1. Financial regulation and fraud in CO₂ markets

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1. INTRODUCTION

Classical literature like that of Rosen (2005), Samuelson (1954), and Baumol and Oates (1988) proposed cap and trade as an alternative to levying usage taxes to curb privately beneficial, but socially undesirable action. In economic terms, the goal of both measures is to curb a recognized and measurable externality.

The idea seems simple, on its face. Public finance, and more specifically the sub-discipline of environmental economics, defines the theoretical optimality of the choice between cap and trade and abatement taxes. The optimal outcome can be achieved either through cap and trade or through a pollution charge. Specifically, capping the quantity of emissions that can be produced results in the equality of marginal abatement costs and the marginal benefits of abatement at a market price to the polluter. On the other hand, by creating a price for every unit of carbon that is emitted, producers have an incentive to reduce the quantity of emissions (n). If the set price lies above the cost of reducing emissions it is less costly to reduce pollutants than to pay the tax. Therefore, an emissions price (or tax) theoretically has the same effect on the market as an emissions quantity cap.

Setting either prices (P) or quantities (Q) with certainty is key to the environmental debate around carbon policy. It is not clear, from a purely theoretical basis, whether cost certainty or benefit certainty is more important in the carbon abatement debate. Some scholars have argued that a focus on benefit certainty is theoretically superior because it puts the emphasis on the environment rather than on the economics (see, e.g., Baumol and Oates, 1988 at 74).

That seemingly straightforward argument favoring benefit certainty, however, ignores key empirical dynamics with regard to carbon prices already demonstrated in the experience of the European Union's Emissions Trading Scheme ('EU ETS').

The pervasiveness of heterogeneous cap and trade programs and growing incidents of fraud in the sector likely exacerbate asymmetric information in the overall product market, creating market price anomalies that can ultimately upend policy development and implementation.

If substantial asymmetric information exists regarding the potential for political risk and fraud to interfere with the use of carbon permits, a greater supply of permits will be necessary to achieve any chosen level of benefit. That is, issuing permits that *exactly* match the desired emissions will overprice the desired benefits.

The remainder of this chapter describes conditions precedent in modern CO₂ markets that would suggest such overpricing will be the norm in current institutional arrangements. Cap and trade markets cannot achieve benefit certainty with substantial price uncertainty arising from factors beyond fundamental supply and demand.

This chapter first describes briefly the relationship between EU ETS development and CO₂ price volatility, showing that volatility has been far higher than expected by economists. Whether modeled as a commodity contract or an option, CO₂ contracts simply do not conform to known price models and expected dynamics. The chapter then suggests a key explanation for such deviations from known pricing models, reviewing many of the known incidents of investor fraud, corporate fraud, and counterfeiting and theft that have interrupted EU ETS CO₂ market operations during the first ten years of its existence. As CO₂ contracts become more widely used – and as prices hopefully rise – such fraud and malfeasance will become more valuable to perpetrators, leading to further incidents similar to the ones described herein. Existing economic theory suggests that markets can be expected to continue to price the probability of such disruptions, upsetting CO₂ price dynamics and potentially destroying the EU ETS and similar systems.

2. WEATHER ANOMALIES AND POLITICAL RISK IN CO₂ MARKET PRICING

Carbon prices under cap and trade systems have been far more volatile than originally envisioned. Part of the problem is related to carbon permit demand that fluctuates with weather conditions that are highly correlated with electric power generation. Equally important, however, is that it has become apparent in recent years that exhibited price anomalies are the result of both weather conditions *and* political uncertainties as well as idiosyncrasies in the carbon permit contract that enable fraud by investors, corporations, and others.

The European Union provides a wealth of information and data on markets that have developed from cap and trade programs. In the EU ETS, both cash and futures contracts are traded in a variety of markets. While trade with EU Allowances ('EUAs') began in 2003, the official EU ETS

began in 2005. Prices before 2005 were, therefore, forward prices on a not yet traded underlying asset. In the 'pre-2005' period, the traded volume was quite low, at some days even zero as the highest bidder price was smaller than the lowest seller price. Daily EUA prices between August 27, 2003 and December 29, 2004, before agreement on EU ETS, were generally stable. The price during this entire period was stable during any small time window, and fluctuated between €7 and €13 over the entire 18-month period, with bid-ask spreads that were quite large, often exceeding €4.

