultimately laid AIG low to the point of having to be bailed out by US taxpayers to the tune of over US$150 billion (O'Harrow and Dennis 2008; Lewis 2009). Encouraged by a big Washington environmental organisation, Sandor helped develop the idea of pollution trading in the 1980s and 1990s and, in the 2000s, with philanthropic support, set up the Chicago Climate Exchange. Similarly, Ken Newcombe, an executive at the World Bank, a long-time derivatives promoter, helped set up the global carbon market at the Prototype Carbon Fund before moving on to Climate Change Capital (a boutique merchant bank), Goldman Sachs' carbon trading desk, and the carbon trading firm C-Quest Capital.

Today, the same institutions that are most active in derivatives are also moving to dominate carbon. Among the main investors and speculators in carbon commodities are – in addition to Goldman Sachs – Deutsche Bank, Morgan Stanley, Barclays Capital, Fortis, Rabobank, BNP Paribas Fortis, Credit Suisse, Sumitomo, Kommunalkredit, Merrill Lynch and Cantor Fitzgerald. JP Morgan Chase has snapped up the carbon offset firms Climate Care and EcoSecurities. As with derivatives, a host of specialised new institutions have also been set up that deal in the new pollution commodities, with names like Sindicatum Carbon Capital, NatSource Asset Management, New Carbon Finance, Carbon Capital Markets, Trading Emissions plc, South Pole Carbon Asset Management, Noble Carbon and so forth. By 2008, about 80 carbon investment funds, largely oriented toward speculation, were managing nearly US$13 billion (Caisse des Depots 2007).

The remainder of this article will use parallels with the new uncertainty markets in order to explore further the political economy of carbon markets. An introductory section will lay out the basic steps through which the new carbon products are created. The two components of carbon markets – cap and trade, and offsets – will then be considered separately. Like the uncertainty markets, carbon markets (which may someday rival them in size) produce highly abstract commodities, partly through quantist procedures characterised by suppression of unknowns, contested quantifications, and lack of transparency. Like uncertainty markets, they select for 'cost-effectiveness' so single-mindedly that they end up interfering with the goal that was to be attained 'cost-effectively'. Like uncertainty markets, too, carbon markets are dominated by speculators, create 'time bombs' of ignorance, and are propped up by the dogma that all imaginable markets must be regulatable. Encouraging the accumulation of 'toxic' assets, they are vulnerable to bubbles and crashes that have particularly grave implications in view of the fact that – to cite the words of British Climate Camp activists – 'nature doesn't do bailouts'. Finally, as with uncertainty markets, carbon markets' re-embedding of various survival goods from one context to another has inexorably given rise to movements of societal self-protection.

Building a new commodity: the basics

Like financial derivatives markets, carbon markets isolate and objectify a new product that is difficult to define. One rough way of defining it is to say that it is a commodification of climate benefits/disbenefits. Governments decide supply levels, setting scarcity, and either sell the commodity or, more usually, give it away to large industrial polluters. Trade in the commodity then supposedly makes climate change mitigation maximally cost-effective. Another way of conceptualising the product is to say that it is the result of the state enclosure, commodification and apportionment of the earth's carbon-cycling capacity, or ability to keep its climate stable (Lohmann 2005, 2006). Governments decide, whether on climatological or political grounds, how much of the world's physical, chemical and biological ability to regulate its own climate should be 'propertised' and privatised and then given away or sold at any particular moment, and to whom; the market then (regressively) distributes that capacity according to cost-effectiveness. Still another way of conceiving of the commodity is as universally fungible greenhouse gas pollution rights backed by an implicit government guarantee that an optimal 'climatically safe' amount of total rights in circulation can in principle be both specified and mandated.

Commodity construction can be summarised as follows:

> *Step 1*
> The goal of overcoming fossil fuel dependence by entrenching a new historical pathway is changed into the goal of placing progressive numerical limits on emissions *(cap)* →
>
> *Step 2*
> A large pool of 'equivalent' emissions reductions is created through regulatory means by abstracting from place, technology, history and gas type, making a liquid market and various cost savings possible *(cap and trade)* →

Step 3
Further tradable emissions reductions 'equivalents' are invented through special compensatory projects, usually in regions not covered by any cap, and added to the commodity pool for additional liquidity and corporate cost savings *(offsets)* →

Step 4
Project bundling, securitisation, financial regulation, 'programmatic offsets' and so forth provide further help in making 'reductions/offsets' into a speculative asset class.

