EMISSION PERMITS AS A MONETARY POLICY TOOL: IS IT FEASIBLE, IS IT ETHICAL?

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Abstract

The price of emission permits is deemed too low to mitigate climate change. In three studies, policy approaches to pricing carbon in a market setting are examined. First, the emission permit market is analyzed comparatively to how the ethanol mandate impacted prices in the corn market. This leads to the realization that the marketization of carbon is more like a currency than a physical commodity. The next study examines emission permits as a monetary policy tool. Emissions correlate GDP output, thus central banks can use emission permits as forward guidance, as a means to optimize the price for climate change mitigation, and as an alternative to interest rates. Opinions of thought leaders are used to question the acceptability of emission permits as a monetary policy tool. The final study is an ethical analysis using deontology, utilitarianism and virtue ethics within a pragmatic philosophical context, analyzing carbon as a monetary policy tool. In order for carbon as a monetary policy tool to be considered ethically acceptable, it must satisfy the temporal, spatial and institutional dilemmas of climate change articulated in Stephen Gardiner's *Perfect Moral Storm*. Under this ethical standard, it is found that using carbon as a monetary policy tool can help address these concerns, but not solve them alone. This research is presented using transdisciplinary methods which provide a unique and holistic approach to policy formation not yet presented in the literature. This research is relevant to policy makers in central banking, the IMF and World Bank.

Acknowledgements

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Chapter One: Introduction

Give someone a fish, you feed them for a day.

Teach someone to fish, you destroy another aquatic ecosystem.

Romer (2011)

Change the rules, and you change the game. Since the dawn of the industrial revolution around 1750, atmospheric concentrations of CO_2 have increased from 280 ppm to an average of 392.67 ppm (Blasing, 2013); a clear indicator that we need new rules.

> Climate change threatens hard-won peace, prosperity, and opportunity for billions of people. Today we must set the world on a new course. Climate change is the defining issue of our age. It is defining our present. Our response will define our future. (United Nations Secretary General Ban Ki Moon, 2014)

We need a system where the specific rules in force at any point in time evolve to keep up with a rapidly changing world (Romer, 2011). Industrial output, a result of current economic design, has created an era where human industrial activity impacts the entire globe, an era that some people call the Anthropocene, or the era of humans. Climate change is the poster child of the Anthropocene. The shear impact of human activity upon the earth is like a parasite destroying its host. In accordance with ecological economics, we need a new economy with a scale relative to the Earth's carrying capacity, one that ensures the fair distribution of these capacities, and their efficient allocation represent the foci for ethical

consideration and acceptability (Brown, 2012). Even though the International Panel on Climate Change has been active since 1988, concentrations of CO_2 continue to rise. Efforts to reduce global Greenhouse Gas emissions are a classic collective action problem, international cooperation is difficult because nations fear "free-riders" (De Canio & Fremstad, 2013; Ostrom, 2009). Free riders are nations that benefit from GHG reductions but do not take part in the reduction themselves. Although there is more buy in since the 2016 Paris Treaty, binding robust commitments are still elusive (Höhne et al., 2017). Philosopher Stephen Gardiner warns that intergenerational costs and geographic disparities exist in which the people who caused climate change should not be the people to pay for its mitigation although they make up the global majority.

One of the problems, in the Post Kyoto era, is that according to the Stern (2006) report the price of carbon is not high enough to bring about the behavioral change necessary to combat climate change. According to a World Bank (2014) report, one of the driving concerns of the market strategy to reduce carbon emissions is that the low price of credits makes them ineffective. Without the demand from EU ETS installations, Kyoto carbon credit prices have reached historic lows. This means that payments to the nascent Reducing Emissions from Deforestation and Forest Degradation program (REDD+) are likewise very low, averaging US$0.51 (€0.37) in 2013, and below one Euro in 2014 (World Bank, 2014). As a result, there is little incentive to invest in carbon sinks and producers of stored

carbon, mostly low-income people, do not receive adequate payment for the land they manage.