By contrast, prices between early 2005 and December 29, 2006 fluctuated greatly. Prices spiked at nearly €30 in July 2005 and again in April 2006, and fell to lows of about €6 by December 2006 (see, e.g., Benz and Trück, 2009 for a detailed review of price dynamics). Figure 1.1 confirms

Source: Thomson Reuters Point Carbon (2016).

Figure 1.1 EU ETS carbon prices, 2005–2015

that the price of carbon futures fell significantly during 2006. Prices then rose through 2007 and the first half of 2008, but plummeted after July 2008.

Important drivers of the market seem to be a combination of short-run weather and political policy announcements rather than any long-term economic fundamentals. Before the EU Parliament agreed on the introduction of the EU ETS in July 2003 and before the first suggestions for National Allocation Plans ('NAPs') were published at the end of 2003, prices were stable. Both announcements led to an increase in prices. Because of the initially generous allocation of allowances to the countries, prices calmed down again between February and March 2004. Reviewing and accepting the NAPs in the second half of the year, prices increased to about €9. Benz and Trück (2009 at 11–12) show that as the main framework of the trading scheme became defined, the price determinants became more fundamental after January 2005.

Chief among those fundamentals, however, is the weather. For example, Thomson Reuters Point Carbon (2006) notes that prices fell in 2005 due to mild weather and a high supply of wind energy from Scandinavia and North Germany. At the end of January 2005, cold weather and high gas and oil prices in the United Kingdom, coupled with low coal prices, resulted in a strong price increase of EUAs. This effect was magnified by a dry summer in July 2005 in southwestern Europe. Low rainfall depleted reserves and prevented full utilization of hydroelectric plants. The lack of cooling water for nuclear power plants resulted in greater utilization of high emission-producing assets, which therefore increased the demand for carbon permits. By July 2005, prices peaked at €29.15. During the last four months of 2005, prices fell to €22. By March 2006, however, prices again increased to approximately €27, due to a long and cold winter between 2005 and 2006.

May 2006 marked completion of the first full cycle of the EU ETS. Benz and Trück (2009 at 11–12) note that by April 2006, however, it was apparent that a surplus of allowances of approximately 10 percent existed. As a consequence, EUA prices fell by 60 percent within one week, amid fears that emissions prices would drop to zero. The EUA market recovered during the summer of 2006 as the industrial sector began selling EUAs to utilities investors as a dry and hot European summer increased the demand for high-emissions assets.

The European experience outlined above is important because the primary purpose of a cap-and-trade-based carbon market is to provide long-term incentives for firms to invest in clean-air technologies. Such technologies – nuclear assets or clean-air coal assets, for example – are

costly to build and they are large baseload units that are technologically intensive. Private investment in these types of assets only makes sense if the long-term benefits of the investment are clear. With carbon permit prices fluctuating wildly, long-term signals regarding the carbon-reducing benefits of investment in clean-air technology are clouded at best and non-existent at worst. Therefore, it is not apparent that a cap and trade system resulting in a market for carbon permits is helpful in aligning private interests with policymakers' long-term goals: the dissemination of technologies that will reduce carbon emissions.

As it stands, CO₂ prices do not conform to commodity price dynamics or option price dynamics, responding more to weather and political risks than financial market and trading influences. The next two sub-sections describe some of the existing evidence underlying current understanding of emissions permit prices.

2.1 While Carbon Permits Are Usually Thought of as a Commodity Contract Because the Deliverable Is a Factor of Production, Price Dynamics of the Contracts Are Not those Expected for Commodities

Cap and trade contracts – being an input to production – were expected to demonstrate the standard behavior of commodity contracts. A commodity contract is a contract to deliver a raw product or primary input such as food, metal, or energy. Since the allowances are used for production, they are removed from the market as they are consumed. Therefore, the right to emit carbon can be compared with other commodities that are traditionally used as factor inputs in production, and standard commodity pricing models can be applied to the carbon emissions market (Benz and Trück, 2009 at 4–15.)

Commodity markets work on a *spot* and a *futures* basis. The spot market is the market for immediate delivery of the commodity. The futures market is the market for delivering the commodity at some point in the future. The futures market is a derivatives market, meaning that its value is derived from the current spot market for the underlying asset. The spot and futures market for the EU's current cap and trade contracts exists on a number of different commodity exchanges. Empirical data from these exchanges can show whether the real-world pricing of cap and trade contracts conforms to the price behavior of other commodities possessing similar characteristics.