In the crucial first stage, climate crisis mitigation is translated into measurable, divisible greenhouse-gas 'emissions reductions'. A large class of tradable reductions is then constructed by stipulating that a reduction of a certain number of molecules achieved at one place or time by one technology is climatically 'the same' as a reduction of an equivalent number of molecules of a range of pollutants by another technology at another place or time. Just as the *bricoleurs* who assembled credit derivatives markets relied on the assumption that separating out various credit uncertainties from loans and injecting them into commodity circuits was mainly a technical matter for experts, so carbon market architects assume that 'climate benefit' units can be unproblematically separated out from the historical pathways and political and social movements involved in a transition away from fossil fuels. In this way, a 'thingified' climate commodity is created whose 'cost-effective' allocation via pollution rights trading can become a coherent, 'apolitical' programme for action ('cap and trade'), and whose status as asset, grant or financial instrument can be engineered to fit various accounting standards (MacKenzie 2009). In a third step, cost-effectiveness is enhanced by creating an additional class of divisible, measurable, thing-like climate-benefit units or 'reduction equivalents' called 'offsets'. These are pooled together with 'reductions', enabling wealthy industries and states to delay reducing their own emissions still further. Such offsets are manufactured by special projects that are claimed to result in less greenhouse gases accumulating in the atmosphere than would be the case in the absence of carbon finance, such as tree plantations (which are supposed to absorb carbon dioxide emissions) or fuel switches, wind farms and hydroelectric dams (which are argued to reduce or displace fossil energy). In theory, 'project-based' credits, no matter what their origin, are to be fungible with the emissions allowances distributed in the North. Indeed, in a sort of commensuration-by-fiat, Articles 3 and 12 of the Kyoto Protocol stipulate, without argument, that these offset credits are *identical* with emissions reductions, thus legislating into existence an abstract, non-situated, omnibus category of reductions/offsets. In its scale and nature, this attempt at commensuration, like that which resulted in the new category of 'risk' associated with contemporary financial markets, is no less momentous than the feats of disembedding that conjured up the historically specific social reality of abstract labour whose emergence Marx described. Yet most governments, business executives and even environmentalists (Tauli-Corpuz 2009) have accepted it without question or comment, perhaps not even grasping what has happened.

Cap and trade

The emissions 'cap' that does the 'environmental' work of cap and trade can be represented by the ovals of Figure 1. One way of achieving the cap is to dictate limits to how much each industrial installation covered by the scheme (represented by A and B) is allowed to pollute. If the overall cap on a sector's emissions is 100 tonnes annually, the government might require A and B to limit their emissions to 50 tonnes a year each. The 'trade' of cap and trade is then supposed to make achieving the overall cap cheaper for both A and B – and thus, so the theory goes, for society as a whole. Suppose, for example, that before the cap represented by either oval in Figure 2 was imposed, A and B each produced 100 tonnes of pollution a year. Suppose further that it is expensive for A to reduce its emissions to 50 tonnes but cheap for B to do so. Suppose, in fact, that it is cheaper for B to reduce its emissions to zero than it is for A to reduce its emissions even by half. In that case, the better economic choice is to allow B to make A's reductions for A. Installation A can be allowed to continue pollution as usual provided that it pays installation B to reduce B's emissions to zero. Assuming that the price that B charges for the necessary pollution permits is more than B's cost of reducing emissions to zero, yet less than A's cost of reducing emissions to 50 tonnes, B makes money from the deal at the same time that A saves money. Both come out ahead – yet the same environmental goal of limiting overall pollution to 100 tonnes a year is met. Whatever the size of the oval that government regulation draws, the cost of keeping pollution within that oval will be lowered by emissions trading. Governments will thus be able to ratchet down the emissions cap (that is, draw smaller and smaller ovals) each year, as in the hypothetical case represented in Figure 2, believing that they are doing so in the cheapest way possible.

This programme of commodity formation has a number of political and climatic blowbacks. First, it at once distances carbon markets from the climate problem in somewhat the same way that historical land markets encouraged concrete processes of abstraction from the question of how land is used. This is because the climate problem is about initiating a long-term historical pathway to overcome current dependence on fossil fuels. Because transfer of fossil

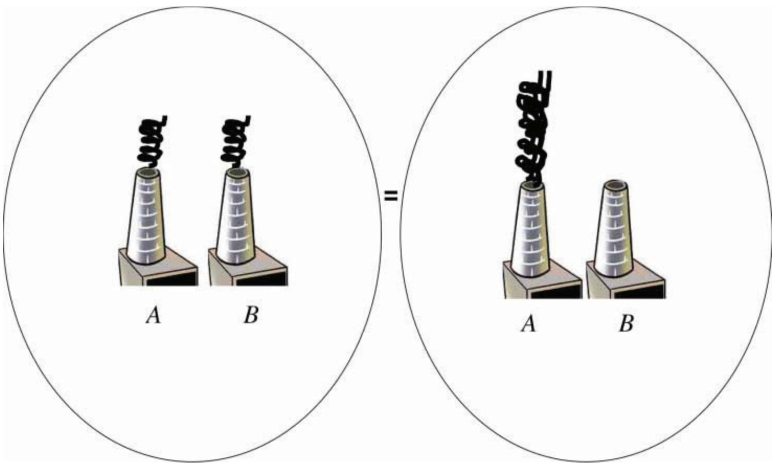

FIGURE 1. The equivalence created by cap and trade.