This dissertation focuses on the design of market-based emission reduction schemes. The European emission reduction schemes are the markets to leverage because they are the largest and dominate the Clean Development mechanism of stored carbon credit markets. However, the principle behind the market mandate approach to mitigation should work for all carbon markets. Emission reduction market based schemes turn GHG pollution into a commodity to make it more expensive and hence more costly to pollute. Specifically, I ask the research question: is it feasible and acceptable to use a market mechanism to increase the price of carbon emission permits? A market mechanism is a specific policy, regulation, or rule that changes the market price.

I go on to explore the institutional design rules that not only raise the price of carbon emissions through increasing the demand for emission permits, but also the potential of using emissions permits as a monetary policy tool as a new way to approach and add to current climate change mitigation strategies and manage the economic growth. Invoking the biological metaphor again; shifting humanity's parasitic activity to a more communal relationship, in which one organism does not destroy its host, but lives symbiotically without destroying it. For a case study I use another commodity market, the commensurable ethanol mandate's impact on the corn market to analyze price increases and the impact of a market mandate on an undervalued commodity. In this manner I invoke economic and ethical

analysis to determine the impacts of using carbon as a monetary tool within the market based approach currently used in multilateral climate change agreements. What I propose is a policy alternative not yet considered in the literature on climate change mitigation strategies. Using emission permits as a monetary policy tool is intended to work alongside other policy approaches such as fiscal carbon taxes and collaborative measures like Nationally Determined Commitments.

The findings of this dissertation are highly relevant to governments seeking to mitigate climate change most effectively and efficiently. This research demonstrates that carbon is most effectively managed as a currency. As such this has policy implications for central banks and for multilateral lending organizations like the IMF and World Bank.

The following figure 1.1 demonstrates the interactions between price changes and market behavior.