The expected future value of a commodity is equal to the current spot price plus carrying costs. This can be stated as

$$F_t = S e^{(r - \delta)(T - t)}, \quad (1)$$

where F is the future price, S is the current spot price, r is the risk-free rate, δ is the carrying cost, t is today, and T is the maturity of the contract.

The conditions just described are the result of what are commonly referred to as arbitrage conditions. If, for instance, the futures price was above the spot price plus storage, arbitrageurs could sell futures and buy on the spot market, storing the commodity for future delivery at a riskless profit. The opposite also generally holds true.

But Paoletta and Taschini (2008 at 13–14) establish that in the case of carbon emissions, the optimal level of emissions is stochastic, so that a firm's demand for emissions allowance contracts is also stochastic. When faced with supply uncertainty, a firm benefits from holding an inventory of the commodity.

The benefit that accrues from holding the underlying commodity rather than the contract for the future is known as the *convenience yield*. The convenience yield keeps spot prices higher relative to futures prices – a pricing structure known as *backwardation*. Backwardation can be expressed in [1] as a condition in which δ represents a positive convenience yield. In other words, the convenience yield is sufficiently large such that the future price is less than the spot price. In addition, the future price decreases as time to maturity increases.

The opposite of a backwardation structure is *contango* – spot prices are less than futures prices. Empirical evidence from the EU carbon market shows that the carbon futures market illustrates characteristics not of backwardation, but of contango, where spot prices are less than futures prices. But the financial economics literature suggests that commodities with contango structures usually have readily available inventories that are easily accessed and stored and stable supply and demand functions (Paoletta and Taschini, 2008 at 15).

Those conditions contradict the performance of carbon markets to date. The reason that commodities used for production can demonstrate backwardation is that supply uncertainty varies across time. When such uncertainty is present, allowances for different vintages can have different spot prices at a given point in time. Thus, even if cap and trade contracts have no cost of storage and are easily accessed, levels of supply and demand for carbon emissions are not easily predicted. In addition, the level of inventories for cap and trade contracts is dependent on current emission levels, which are stochastic and unpredictable.

Because the empirically observed convenience yield for cap and trade contracts does not conform to standard finance theory for commodities, a price analysis based on a historically consistent theory of future-spot parity is probably not very useful (see, e.g., Paoletta and Taschini, 2008 and Borak et al., 2006.)

2.2 While Carbon Permits Can Be Considered an Option Contract Because the Producer Can Choose Whether to Use the Allowances in any given Settlement Period, Price Dynamics of the Contracts Are Not those Expected for Typical Options

A futures contract only allows for delivery at a specific date in the future. A carbon contract can be used for production at any time within that period, until expiration. A carbon cap and trade contract may therefore be more like an option than a future, potentially with different price dynamics. (For a primer on financial options, see Hull [2006].)

An option is a contract between a buyer and seller that gives the buyer the right, but not the obligation, to buy or sell an asset at a specified price on or before a specified date. The option to buy an asset is known as a call option, and the right to sell an asset is known as a put option. In the context of a carbon market, an emissions contract would be similar to a put option because it allows the contract holder to exercise a right to emit carbon during a specific time period – the owner has the right to ‘sell’ their CO₂.

A multi-period cap and trade contract can be characterized as a sequence of European put options (options that can be exercised at a specific expiration date in the future) that come into effect sequentially through the life of a contract. The decision of when to exercise each put option is characterized as a real option, an optimal-stopping-time problem, similar to the problem of early exercise on an American option. Consistent with common intuition, early exercise is optimal only when the holder’s demand for emissions increases.

One of the most common models to price options is the Black-Scholes model. According to the Black-Scholes valuation model, the value p of a European put on a non-dividend paying asset is estimated by

$$p = Xe^{-r_f T} \Phi(-d_2) - S \Phi(-d_1), \text{ where} \quad (2)$$

$$d_1 = \frac{\ln(S/X) + r_f T}{\sigma \sqrt{T}} + \frac{1}{2} \sigma \sqrt{T}$$

$$d_2 = d_1 - \sigma \sqrt{T}$$

Φ = the standard normal cumulative distribution function;

X = strike price;

S = price of the underlying asset;

T = time to maturity;

r_f = discount rate; and

σ = volatility of the underlying asset value.