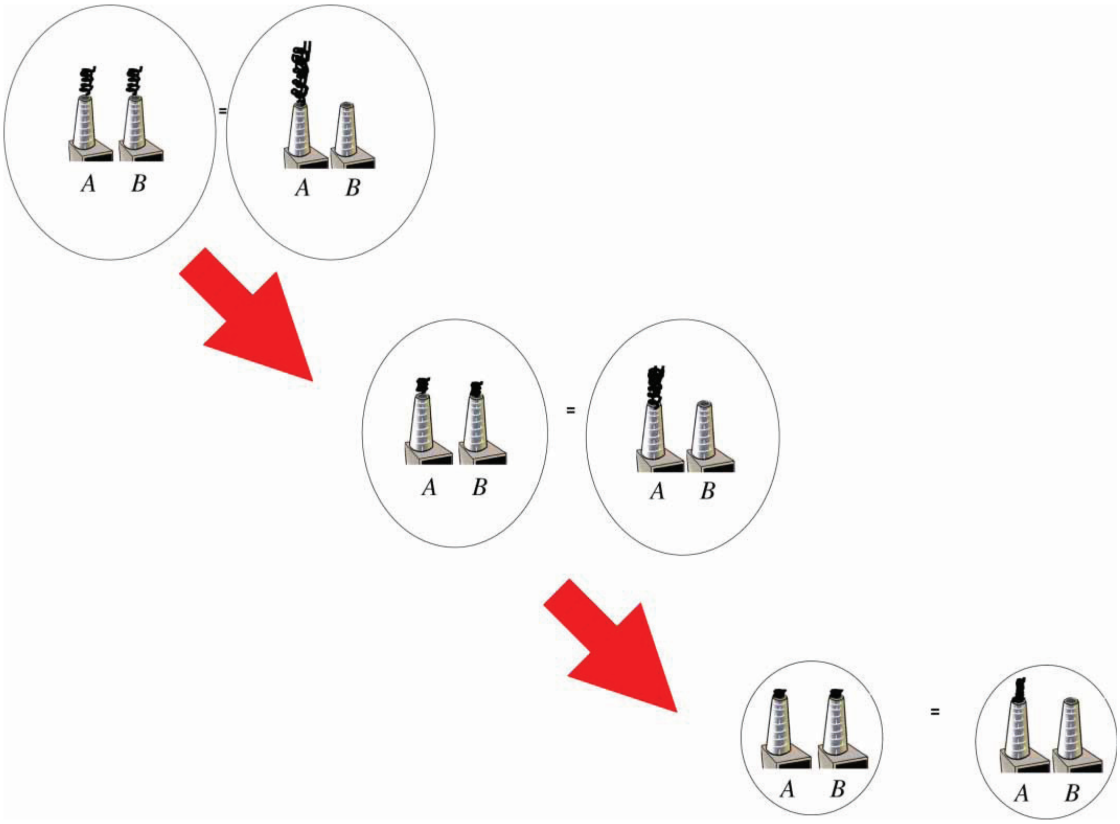

FIGURE 2. Emissions reductions under the theory of cap and trade.

carbon out of the ground is irreversible over humanly relevant time scales and fossil-origin carbon is building up catastrophically in the atmosphere and oceans, most unmined coal, oil and gas will have to stay in the ground (Leggett 2001; Flannery 2005). Accordingly, industrialised societies currently 'locked in' (Unruh 2000: 817) to fossil fuels need to institute structurally different non-fossil energy, transport, agricultural and consumption regimes within at most a few decades. Infrastructure, particularly in industrialised nations, will have to be reorganised, and state support shifted from fossil-fuelled development toward popular movements constructing or defending low-carbon means of livelihood. The phenomenon of path dependence (Arthur 1994) assumes great importance, meaning that the first steps must be undertaken immediately (Kallbekken and Rive 2005), particularly in the industrialised North, to minimise future dangers and costs alike, with short-term costs assuming secondary importance.

It follows that short-term actions can be assessed for their climatic effectiveness and longer-term cost only by determining the part they play in a longer-term shift away from reliance on fossil fuels. Cutting 100 million tonnes of emissions through routine, cheap efficiency improvements that leave a fossil-fuelled infrastructure as it is will be both more climatically damaging and more expensive in the long term than cutting 100 million tonnes through investment in renewable technologies with a high potential for wide adoption, or through initiating approaches to food production, energy generation, or transport that are fundamentally more conducive to climatic stability (Lohmann 2006: 101–21). It matters, in short, not only how much emissions are cut but how they are cut.

Cap and trade, however, is designed to treat emissions-reduction measures as equal regardless of whether they are likely to contribute to unquantifiable but important positive global social synergisms. For example, the equivalence illustrated in Figure 2 abstracts from what kind of industries A and B are, as well as the political context of electricity generation in industrialised nations. The 'A' industries – the big carbon-permit buyers – are likely to be the companies most locked into fossil fuel use and therefore also the ones where change is most necessary and most urgent – major electricity generators, for instance. Such industries tend to have billions of dollars tied up in non-convertible fossil fuel plants whose lifetime is measured in decades. Cap and trade gives such industries additional incentives for delaying structural change not only because it gives them the alternative of buying or being given bankable pollution permits, but also because it relies on prices that cannot be set 40 years in advance (Lohmann 2006: 114). Treating 'technology neutrality' as a virtue, cap and trade directs ingenuity toward positing measurable 'equivalences' between emissions of different types in different places and times, not toward fostering targeted innovations that can initiate or sustain a historical trajectory away from fossil fuels (the effectiveness of which is less easy to measure). Indeed, once the carbon commodity has been defined, to weigh different long-range social and technological trajectories or evaluate and 'backcast' from distant goals is already to threaten the efficiency imperative. 'What is the best way to tackle climate change?' asked Matthew Whittell of Climate Exchange plc rhetorically in July 2008. 'If we have a global carbon price, the market sorts it out' (Scott 2008: 4).