Figure 1.1 Carbon as a Monetary Policy Tool in the Emission Market

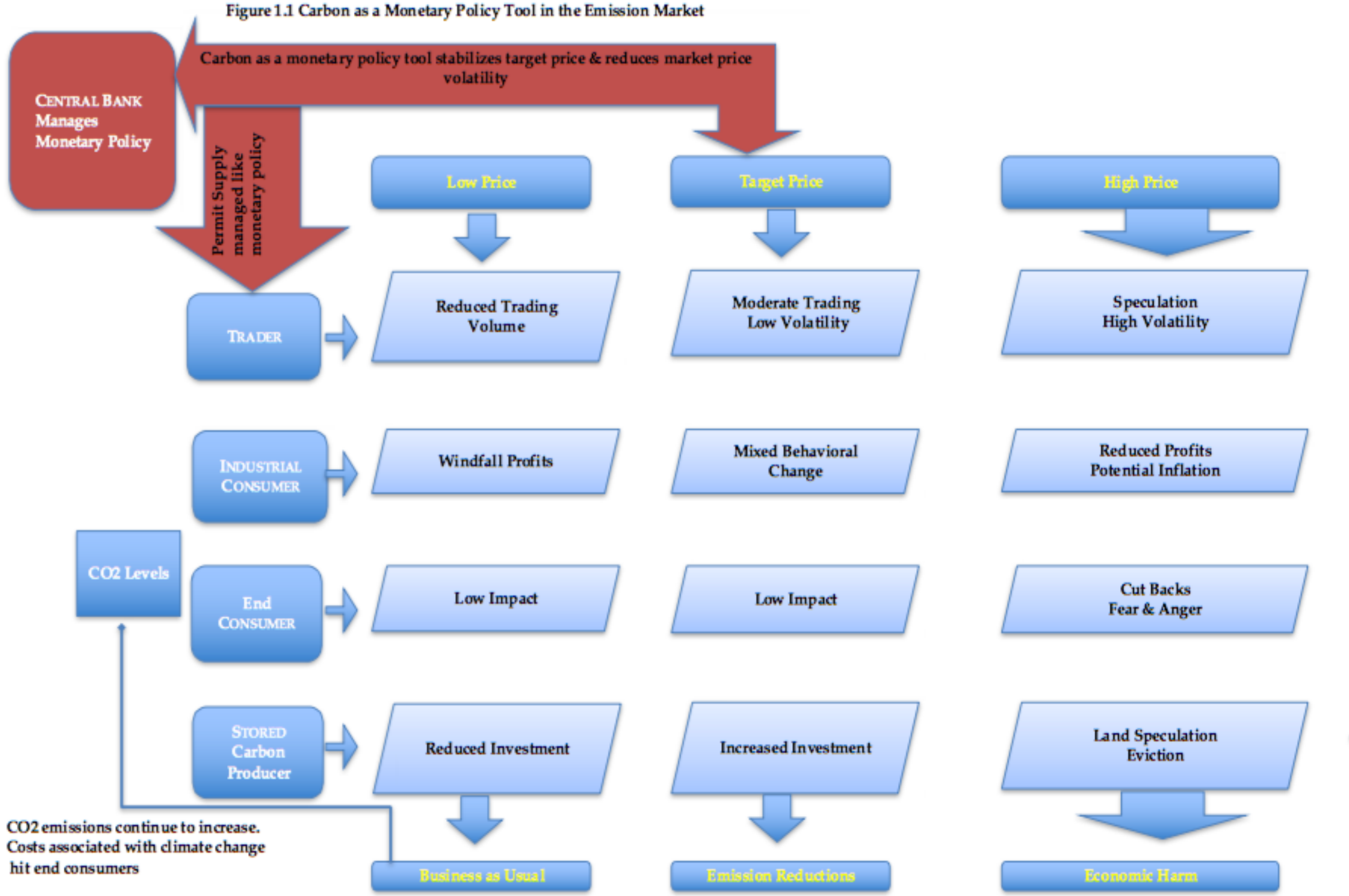


Figure 1.1 The concentration of atmospheric carbon dioxide determines the allocation of emission credits, which is the supply of tradeable permits in the carbon market. The supply of carbon permits determines the price of emissions The above relationships reflect the expected outcomes relative to different price scenarios. The target price reflects the EU policy that determines how many emission permits are allocated and auctioned. This is thought to be the optimum price range to reduce carbon emissions within the given economic environment. The current target price ranges from €20-30, it is thought that this price is sufficient to reduce emissions without harming economic growth.

Figure 1.1: Carbon as a Monetary Policy Tool in the Emission Market

Figure 1.1 shows that prices have a driving impact on the economy and on emissions. The current scenario is one of a low price environment. In this situation we witness low trading activity in the Emission Trading Schemes, this reduces the need for a secondary market in which emissions are trade over the counter and not in an auction setting. This then translates to low prices for stored carbon projects in low and middle income countries and no incentive to limit land-use changes, which are significant emitters of GHG emissions. Meanwhile end consumers in industrial countries do not realize savings on utility bills because utility companies factor in higher prices. So in the end consumers do not realize savings, but producers of stored carbon do not benefit either. Low emission permit prices are a lose-lose scenario for primary producers of sequestered carbon and consumers of electricity, the only winners are utility companies.

If the emission price is too high emission trading will be volatile creating uncertainty in the market. In such an environment end consumers are unsure of future utility price increases and may become politically unstable. In this scenario producers of stored carbon in low income countries may face land speculation from profit seeking investors attempting to ride a sequestration super cycle. Utility companies also face uncertainty due to permit price inflation. So in this case all parties could be harmed.

This demonstrates the need to find the goldilocks zone for the permit price. As will be demonstrated in this dissertation the price of carbon is most efficiently managed in a currency environment by a central bank. This is because emission

permits have more in common with currencies than with a physical commodity like wheat or oil. The supply of permits is set by bureaucrats, not so much by the demand from firms seeking the right to pollute.