The cap and trade ‘option’ can be traded and a market participant could value the put option using the Black-Scholes model. The Black-Scholes model, however, has numerous shortcuts and anomalies that limit its use in valuing even common stock options for which it was designed.

First, the model is only used to value an option if it were to be exercised at expiration (European options). Therefore, it cannot value American options which can be exercised at any point in time before expiration.

Second, the model also assumes that the return on the underlying asset is normally distributed, which may not be the case for carbon emissions, and has certainly not been the case for stocks. (Historically, stock market returns have been skewed or *leptokurtic* – exhibiting more returns in the ‘tails’ of the distribution than would be found in a normal distribution) (see, e.g., Mandelbrot, 1963; Fama, 1965; Theodossiou, 1998).

Third, the model assumes a constant discount rate, even though the discount rate could change over the life of the contract. Fourth, the model assumes a constant volatility of the underlying asset, which market experience has already shown to vary substantially over time.

The empirical literature testing the accuracy of the Black-Scholes model is enormous. Although most studies confirm that market prices generally are close to the estimates resulting from Black-Scholes, many important anomalies have been found. Several alternatives to the Black-Scholes exist, but they each have their own problems.

In addition to the established anomalies of Black-Scholes and other models in pricing stock options, the market for carbon emissions has its own anomalies that complicate the valuation of cap and trade contracts as options. As discussed above, cap and trade contracts leave holders with the risk of having too few abatement options at the end of the commitment term when they may need those options. Alternatively, a firm that holds more permits than it expects to need may still hold onto the surplus because those permits have some option value, given that purchasing options in the future may be costly. Illiquidity arises endogenously from the fact that firms cannot emit without having permits and thus fear that they may face a market squeeze at the end of the year. The combination of the general anomalies of commodities and options valuation models with the anomalies in the carbon emissions market seriously complicates the valuation of cap and trade permits.

2.3 Exhibited Characteristics of Carbon Permit Prices Confirm that They Are Tremendously Complex Financial Contracts so that Financial Economics Is Unlikely to Find the True Value of ‘Cap and Trade’ Permits

Emission allowance prices have exhibited periods of high volatility, arising in part due to the correlation between CO₂ emissions and external events such as seasonal changes and environmental disasters. Those external factors increase the difficulty of modeling emission allowance values, making it difficult for market participants to plan ahead for their future carbon emissions.

Similar dynamics are common in other emissions markets. Producers of SO₂ emissions have been granted allowance permits through the United States Acid Rain Program since 1995. Paoella and Taschini (2008) suggest that the spot price for SO₂, at least from June 2003 until November 2005, could be consistent with a stochastic mean-reverting process with a constant positive drift, as desired by cap and trade policy. The prices dropped precipitously after November 2005, however, suggesting that an assumption that the SO₂ cap and trade market was working correctly and that the policy was responsible for the gradual upward trend in price movement would most likely be wrong (Paoella and Taschini, 2008 at 7–8). The point is that shocks routinely upset even well-functioning emissions markets.

Studies of the European CO₂ markets illustrate similar anomalous collapses. According to market participants, political and regulatory uncertainties, weather, and fuel prices were the most important *and* most volatile factors affecting allowance prices (Uhrig-Homburg and Wagner, 2009). Weather changes (such as temperature, rainfall, and wind speed), fuel prices, and economic growth all affect CO₂ production levels. Unexpected events, such as power plant breakdowns or environmental disasters that shock the supply and demand balance for CO₂, and changes in fuel spreads shock the demand *and* supply side of CO₂ allowances and consequently market prices (Benz and Trück, 2009 at 6).

For example, energy consumption (and hence CO₂ emissions) increases with cold weather. Non-CO₂ power generation is affected by rainfall and wind speed. In addition, the relative costs of coal, oil, and natural gas affect the decision to move forward with CO₂ abatement projects, and fuel switching costs can be high. These sources of price uncertainty have a short or medium-term impact on liquidity, which in turn affects the volatility of emission allowance prices (Benz and Trück, 2009 at 6). In addition, the prohibition on banking emission allowances between distinct phases of the EU ETS significantly affects futures pricing in that market (Daskalakis, Psychoyiosb, and Markellosa, 2009).