Of course, cap and trade also gives incentives to 'B' industries – including those that may be dirty now but have the advantage of being less structurally addicted to fossil fuels – to hasten development of lower-carbon ways of doing business, and to independent businesses to develop new low-carbon technologies to sell to the 'A's. In the aggregate, however, entrepreneurs tempted to take advantage of the new market will concentrate on realising the cheapest (or most culturally entrenched) opportunities for emissions reductions first, regardless of whether they lead to long-term structural change away from fossil fuels. There is a 'tradeoff between maximising cost reduction and maximising technological development likely to significantly increase global capacity to address global warming', concludes emissions trading expert David Driesen (2008: 56; see also Liroff 1986: 100; Malueg 1989: 52; Taylor et al. 2005; Williams and Zabel 2008). In contexts in which increasing returns are significant, leaving research and development of critical technologies largely to private firms incentivised by price cannot guarantee, in the words of W. Brian Arthur (1994: 27), that the 'fittest technology in the long run sense will be the one that survives'. Other experts are explicit that carbon prices cannot 'deliver the escape velocity required to get investment in technological innovation into orbit, in time' (Prins and Rayner 2008: 973; see also Sachs 2008, 2009) and that 'there is little evidence of price incentives inducing a fundamental transformation in the economy or society' (Banuri and Opschoor 2007: 22; see also Buck 2007; Lovell 2007).

Carbon markets' inbuilt bias against the structural change demanded by the climate problem is exacerbated by the endemic rent-seeking that makes their regulators so vulnerable to capture. In the European Union (EU), corporations aware that carbon permits are a lucrative asset lobby governments for as many as they can get, then, in the case of electricity generators, pass on to consumers the nominal 'opportunity cost' of withholding these free carbon assets from the market. It is estimated that in five European countries, windfall profits for power generators from cap and trade will reach US$112 billion by 2012 (*Point Carbon* 2008b). Much of this free money is being ploughed back into long-term fossil fuel investments, further locking in global warming. Given low prices, moreover, cap and trade works against the possibility of locking in any energy-use changes brought about by recession. According to Deutsche Bank commodities market analysts, any minimal shortfall in carbon permits that might appear through 2020 can be met via existing fossil-fired installations; even if circumstances change, the most that could happen would be that some new gas-fired plant gets built ahead of new coal-fired plant (Deutsche Bank 2009). Renewable energy development not only gains no demonstrable benefits from the EU ETS, but is being actively undermined by it.[6]

Cap and trade also detaches climate policy from the global warming problem by giving short shrift to climatological uncertainties and indeterminacies. The sum of fungible greenhouse gas pollution rights that governments create for trade are intended ultimately to approximate an economically optimal, 'climatically safe' level of overall greenhouse gas pollution. However, estimation of how much space exists in the interlinked above-ground system of oceans, surface rock, soils, vegetation and air in which carbon from underground fossil sources might be 'safely' dumped presupposes agreement both on what kind of world is considered tolerable and what the physical response will be of the above-ground system to the increasing load of fossil carbon with which it has to cope. No non-political answer can be found to the first question, and no probabilistic answer can be found to the second due to the many unknowns, indeterminacies, nonlinearities, unknowables and positive feedbacks (what many climatologists like to refer to as 'monsters') of the climate system (Lohmann 2009a). As Harvard economist Martin Weitzman (2009: 17) has recently written, to disregard the 'incredible magnitude of the deep structural uncertainties that are involved in climate-change analysis' by 'presenting a cost-benefit estimate for [a] situation with potentially unlimited downside exposure as if it is accurate and objective' is dangerously 'misleading'. Weitzman's warning to climate change economists precisely parallels well-established critiques of the simplifications that quants use to help commodify uncertainties in the financial markets. As in the uncertainty markets, trying to achieve cost-effectiveness through trade becomes incoherent insofar as creating the market framework necessary to make sense of the notion of 'cost-effectiveness' entails losing touch with what is supposedly being costed. Like the new uncertainty markets, carbon markets thus provide a rich seam of startling, concrete new illustrations of the hoary popular wisdom that 'some of the good things in life are corrupted or degraded if turned into commodities' (Sandel 2009).

Offsets

Carbon offsets disconnect carbon markets still further from the climate problem. Like cap and trade and financial derivatives trading, offset trading relies on the creation of new equivalences (Figure 3). Instead of cutting their greenhouse gas pollution (top arrow), industries, nations or individuals finance an ingenious range of schemes elsewhere (bottom right) that are cheaper to implement: dams, wind farms, fuel switches, methane burning, efficiency programmes, forestry, ocean-fertilisation fly-ash reprocessing, and so on. Governments can claim to be tightening their carbon 'caps' while in fact allowing 'holes' to be punched in them to admit a flood of carbon credits from outside (Lohmann 2008; FERN 2009: 1; International Rivers 2009). Offsets thus protect continued fossil fuel use in the industrialised North; yet, because most offsets also strengthen fossil fuel interests in the global South, they generally fail to slow it there as well.[7] Like financial derivatives, moreover, offset commodities are speculative assets, further loosening their connection with climate change mitigation. For instance, the Kyoto Protocol offsets known as Certified Emissions Reductions (CERs) are often swapped or arbitraged with the greenhouse gas pollution rights granted by European governments to corporations (EUAs or European Union Allowances), facilitating greater liquidity and larger positions.