The chapters of this dissertation demonstrate the complexity of climate change policy making, specifically the difficulty of carbon pricing in a tax revolt era. The second chapter reviews the literature associated with carbon pricing, while the third explains the methods used to address real-world-policy-problem solving. The fourth chapter asks what can the carbon markets learn from the corn market. In 2005 the ethanol mandate, embedded in the Renewable Fuels Standard Act, sent demand signals around the world altering the global food supply. This poorly understood policy offers imperative information for carbon markets regarding the speculation, transparency and supply within a trading market. Chapter five is the result of a series of interviews with thought leaders; experts in macroeconomic finance and climate change policy. The interviews engaged these experts on the market dynamics of the ethanol mandate and the potential for carbon market policies. The results of these interviews were surprising, in that the experts mistrusted the tradeable permit approach; surprising, because most of them were instrumental in designing various emission markets.

Consequently, the following chapter proposes using a market policy tool that addresses many of the concerns that the expert interviews revealed about market trading uncertainty. Chapter six develops the feedback from the expert interviews into a unique policy alternative, namely using emission permits as a

monetary policy tool to help manage inflation. Thus, this quenches the interview participants' concern regarding market volatility and unintended consequences. In chapter seven, the concept of using emission permits as a monetary policy tool is analyzed from an ethical perspective. This chapter uses a different format; it critiques the policy through the methods of applied ethics in light of Stephen Gardner's seminal tri-part ethical framework. Gardner frames climate change as being a dilemma between generations, geography and institutional inadequacy. Using this framework as an ethical standard is the means for determining the acceptability of emissions as a monetary policy tool.

In scope, this dissertation spans the gap between academic research and the messy world of policy making. It is transdisciplinary in that it weaves different theories and research methods to address a real-world problem in a meaningful way. It draws primarily from policy and economic theory, sociology and ethical pragmatism within an environmental context, by using quantitative, qualitative and ethical analysis methods. In doing so it aims to bring a holistic collaborative approach to tackling the jurisdictional Gordian knot of climate change policy.

Chapter Two: Literature Review

2.1 Markets as Policy Tools: Commodifying Pollution

Pollution is a negative externality; an externality is when the action of one economic agent, like a consumer or firm, affects another agent, and this effect is not included in the market price (Gowdy, 2010, p. 80). The generalized logic of welfare economics translated by economist Arthur Pigou gave rise to pollution regulation (Lane, 2012). In 1920, Pigou demonstrated that such externalities could be accounted for if a tax equal to the social cost were applied to the polluting emission, thereby avoiding the negative economic implications that lead to market failure (Sinclair-Desgagne, & Nimubona, 2005). Later it was proposed that markets in combination with regulatory limits could achieve beneficial environmental outcomes. Proposing, "If factors of production [pollution] are thought of as rights, it becomes easier to understand that the right to do something which has a harmful effect (such as the creation of smoke, noise, smells, etc.) is also a factor of production" (Coase, 1960, p. 44). Therefore, if it is part of the production process, it is a cost, and since firms try to limit costs, they will attempt to limit pollution.

This idea turns a non-excludable problem, like pollution, into an excludable product, essentially making it possible to purchase the "right" to pollute. Essentially, it is harnessing a problem of the commons, by in essence enclosing it (Zia, 2013, loc. 3281-3282). Climate change is frequently referred to as a tragedy of the commons (Broome, 2012; Brown & Garver, 2009; Downie, 2015; Gardiner, 2011;

Jameison, 2014; Ormstead, 2016). Tragedy of the commons refers to Garret Hardin's (1968) classic paper in which a commonly held pasture is destroyed due to over grazing. The following table displays the relationship between enclosed - *private,* resources and goods in comparison to resources and goods that are not so easily managed.