As a result of the complex fundamental dynamics, forecasting models based on fundamentals and future-spot parity of CO₂ yield implausible results due to market complexity and to the particular behavior of the allowances, such as inconsistent behavior of CO₂ allowance convenience yields (Paoletta and Taschini, 2008). Other studies have also shown that CO₂ emission allowance prices are nonstationary and exhibit abrupt discontinuous shifts, short periods of high volatility, with heavy tails in the distribution (Daskalakisa, Psychoyiosb, and Markellosa, 2009). One study analyzing the dynamic behavior of CO₂ emission allowance spot prices for the European emissions market demonstrates that steep price increases typically occur when the end of the trading period is approaching, in contrast to a smooth approach to spot prices demonstrated in typical commodity markets (Seifert, Uhrig-Homburg, and Wagner, 2008).

The institutional and financial characteristics described above make the choice of a proper statistical model crucial (albeit perhaps impossible) for purposes of risk management and carbon permit securities valuation. Given the interrelationship of carbon prices with both fundamental and policy variables, emission allowance prices and returns will exhibit different periods of behavior that include price spikes, volatility spikes, and heteroskedastic returns. The 'jumpiness' of price series necessitates using not only traditional time series models, but jump and jump-diffusion models to analyze the statistical properties of the series (Benz and Trück, 2009).

The dynamics discussed above are not limited to the EU. In addition to the EU cap and trade emission allowances, which are government-issued offsets that are limited in supply, other 'low cost' emission credits that will assist the countries that are signatories to the Kyoto protocol in meeting their emission reduction targets include Certified Emission Reductions ('CERs') and Emission Reduction Units ('ERUs'). CERs are created from projects in developing countries such as Brazil, Mexico, China and India that reduce greenhouse gas, whereas ERUs are allowances that have been allocated to mainly Eastern European countries that have already met their emission reduction targets. CERs and ERUs are both fully fungible with the EU emission allowances and can therefore be banked and traded within the EU ETS. According to an early 2006 report, some project developers had already sold forward their CERs for delivery in 2006 and 2007, while others were banking their CERs until the price became more favorable (Borod and Tan, 2006).

An important lesson from the EU's experience with CER and ERUs is the arbitrage opportunities that have arisen due to the significant price difference between EU allowances and CERs. Funds and other entities finance energy projects that result in CERs. Then, those entities aggregate the CERs that are produced and create pools of carbon credits that are

diversified across projects and countries (Borod and Tan, 2006). These arbitrage opportunities mitigate both credit and country risk, but further complicate efforts to price emission allowance contracts alone.

Given the number of pricing anomalies that exist in financial markets, and the fact that carbon permits would share properties, at least in part, with many financial assets whose prices exhibit similar – but not identical – anomalies, valuations driven by cap and trade markets are unlikely to uncover the true price of carbon permits in the multiple sources of statistical noise in market prices. Although uncertainty may surround the value of such contracts *ex ante*, one can be sure that market participants will soon discover weaknesses in either the contract terms or the market structure and will seek to exploit any arbitrage opportunities that present themselves. Consequently, the nascent market will have to be monitored closely and carefully regulated. Market regulation itself, however, is far from efficient and fraught with difficulties so that, in fact, such opportunities are already manifest.

3. CO₂ PERMIT FRAUD

CO₂ markets have been embroiled in fraud and market interruptions since their inception, making them unsuitable for managing emissions without exposing the broader economy to the potential for commodity market panics and crashes.

The Interpol Environmental Crime Programme now lists ten classifications of carbon crimes that have already occurred throughout the world and continue to remain a threat (Interpol Environmental Crime Programme, 2013). These include:

- Manipulating measurements to fraudulently claim additional carbon credits (additionality);
- Sale of carbon credits that either do not exist or belong to someone else;
- False or misleading claims with respect to the environmental or financial benefits of carbon market investments;
- Exploitation of weak regulations to commit financial crimes;
- Tax fraud;
- Securities fraud;
- Transfer mispricing;
- Money laundering;
- Internet crimes and computer hacking to steal carbon credits; and
- Phishing/theft of personal information or identity theft.