Quantitative experts play as much a role in the production of offsets as they do in the production of commodities for the financial derivatives market. For example, in the 1990s, scientists at the Intergovernmental Panel on Climate Change (IPCC) devised conversion factors between carbon dioxide and other greenhouse gases according to an abstract 'global warming potential' (Forster et al. 2007), simplifying a vast range of disputed atmospheric effects and interactions along various axes and time scales into single numbers. The resulting hybrid commodity and increase in market liquidity has made it possible for

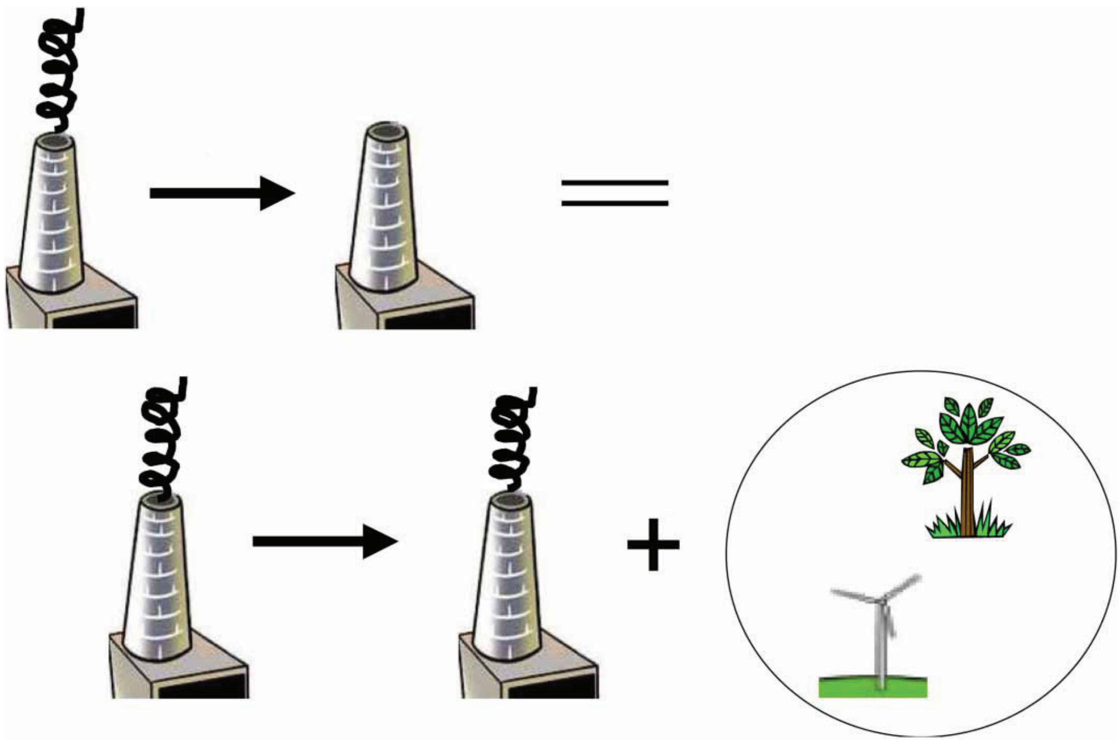

FIGURE 3. The 'equivalence' created by offset trading.

Northern industries to achieve spectacular profits from the Kyoto carbon market. In what is far from being an isolated case, for example, the chemicals firm Rhodia (France) recently invested US$15 million in equipment that destroys nitrous oxide at a subsidiary in Korea. Because nitrous oxide is a greenhouse gas stipulated to have 298 times more 'global warming potential' than carbon dioxide, huge quantities of carbon dioxide pollution permits can be generated by getting rid of very little nitrous oxide. As a result, Rhodia is on track to produce $1 billion in UN-approved carbon pollution rights for sale to industries in industrialised countries (Wara 2007: 595–6; Ball 2008b).

Another type of work carbon market 'quants' are delegated is to identify, for each offset project, a unique storyline describing a hypothetical world without the project, and then assign a single number to the greenhouse gas emissions associated with that world. They then subtract from this number the amount of emissions associated with the real world that contains the project to derive the number of carbon credits that the project can sell. Hence just as financial quants disaggregate different kinds of uncertainty from their contexts, carbon quants disentangle carbon offset projects from an imaginary 'baseline' to show that the projects are 'additional' and how much they are 'additional'. In so doing they engage in similarly creative efforts to domesticate, simplify and quantify unknowns. Carbon quants have no choice but to present the counterfactual without-project scenario not as indeterminate and dependent on political choice but as measurable, singular, determinate and a matter for economic and technical prediction. The offset market's requirement for a single number, in other words, amounts to a methodological assumption that 'no other world is possible'.

Such quantist simplifications have both short- and long-term blowbacks. For instance, the arbitrariness of 'global warming potential' figures means that disagreements and revisions are inevitable: in 2007, the IPCC increased the 'global warming potential' for HFC-23 over a 100-year horizon by over 23 per cent, enabling at a keystroke the production of millions of tonnes more carbon credits. Quantist calculations of carbon offset credits are even more highly contested. As Kevin Anderson, Director of the UK's Tyndall Centre for Climate Change Research, notes, the counterfactual 'baseline' against which the purported emissions savings of an offset project are measured must be calculated over 100 years to correspond with the approximate residence time of carbon dioxide in the atmosphere. For example, a wind farm in India may claim to be generating carbon credits because it is saving, over a century, fossil fuels over and above what would have been saved without the project,

> but the wind turbines will give access to electricity that gives access to a television that gives access to adverts that sell small scooters, and then some entrepreneur sets up a small petrol depot for the small scooters, and another entrepreneur buys some wagons instead of using oxen, and the whole thing builds up over the next 20 or 30 years. ... If you can imagine Marconi and the Wright brothers getting together to discuss whether in 2009, EasyJet and the internet would be facilitating each other through internet booking, that's the level of ... certainty you'd have to

> have over that period. You cannot have that. Society is inherently complex. (Anderson 2009; see also Fischer 2005: 1807; Trexler et al. 2006: 30)