Table 2.1

Economic Resource Matrix

	Excludable	Non-excludable
Rival	Privatization, pay for service, intellectual property rights: controls who has access of use, usually through monetary means. Pollution when regulated	Tragedy of the Commons. Infrastructure: roads the more people access them the more crowded they become, reducing efficiency macroeconomic money
Non-rival	Potential for privatization, pricing reduces consumption. Ideas, technology	Public goods. Lighthouses, ecosystem services: photosynthesis

Adapted from Birner, 2012; Daly & Farley, 2004, p. 160.

Pricing carbon is an attempt to privatize pollution by forcing emitters to purchase the right to pollute. When a limit is set and the pollution privatized, firms can choose whether it is more efficient for them to modernize their production methods to be less polluting, or purchase the right to pollute. According to the Coase (1960) Theorem, the level of an externality like pollution is independent from institutional factors such as the assignment of liability for damages unless there are transaction costs applied. In order to apply transactions costs, the

externality is treated as a commodity (Hurwicz, 1995). A commodity is a useful raw material of value. In our case Green House Gases are *commodified* making them tradeable goods and as a result the *useful* aspect is to reduce their atmospheric concentration.

Following from Coase's theory, Thomas Crocker (1966), John Dales (1968), and David Montgomery (1972) demonstrated that this "right" could be turned into tradable permits that were thought to be more efficient than "command and control" policies that regulate polluting emissions through strict regulatory limits. This concept became the driving principle that was to become the foundation of emission trading schemes (cap and trade) such as the Clean Air Act (1970, 1990), the Montreal Protocol (1992) to control ozone depletion and the Kyoto Protocol to mitigate climate change (Calel, 2011; Lane, 2012; MacKenzie, 2009).

U.S. diplomats with the support of the international business community pressed international emissions trading into the Kyoto Protocol, which the Europeans opposed, preferring the regulatory mechanism. However, despite America's push for the market mechanism, the first international emissions trading scheme to get underway would not include the US (Voß, 2007). The European Union Emission Trading System began operation in 2005 with the market design to price a ton of carbon below €30/tCO_2e (US$41/t$CO_2$e)[1] (World Bank, 2014). The opening price in January, 2005 was €15/tCO_2e.

[1] CO_2e refers to carbon dioxide equivalent: a functional measurement for creating a common standard for calculating GHG emissions

2.2 The Price Problem

The goal of a carbon market is to bring emissions into economic measurement by pricing them. In such a market, emissions have a direct cost (because allowances to emit greenhouses gases need to be purchased), or an opportunity cost (because allowances that are not used to cover emissions can be sold for a profit) (MacKenzie, 2009). The EU-ETS established a European market of allowances for 2.2 billion tons of carbon emissions from 11,500 utility firms (Sovacool, 2011). In 2006, the daily transaction volume in emission allowances reached 60 million Euros (Voß, 2007).

As such, with a view to the fundamental changes in concepts, institutions and practices of environmental policy (as compared to the formerly predominant mode of command-and-control regulation), emissions trading appears to not only be successful, but also an innovation in governance. As a result, emissions trading has become something of a global standard in environmental governance (Voß, 2007). Or so it seemed in 2007. The appropriate allocation of emission permits, which determines the trading price of carbon through the concept of supply and demand, has been problematic from the very beginning (Wrake, 2009). In addition, confidence in the EU ETS has been hit hard since the design mechanism has been unable to cope with the major economic downturn (World Bank, 2014).

Despite three phases of permit allocation, and although the price of carbon flirted briefly with the appropriate price of €30/tCO_2 e in 2006 and again in 2008, since the economic downturn the price has hovered in the €4/tCO_2 e (US$5.5/$tCO_2$

e) range, far below the €30/tCO_2 e high (Point Carbon, 2013). And nowhere near the target price of $85/$tCO_2$ e that economist Sir Nicholas Stern claims is needed to create the economic behavior changes necessary to combat climate change effectively (2006). However, more recent research indicates that prices need not be that high in order to achieve economically significant behavioral change. On the positive side, according to the Grantham Research Institute on Climate Change and the Environment, over-allocation of carbon permits early in the scheme, and the global recession more recently, have reduced the direct impact of the EU ETS on emissions, but the EU ETS has been effective at getting attention about climate change in company boardrooms, which is a prerequisite for change, thus helping to deter major carbon intensive investments (Liang et al., 2013.)