The important point for the economics of cap and trade is that each market disruption creates greater uncertainty for end users of carbon permits, creating a classic ‘lemons’ discount on market prices. As the Nobel Prize-winning economist George Akerlof has explained:

Consider a market in which goods are sold honestly or dishonestly; quality may be represented, or it may be misrepresented. The purchaser’s problem of course, is to identify quality. The presence of people in the market who are willing to offer inferior goods tends to drive the market out of existence . . . It is this possibility that represents the major costs of dishonesty – for dishonest dealings tend to drive honest dealings out of the market. There may be potential buyers of good quality products and there may be potential sellers of such products in the appropriate price range; however, the presence of people who wish to pawn bad wares as good wares tends to drive out the legitimate business. The cost of dishonesty, therefore, lies not only in the amount by which the purchaser is cheated; the cost also must include the loss incurred from driving legitimate business out of existence. (Akerlof, 1970 at 495)

In the presence of such quality uncertainty, therefore, prices are bid down to adjust for the probability of fraud, no matter what quantity is supplied via the cap and trade policy.

3.1 Investor Fraud

By 2008, the environmental finance sector already included 90 hedge funds and 80 private equity funds, as well as mutual funds, ETFs, and venture capitalist funds. According to a survey by Carbon Finance, a carbon market data service, over 2008–09, funds under management grew by 20 per cent to \$16.1bn. The number of carbon funds and government purchase programs over that period increased from 80 to 88 (*Financial Times*, 2009a). ‘[T]hirty-eight of the 88 funds listed are governmental carbon purchasing vehicles, or are run by multi-laterals either for governments or emitting companies, or a combination. . . . The majority of the remainder are open to institutional investors . . .’ (*Financial Times*, 2009a). The returns can be lucrative. From 2005 to 2008, ‘The European Carbon Fund, run by French bank Natixis . . . generated an annual return of 27.8 per cent’ (*Financial Times*, 2009a).

In just the US, those vehicles invest across some 38 distinct markets dealing in everything from acid rain emissions permits to California’s mobile emissions reductions credits. By just 2007, \$64 billion in assets were traded on the global carbon market, growing to roughly \$100 billion in 2008 (Conniff, 2008). Total market value recently peaked in 2012 at roughly \$145 billion, falling to roughly \$70 billion in 2015 (Thomson Reuters Point Carbon, 2016).

The problem is that such returns quickly attract fraudulent schemes. For instance, Interpol reported that in 2009 and 2010, an Australian investment firm ran an aggressive telemarketing strategy advertising false connections to legitimate organizations and environmental standards. Potential investors were offered a high return investment opportunity in carbon credits. The firm is estimated to have defrauded Australian investors of \$3.2 million (Australian Competition and Consumer Commission, 2010).

In 2012, FT Alphaville warned of a firm called ‘Enviro Associates’ that was selling voluntary carbon credits for investment purposes, all the while warning that:

Voluntary Carbon Credits were not designed to be purchased for investment purposes; for that reason Carbon Credits (VERs) are not for all specifications of Investors due to its high risk and undeveloped market landscape and uncertainty . . .

Individuals should be aware if they are purchasing for speculative means that there is little or no liquidity at present in the market which in turn would affect your ability to sell/exit from a holding at this time. This may change in the future. (Murphy, 2013)

Enviro Associates claimed to be a ‘clearing member’ of Gemmax Solutions, a payments and clearing service. Britain’s Financial Conduct Authority warns, however, that:

Several unauthorised firms promoting and selling carbon credits are telling investors that Carbon Neutral Investments Limited (CNI) or Gemmax Solutions, firms authorised by us, will handle the money in their investment. We believe this is done to suggest investors will be protected as though they are dealing with an authorised firm. But this is incorrect. (Murphy, 2013; see also BBC World News, 2012)

Without investor protection and regulatory oversight, carbon schemes continue to proliferate.

Britain’s Financial Services Authority (‘FSA’, now the Financial Conduct Authority, or ‘FCA’) warned investors about carbon frauds, emphasizing that they do not regulate carbon credits in the same manner as shares of stock (Financial Services Authority, 2012). Still, investors flock to these green ‘investment’ opportunities.

In November 2013, the FSA reported that it had already shut down 19 companies in the past 15 months for bilking roughly 1,500 investors out of roughly \$38.7 million through carbon schemes (Szabo, 2013).

The UK Insolvency Service said the firms mainly targeted the elderly with high pressure sales techniques and promises of hefty returns of more than 40 percent. ‘Salesmen played on peoples’ [sic] keenness to “do their

bit” to save the environment while making an investment at the same time’, the Service said in a statement (Szabo, 2013). The FCA has put hundreds of companies under investigation since 2011 and listed many of them on its website (Szabo, 2013).