One of the sources of this complexity is offset projects themselves. First, the degree to which any particular offset project helps entrench dependence on fossil fuels in both North and South – thus undermining climatic stability – is not calculable (and thus, like many extreme price scenarios in the financial markets, is not calculated). Second, in a parallel with reflexivity in the financial markets, offset accounting undermines its own stability by setting up perverse incentives for credit entrepreneurs to bring about 'business as usual' scenarios which are the highest emitting possible, in order to make proposed projects appear to be saving as much carbon as possible (Wara 2007).[8] Third, as in the financial markets, building the commodity entails cultivating ignorance in a way that, again, discredits the notion that calculating the climatic efficacy of carbon offsets is possible. For example, by framing project proponents as free decision makers whose initiatives 'make a difference' while treating everyone else deterministically, offset accounting suppresses alternative political approaches to climate change. Because long-term low-carbon pathways rejected as 'implausible' by carbon accountants are discriminated against by offset funding in favour of minor rearrangements in high-carbon systems, knowledge about those pathways often suffers. In Minas Gerais, Brazil, for instance, opportunities to explore low-carbon options involving small-scale agriculture and renewable energy are undermined by offset finance flowing to a large, land-grabbing plantation, charcoal and pig iron firm (FASE 2003; Suptitz et al. 2004; Gilbertson and Reyes 2009). As in the financial markets, in addition, the sheer complexity of the calculations, acronyms and monitoring and legal requirements militates against transparency. United Nations carbon-offset methodologies and project-design documents – to say nothing of emerging collateralised debt obligation-type instruments for carbon (Kwong 2008), 'Capital Protected Forestry Carbon Credit Notes' and the like – are so obscurely technical that they wind up hiding the climatic hazards associated with offsets not only from the public but also from many market players themselves.[9] Just as financial-sector quantism lost touch with the on-the-ground realities of mortgage holders in low-income neighbourhoods of US cities, so carbon-sector quantism distances itself from the social or biophysical realities of specific carbon offset projects. In both cases, too, second-order ignorance exacerbates the dangers: isolated by their equations, background and location, quants tend not to be aware that they are not aware.

Unsurprisingly, just as different investment banks calculated different prices for the same collateralised debt obligation tranche because they used different correlation models (Tett 2009: 117), different offset experts, regulators and environmentalists offer different estimates of the number of carbon credits that a project should be allowed to generate. One 2007 study concluded that carbon finance could not have been a factor in the construction of several hundred hydropower projects in the Kyoto offset pipeline in China, meaning that they should not be allowed to produce any pollution licences at all (Haya 2007). Another showed that carbon-credit revenue amounted to a very small part of the projected internal rate of return for 546 of the first 803 Clean Development Mechanism (CDM) projects (Schneider 2007; see also Dispatches 2007). According to one prominent carbon banker, project proponents ‘tell their financial backers that the projects are going to make lots of money’ at the same time as they claim to regulators ‘that they wouldn’t be financially viable’ without carbon finance (Harvey 2005).

Although the impossibility of making a distinction between fraudulent and non-fraudulent calculations makes offset regulation ultimately pointless, maintaining the appearance of regulation is a commercial boon for both credit buyers and credit sellers because it allows skilful and well-paid carbon accountants to continue fabricating huge numbers of pollution rights for sale to Northern fossil fuel polluters, who are only too happy not to inquire too closely into their origin. It also allows governments and environmentalists to ‘continue to pretend that regulating emissions is going to be cheap and easy’, to borrow the words of David Victor of the University of California, San Diego (Ball 2009: A11). Accordingly, great efforts are made to preserve the illusion of regulatability by attributing scandals to isolated ‘carbon cowboys’ (Harvey 2007).[10] Just as, in 1994, a concerted Wall Street lobbying campaign was able to get the US Congress to set aside concerns expressed by the General Accounting Office (GAO) about the overall regulatability of derivatives trading (Tett 2009: 46), so too in 2008 carbon trading proponents were able to persuade Congress to ignore the GAO’s similar warning that ‘it is impossible to know with certainty whether any given offset is additional’ (US GAO 2008: 39). The Waxman–Markey carbon trading act that passed the US House of Representatives in 2009 accordingly allows the importation of billions of tonnes of carbon credits from abroad. Avoiding the issue of whether such transactions are regulatable, traders and governments as well as many middle-class environmental activists insist instead on pursuing ever more implausible schemes for certification or reform.[11] Stefan Singer, a senior European climate officer with the World Wide Fund for Nature, recently went so far as to propose trying to detach the European carbon market from mechanisms of financial gain. ‘It was never the intention [of the EU ETS] to create profits’, Singer complained during an October 2008 panel on carbon trading, prompting Louis Redshaw of Barclays Capital to remind him gently: ‘it’s inevitable if you institute a trading system’ (*Trading Carbon* 2008: 28).

Continued reliance on quantist offset assembly lines, however, unavoidably stores up an asset valuation problem similar to that associated with derivatives based on mortgages. ‘I guess in many ways it’s akin to subprime’, Marc Stuart of the offset consulting and trading firm EcoSecurities confessed to the *Wall Street Journal* in 2008 in the wake of his firm’s first stock crash. ‘You keep layering on crap until you say, “We can’t do this anymore”’ (Ball 2008a). By 2009, policy analyst Michelle Chan and others were calling the attention of the US Congress to the dangers of a ‘subprime carbon’ bubble followed by a collapse due to rapid devaluation (Chan 2009; see also Michaelowa 2007; Morris 2009; Suppan 2009; Taibbi 2009).