Although this demonstrates that the target carbon price need not be as high as Stern anticipated 10 years ago, the mechanism for increasing the price of carbon has yet to be realized. The price of carbon credits in the EU ETS is still well below €30/tCO_2 e, around € 6-8/tCO_2 e because the supply of credits exceeds the demand. This has resulted in European utility corporations that produce electricity to garner windfall profits since they set the consumer price at the policy target price of €30/tCO_2 e for consumers to purchase electricity, but they pay only the depressed market price for carbon credits on the exchange (Lohmann, 2009; Savocool, 2011).

Although problems still exist, the *concept* of carbon as a privatized excludable commodity has been successful, tradable emission permits are

increasingly recognized as financial instruments, and according to the World Bank (2014), eight new markets opened around the world in 2013. Despite broad unity on action for climate change at the COP 21 Paris summit in December 2015, the EU ETS price is still below 10 Euros.

2.3 Carbon Emission Market Policies: Supply and Demand

The first mandatory emissions market, the European Union Emissions Trading System, was started in January of 2005 (MacKenzie, 2009). It captured roughly 11,500 factories in the EU requiring them to buy and sell permits. This represented about 40% of the EU's total equivalent carbon dioxide emissions (Sovacool, 2011). However, the EU-ETS did not include the aviation and shipping industries (Helm, 2010), aviation was included in 2013, increasing coverage to 45% of CO2 emissions (World Bank, 2014, p. 50). The allocation of permits is decided with each new phase – the EU-ETS is currently in phase 3, which started in January 2013, and will operate until 2020. This phase primarily allocated permits through an auction process rather than gifting them to regulated industries (Santor et al., 2014). The permit price is still below the target price € 20-30, leading policy makers to consider "backloading", which would mean that fewer permits would be released in the future than was initially planned (EcoLogic, 2013).

Although confidence in the EU-ETS has been damaged due to the global recession and misallocation of permits, according to the World Bank there are now 17 emissions trading schemes around the world that account for 12% of all global GHG emissions. Also the largest emitters of CO_2, the US and China now have

regional emission trading schemes (2014). Because carbon is a *base element* it has a consistent weight independent of geography; a tonne of carbon in Europe is therefore equal in substance to a metric ton of carbon on the California exchange even though the policy limit of emission allowance may be different and therefore the price granting the right to pollute could be different in different regions. When carbon is turned into a tradable commodity, its fungiblity (the ability to replace it with an item of equal value, like cash) makes it transferable beyond policy borders. In this sense carbon is fundamentally different from the commodity corn market, which it will be compared to later in this dissertation, because the commodity corn market is concentrated in Chicago where the price is set. Carbon markets are nascent and as such hold no significant historical reference, which is why one must compare it to other markets to examine the potential impacts of mandates on the market price. For this reason, in a future section the case study of a market mandate's impact on the commodity corn market and, hence global food prices, will be examined. However, for the next step, we will look toward the design of pollution markets.

2.4 Market Design

The market design for CO_2 mitigation is based upon a trading market that sets a regulatory cap that limits how much CO_2 can be emitted by large corporations, such as electricity generators, steel and cement manufacturers. The cap thus determines the number of permits that polluters must compete for in the market. Firms that are required by law to take part in the market system have

flexibility; they can decide to reduce their emissions and sell their permits (allowances) to firms that find reducing emissions too expensive. Therefore, the easiest emission reductions are made first, even though the permit price may be inexpensive. Through tightening the cap (reducing the number of permits allocated or auctioned), permits eventually become more expensive, creating an incentive to reduce emissions further. A firms' ability to trade emission permits creates a market in which permit price moves towards its highest value of use (Stavins, 2009). Companies that can easily make changes to reduce GHG emissions do so because it is cheaper for them to change their emissions than it is for them to purchase permits. For an exhaustive review of climate policy see: The Economics and Politics of Climate Change (Helm & Hepburn, 2010). For an extensive and up to date review of the carbon markets see: State and Trends of Carbon Pricing (World Bank, 2014).