In June 2016, French courts convicted seven ex-Deutsche Bank traders in a CO₂-based VAT fraud scheme alleged to have defrauded authorities out of €145 million of tax revenues. The case involved police raiding Deutsche Bank three times and the bank, itself, paying some €220 million related to a prior action (Matussek, 2016).

In the US, carbon schemes have prompted several States Attorneys General, including those of California, Vermont, Arkansas, Delaware, Maine, Mississippi, Oklahoma, Illinois, Connecticut and New Hampshire, to back efforts by the Federal Trade Commission to investigate consumer fraud in the carbon offsets market (see, e.g., Environmental News Service, 2008).

In February 2016, the New York State Public Service Commission issued its ‘Order Resetting Retail Energy Markets and Establishing Further Process’, which, in part, required that companies selling ‘renewable’ energy packages to consumers actually obtain such energy from such sources rather than just using offsets purchased from the market (Giannasca, 2016).

3.2 Corporate Fraud

Clean Development Mechanism (‘CDM’) projects generate carbon credits based on the extent to which the project resulted in fewer emissions than would otherwise have occurred. Companies, therefore, have an incentive to either inflate the estimate of emissions that would have occurred without the project or claim that the project will reduce emissions by more than it actually does.

In order to constrain firms from mischaracterizing their projects, the CDM mechanism requires third-party validation and verification before a project receives carbon credits. Third-party verification is carried out by Designated Operation Entities (‘DOEs’) certified by the CDM Executive Board. Even independent third party auditors, however, may be susceptible to bribes or collusion to manipulate the results.

According to Transparency International, bribery is most common at the project approval stage. ‘Although kickbacks to officials have not been reported, a Russian agency reportedly asked for direct monetary payments. In South-east Asian countries, it is fairly common for developers to invite the authorities to workshops (with attractive per diems) before submitting projects for approval. In China, it is not uncommon

for project developers to invite experts reviewing their projects to dinner' (Transparency International, 2009 at 44).

In 2008 and 2009, respectively, the UN temporarily suspended two independent organizations – Norwegian company Det Norske Veritas and Swiss firm SGS – after 'spot checks found flaws in their methodologies'. At the time, these two companies were dominating the validation/verification market (see Szabo, 2008). Investigations showed that both companies had approved projects without sufficient review (Fortson and Leake, 2010; Murray, 2009).

The UN inspection found one company had a flawed review process, inadequate preparation and training of their auditing staff, and an overall failure to assign auditors with the proper technical skills. The other was suspended after an inspection raised concerns about staff qualifications and the quality of its internal reviews. (Interpol Environmental Crime Programme, 2013)

In a follow-up review in 2009, the five largest DOEs' validation processes were scored on an A-to-F scale. None received a score higher than a D (Schapiro, 2010).

3.3 Counterfeiting and Theft

There are many examples of fake or invalid carbon permits being sold to unwitting buyers.

In one infamous example, in March 2010, the Hungarian government took possession of two million carbon credits which had been surrendered to them by Hungarian businesses.

The rules of the EU ETS allowed the Hungarian government to legally sell these carbon credits to others because Hungary anticipated being below its Kyoto Protocol target. However, the EU rules prevented these credits from being re-used within the EU (see EurActiv, 2010). Thus, Hungary sold the carbon credits to Hungarian Energy Power, 'with restrictions that they were ineligible for use in Europe and notified the European Commission of the sale' (Airlie, 2010a).

Hungarian Energy Power then sold the credits to a British trading company, which resold them to a firm in Hong Kong. The Hong Kong firm, however, then put those same recycled carbon credits on BlueNext, a Paris carbon exchange [*The Economist*, 2010], where a number of European brokers and banks purchased them not knowing the carbon credits had already been used in Europe. (Fortson and Leake, 2010)

When BlueNext discovered the credits were ineligible for use in the EU, the exchange 'immediately suspended trading sending the spot price for

CERs spiraling downward' (*The Economist*, 2010). After shutting down for three days to isolate the problem credits, BlueNext facilitated 'swap backs' (Airlie, 2010a), in which the sellers bought back the credits. Prices rose to their previous levels when trading reopened (*The Economist*, 2010).