Conclusion

New markets in uncertainty and carbon that were developed during the last decades of the twentieth century created rich new possibilities for accumulation against a background of growing worldwide inequality and disappointing returns on traditional investment. Nurtured by an ideology of universal calculability exemplified by the efficient markets hypothesis and by linear views of the relationship among atmospheric change, geochemical cycles and social systems, the markets' architects, although facing different pressures, sought to enhance the cost-effectiveness of both finance and climate action through intensive efforts to commodify two of the furthest, least tangible and most recalcitrant reaches of the infrastructure of human existence. Predictably, both new markets quickly became playgrounds for speculative investment, multiplying the dangers involved.

As various types of uncertainty were isolated, recontextualised, quantified, sliced, diced and circulated, a new finance emerged out of the disembedding and fusion of banking, gambling and insurance. Credit expanded enormously, multiplying leverage, creating unprecedented opportunities and pressures to lend and blowing asset bubbles up to huge sizes. Questions of what debt is *for*, how much leverage is necessary, and whether unlimited liquidity is always and everywhere a good thing, became passé. Similarly, as global warming solutions became identified with reductions in an abstract quantity of tradable emission rights, emissions reductions were swapped and pooled with 'offsets' manufactured through quantitative techniques. As the resulting amalgam was sliced, diced, bought and sold, a new 'climate change mitigation problem' emerged, disembedded from history, politics and fossil fuels and re-embedded in neoclassical economics and property law. Again, the question of what the new market was *for* got lost amid ever more ambitious attempts to maintain and extend it.

Yet the ambitious new trading projects soon came to grief even in their own terms. The extreme abstraction needed for commodity formation in each case wound up exacerbating, even engendering, systemic crises that threatened the social order. The unchecked pursuit of liquidity in the uncertainty markets led in the end to a financial stampede for the exits and a drying up of liquidity. The imperative to take positions 'against every possible state of nature' entailed losing touch with vernacular, safety-first conceptions of livelihood in favour of an ill-fated, cascading 'technical-fix' approach to unknowns. Meanwhile, headlong attempts to implement a 'market solution' for global warming, in abstracting from how emissions reductions are made, entrenched fossil fuel infrastructure, undercut the political mobilisation needed for a climate solution and undermined low-carbon practices of diverse kinds and wide geographical reach.

As a result, both markets have provoked strong, if diverse and confused, movements of societal self-defence. This pattern of action and reaction constitutes a chapter in the political history of commodification as significant in some ways as that describing the movements to commodify land and labour analysed by Karl Polanyi. In each case, these movements of self-defence have been, roughly speaking, a mixture of two elements. In finance, the establishment response has been largely a technical fix focused on bailing out dysfunctional financial institutions 'too big to fail' and encouraging regulators to oversee more and better commodification of uncertainties. Also significant, however, are proposals being pressed both inside and outside government to scale back the commodification of uncertainty in one or another respect and reconsider the role and governance of finance in society while switching resources toward ensuring the vitality of the basket of incommensurables on which ordinary people rely for their livelihoods. In the case of climate change, the response has been similar. On the one hand are technical-fix proposals demanding that governments expand carbon markets worldwide in the interests of enhanced liquidity while regulators and certifiers oversee better measurement and calculation of carbon commodities. On the other are movements to call off or limit the attempt to commodify the earth's carbon-cycling capacity and instead mobilise for a fair transition away from fossil-fuel dependence (Martinez-Alier 2007; Lohmann 2009b, 2009c; *Environmental Rights Action* 2009).

How can progressive forces best contribute to such movements? What sort of alliances can be fashioned among, say, ordinary victims of the financial crash, movements for new financial and tax regimes, environmental justice movements battling fossil fuel extraction and pollution, health and peace activists, campaigners for alternative energy and transport, grassroots resisters of carbon offset projects in the South, movements for food sovereignty, and a Northern public frustrated at the largesse being lavished by their governments and the United Nations climate apparatus on the creation of yet another dysfunctional speculative market? The answers are not yet clear, but in trying to place the new uncertainty and carbon markets within a broader history of commodification, this article has tried to suggest that comparative study of the financial and carbon markets can inform constructive responses to a new era of turbulence. Financial crisis, climate crisis: each can perhaps help teach what needs to be avoided when contending with the other.

Notes

All of the following colleagues have either commented helpfully on drafts of this article or contributed to discussions and debates out of which the article emerged: Michelle Chan, Nick Hildyard, Jutta Kill, John O'Neill, Raj Patel, Steven Pavett, Oscar Reyes, Sarah Sexton, Sandra Smithey, Servaas Storm, Heather Williams and an anonymous reviewer for *New Political Economy*.

1. As Viviana Zelizer (1983) documents, life insurance was widely frowned upon for moral reasons in earlier eras – a type of restriction that prefigured its contemporary 'embedding' in the legal apparatus preventing insurance fraud.
2. Nassim Taleb (2007b: 126–32) astutely points out that no matter how much social landscaping they do, casinos still cannot prevent 'black swans' – unlikely events of extreme consequence – from popping up in the form of, say, disgruntled employees trying to blow up the building – often with financial results far greater than any of those that their elaborate 'risk management' systems are designed to protect against.
3. In a sense, of course, traditional commercial banking also involved 'gambling' through its provision of mortgages and business loans. But this 'gambling', if it can be called that at all, was even more heavily conditioned. Mortgages and loans were typically extended only in the context of face-to-face contact with clients, access to a range of 'local knowledge' about their status, heavy collateral requirements and legal recourse to repossession.
4. Although many economists refer to this development simply as the 'privatisation of risk', this article avoids what has become an indiscriminate use of the R-word in favour of another inadequate shorthand, 'uncertainty'. This is in the hope that using a less familiar word – and one which, since Frank Knight (1921), has often been contrasted with 'risk' – may help problematise a concept the scale of whose metamorphosis over the past 35 years has often been underappreciated.
5. What Frank Knight (1921) had dichotomised as risk and uncertainty tended to be run together, as were the 'fat-tailed' and 'thin-tailed' distributions described in statistics and what Ian Hacking (1995) has called 'looping' and 'non-looping' phenomena. John Kay (2009: 143) describes the attempt to transform 'the