In 2005 carbon dioxide emissions represented 85% of all GHG emissions that are released from fossil fuel combustion in the US (Stavins, 2009). Other GHGs such as methane and HFCs exist and attempts have been made to integrate them into the market system through carbon equivalencies. However, attempting to make a homogeneous market standard here creates complications of monitoring and accounting and therefore the viability of equivalency will need to be addressed in future research.

In an attempt to create a concise comparative analysis this proposal only addresses carbon as a comparison to other commodities since addressing other

GHGs, although eventually imperative, excessively complicates the ability of traded carbon emission permits or allowances to be fungible assets. Furthermore, the key goal of this research is to explore how best to reach and manage the target price for carbon emissions, and although capturing other emissions is imperative to mitigating climate change, it is tangential to the discussion of price. Before addressing the price target specifically, it is important to address the nature of what is being traded.

2.5 Fungible Carbon: From Commodity to Currency

In turning carbon into a commodity via the process of emission permits and the trading of those permits, carbon becomes a fungible good. The concept of a fungible good is its equivalency to cash. The literature on carbon as a currency is sparse, but the concept has been noted from the onset of mitigating climate change through the market mechanism. In 2003, the International Financial Reporting Interpretations Committee, a committee of the International Accounting Standards Board, stated that an emissions permit is akin to, and should be accounted for, monetary currency (Button, 2008).

In addition, then British Secretary of State for Environment, Food and Rural Affairs, David Miliband said, Imagine a country where carbon becomes a new currency. We carry bank-cards that store both pounds and carbon points. When we buy electricity, gas and fuel, we use our carbon points as well as pounds. He argued that while a carbon tax would hit all consumers, individual carbon caps would target only those with a carbon intensive lifestyle, typically high earners.

Those on a low income, or who did not own a car or fly regularly, could boost their income by selling their carbon allowances (Clover, 2006). In this scenario, carbon pricing becomes a politically progressive policy tool because it provides an opportunity cost for those choosing to reduce their GHG emissions. Under the EU-ETS, and RGGI in the North Eastern US, carbon units can be saved, as money is in a bank.

While standard commodities such as wheat and oil have a value due to their utility, the carbon permit-credit, like paper money, is essentially made up; its value comes from the cap, which limits its supply (Button, 2008). As a result, the policy that reduces its supply sets the market scarcity, which in turn determines its value (Descheneau, 2012). Hence the emissions market is more similar to trading a currency than eliminating a pollutant (Victor & House, 2004). This is because the supply of the market is set by policy not by production, as it is in mining and agriculture.

Like currencies, not all emission permits are created equally because a government determines the permit supply in the market and it is the government that sets the cap (the limit that determines supply). A market that has an excess of emission permits for sale will have a lower price than a market in which there are few available permits and demand is high.

Just as monetary policy varies from nation to nation, the value of carbon emission credits vary depending upon the supply and demand for credits from a particular country. This puts policy makers in a difficult position, especially in

uncertain economic times, creating the supply of permits in a market can have dramatic impacts on industrial output and so in times of recession it is more likely that permits will be over allocated (Sartor, Pallière, & Lecourt, 2014). As such the long term policy goal of reducing CO_2 comes into conflict with the short term goal of stimulating growth in uncertain economic times. This, in short, is an ethical dilemma, in which immediate policy alternatives are in conflict with long term well-being. Public institutions invariably must negotiate market turbulence with social needs (Ventriss, 2013). As we shall see shortly this is similar to the dilemma of monetary policy in the political arena.