While the European Commission has now closed the loophole that allowed the credits to re-enter the EU ETS (*Utility Week*, 2010), the episode highlights the importance of 'strong regulations for monitoring the transfer of carbon credits through several foreign exchanges, particularly cross-checking between those exchanges' (Interpol Environmental Crime Programme, 2013).

Carbon permits are also the target of thieves and – due to their electronic registry – hackers. A hacking attack in November of 2010 resulted in the theft of 1.6 million carbon credits (valued at €23.5 million) from the Romanian registry account of Holcim Ltd, the world's second largest cement-maker (Airlie, 2010b). Holcim immediately posted the identification numbers of the stolen credits on its website and law enforcement efforts between Romania and Liechtenstein were able to track and return 600,000 of the stolen credits (Emissions Handelsregister, 2010). Still, while the unique identification numbers of the carbon credits allowed them to be tracked, not all the credits could be returned to Holcim. As it turned out, some 'jurisdictions required the holder to return the stolen credits to the legal owner at the holder's loss, while other jurisdictions allowed the buyer to keep them, with the original owner carrying the loss' (Airlie, 2010b; Macken, 2011).

In another high-profile incident, the European Union's emissions trading system was shut down for a week after cyber-thieves stole emissions allowances worth €7m from an account in the Czech Republic, while criminals also hacked into trading accounts in Austria, Poland, Greece, and Estonia. 'The Commission proposed tighter security measures in 2010 after discovering that hackers had broken into the registries where allowances are stored', but member states have repeatedly claimed they cannot afford the improvements (Chaffin, 2011). It is easy to imagine a similar situation arising in US markets where states would have to bear such unexpected costs.

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

The ETS has suffered from a drastic oversupply of carbon permits for quite some time. In October 2009, Peter Zapfel, assistant to the deputy director general of the environment department at the European

Commission, stated that the oversupply of government allowances was threatening to overwhelm the system. At the time, many newer EU members from Central and Eastern Europe contributed to a huge oversupply of credits. These countries had excess credits that numbered roughly five times those in the European market, depressing prices and undermining the carbon reduction goals the market was formed to support (*Financial Times*, 2009b).

Since then, little has changed. In fact, by January 2013, record low auction bids from utilities, factories, and banks led Germany to cancel an auction of European Union emission permits for the first time, ever. Connie Hedegaard, the EU's climate chief, said the cancellation should be a 'wake-up call' for those who do not support the plan to strengthen the emissions trading system (*Bloomberg News*, 2013). Throughout 2015, EUA and CER prices remained below €8, far short of the €20 level needed to prompt industry and utilities to invest in greener energy (Thomson Reuters Point Carbon, 2016 at 5–8).

The US faces similar problems with low prices. In 2014, it was reported that California companies bought all 16.95 million allowances to release carbon emissions at the state's May 16, 2014 auction at roughly \$11.50 each, slightly higher than the previous two auctions in February and November. An additional 4 million permits that can't be used until 2017, of the 9.2 million that were available, sold at \$11.36 (Environmental Leader, 2014). California carbon prices are expected to remain low through 2020 due to excess permits (Environmental Leader, 2014).

Since then, prices have remained stagnant. While North American trading volume roughly doubled across 2015, California auctions settled at a price of roughly \$12.50, just above minimum prices. RGGI prices in the Northeast peaked in 2015 at \$7.50, although, again, that is still near the minimum allowable price (California Public Utilities Commission, 2016).

5. CONCLUSION

Cap and trade markets are not pricing CO₂ at levels that inhibit emissions. As Akerlof noted, 'dishonest dealings tend to drive honest dealings out of the market. . . . The cost of dishonesty, therefore, lies not only in the amount by which the purchaser is cheated; the cost also must include the loss incurred from driving legitimate business out of existence' (Akerlof, 1970 at 495).

Cap and Trade purists seem to think that CO₂ markets will work without a 'central banker' and market supervisor. While markets offer distinct advantages over fiat policy, recent financial research and

economic experience suggest that market monitoring and surveillance still has merits. Over-reliance on unsupervised over-the-counter markets trading in home mortgages created systemic risk and financial crisis around the world in 2008, with the effects lingering in many countries today. Without remediation, therefore, current CO₂ markets risk substantially mispricing emissions – at the least – and potentially market collapse.

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