uncertainty described by Keynes and Knight' into the 'well-defined, quantifiable risk that responds to the techniques developed by the successors of [Frank] Ramsey and [L.J.] Savage'.

6. The UK government admits that it is because large-scale energy producers 'are covered by the EU Emissions Trading Scheme' that official renewables strategy has no provisions for setting large-scale energy production on a different technological path (United Kingdom Department for Business, Enterprise and Regulatory Reform 2008: 20–1). Article 26 of the EU Emissions Trading Directive bans governments from legislating 'inefficient' carbon dioxide emissions limits on energy generators covered by the EU ETS (European Environment Agency 2008: 27; *Environmental Data Service Europe Daily* 2007; Solarenergie Forderverein Deutschland eV 2009). In California, many renewable energy developers are 'critical of cap and trade, due to the volatility and uncertainty of carbon prices under cap and trade, which they point to as unreliable when it comes to planning, developing, and financing renewable energy projects' (Jose Carmona, The Verde Group, personal communication).
7. At the beginning of 2009, three-quarters of Kyoto offset credits issued were manufactured by large firms making minor technical adjustments at a few industrial installations to eliminate HFCs and N_2O. No credits came from the development of solar or tidal power. By 2020, the proportion of credits from HFC and N_2O projects is expected to decline to a quarter (although increasing tenfold in absolute terms), but not because of any trend toward projects which verifiably curb the flow of fossil carbon out of the ground, but through a growth in, for example, credits from landfill gas burning projects (8 per cent) or schemes to burn off methane seeping from coal mines (5 per cent) (United Nations Environment Programme 2009). Credits from solar and tidal power will remain negligible, and although wind power credits will rise to 8 per cent of the total, the degree to which wind displaces, rather than simply adds to, fossil energy, is disputed (Gilbertson 2009). Offset projects undertaken outside the Kyoto framework also support expanded fossil fuel use: offsets being sold on the voluntary market include credits generated by using carbon dioxide to pump out the remaining sticky oil at the bottom of nearly exhausted wells, and industry lobbyists are pressing for coal-burning power plants to be allowed to generate pollution rights by capturing carbon dioxide out of their stacks, liquefying it, and pumping the strongly alkaline product into underground 'toxic waste dumps'. In general, the offset market incentivises entrepreneurs not to develop climate solutions, but rather to find or invent new 'emissions reduction equivalents' that can be used in manufacturing substantial blocks of cheap carbon credits for sale. One case in point is the lobbying drive by Wall Street firms, large Washington nature conservation organisations, carbon consultants, and government officials in support of the creation of billions of tonnes of cheap credits from projects to 'Reduce Emissions from Deforestation and Forest Degradation' (REDD). Like mortgage providers feeding the collateralised debt obligation production line by amassing prospective homebuyers' signatures on repayment contracts, carbon consultants seeking to give flesh to the new equation 'forest conservation=emissions reductions' are currently fanning out in rural areas of countries such as Indonesia, Papua New Guinea and the Democratic Republic of Congo looking for prospective 'stakeholders' to guarantee carbon credit-producing forestry projects. Offsets' fossil-fuel bias is reinforced by the reality that the companies best equipped to gain regulatory permission to sell carbon credits are well-capitalised, often fossil-dependent corporations with government connections and the ability to hire carbon consultants and accountants (Lohmann 2006: 147, 272–80; *Sunday Times* 2007).
8. Kyoto Protocol offset projects often create incentives for emissions-related environmental laws not to be enforced, since the greater the 'baseline' emissions, the greater the payoffs that can be derived from carbon projects (Lohmann 2006). This trend normalises the expectation that certain laws will be obeyed only if it becomes possible to earn carbon credits by doing so. Christina Figueres (2007: S51) describes an example of a new type of CDM project alleged to 'lead to a greater level of enforcement of the existing mandatory policy/regulation than would otherwise be the case'. Logically (yet impracticably), such policies should necessitate incessant recalculation of the baseline and continual alteration in the number of credits calculated. Carbon traders or regulators cannot police 'gaming' in order to guarantee a benign fit between market actors and the mathematics any more than their counterparts in the advanced derivatives markets.
9. This obscurity is deepened by the fact that the trend in the carbon markets is to conduct most trading over the counter rather than through exchanges. About 70 per cent of European Union Allowances, for example, are traded over the counter (*Point Carbon* 2008a).
10. 'We don't want an Enron scandal', cautioned one worried executive of Det Norske Veritas, one of the 'big four' private firms licensed by the UN to validate and verify carbon credits, two years before his own company was temporarily banned from verifying Kyoto Protocol offsets after an investigation revealed 'irregularities' in its auditing procedures (Young 2008).

11. Examples include the Gold Standard programme for CDM credits originated by a business–non-governmental organisation (NGO) alliance and the UK government's proposals for regulation of voluntary market offsets.

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