In regions where carbon emission markets are determined by political immediacy, managing the supply of emission permits is crucial to effective mitigation. From an environmental perspective, one concern is that carbon permits of a lesser environmental or financial quality will enter a market and drive down the price, thus reducing overall GHG mitigation. It is important to remember that what is being discussed here is the emission permit market, and not the off-set market, where the issue of quality is even more problematic. Different market prices give rise to concerns of *Leakage*, where a firm may move its enterprise to avoid the cost of emission permits, or reduce cost by moving production to places or markets of lower cost (Sovacool, 2011; Sovacool & Brown, 2009).

If emission permits were traded as a currency, non-equivalent units would be traded much as nonequivalent currencies like the Euro and the U.S. dollar are traded in an international currency market (Button, 2008). This then allows permits

to be treated differently without risking "hot air", *leakage* transactions. This is where permits of a lesser quality and from a different region are traded in a market with higher standards. When this happens because the quality of the permit is of a lesser significance, mitigation effects are of less benefit.

Currently emission permits are perceived and traded as a commodity, but I will explore if they would be better managed as a currency, as Button (2008) and Victor and House (2004) suggest. This would allow them to have different values across markets. Given carbon's monetary characteristics it follows, that if carbon can be treated as money, is it feasible to use it as a monetary policy tool?

2.6 If Emission Permits act like a Currency, Could the Central Bank Use them as a Policy Tool?

In the previous section, carbon emission permits were compared to monetary characteristics. As previously mentioned, there are political aspects to managing emission permit supply that are akin to the dilemma of monetary policy. In this section, carbon emission permits will be analyzed as a monetary policy tool within a central bank, using the Federal Reserve as an example.

The Federal Reserve, commonly called the Fed, is the central bank of the US. The Federal Reserve is generally perceived as a "decentralized" central bank because of its cooperative relationship amongst its regional private members. However, its monetary policy is as centralized as any other nations'. The committee that oversees monetary policy is the Federal Open Market Committee, while the international reserves are held and transactions performed by the

Federal Reserve Bank of New York. This research focuses only on the monetary policy objectives as they might apply to carbon as a monetary policy tool.

Congress oversees the Fed, but the FOMC is relatively autonomous, under the Federal Reserve Act of 1913. Section 2A states the monetary policy objectives:

> The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.[2]

Unlike a private bank, central banks are not profit-seeking; their goals are to create an environment of stability so that prosperity and long-term investment can take place. This is in part why central banks are relatively autonomous from political interference.

Throughout the 1980s many central banks were granted greater independence because it was believed that "the government has an incentive to inflate the currency in order to impose a *tax* (my italics) presumably with lower political costs than would be associated with other, more direct forms." It was understood that independent central banks were [and are] a useful means for

[2] 12 USC 225a. As added by act of November 16, 1977 (91 Stat. 1387) and amended by acts of October 27, 1978 (92 Stat. 1897); Aug. 23, 1988 (102 Stat. 1375); and Dec. 27, 2000 (114 Stat. 3028).

maintaining price stability and thus for controlling inflation without political fallout (Miller, 1998). In other words, appointed central bank directors do not face short-term election cycles. This is the dilemma previously raised in which short term goals are in conflict with long term needs. In short, Central Bankers do not have to face the electorate every four or five years and therefore can focus more on the long term interest of the macro economy. As a result, it is easier for central bankers to act in "long-run" economic interest of the nation and thus they are buffered from direct public scrutiny. The assets of central banks that are used to manage the money supply are more easily preserved with central bank independence, since politicians have an incentive to print money to make it appear the economy is growing faster than it really is.

As a result, monetary policy is seen as a common good that needs to be protected from the political electorate. In this way monetary policy is similar to the interest of climate change. Monetary policy is seen as too important and too delicate to be left to be left to the fickle polis.

2.7 Linking Climate Change and Monetary Policy

This research so far has focused on the human earth relationship; the fact that through industrial pollution and land use changes, humanity is altering the earth's atmosphere to the extent that, according to economist Sir Nicholas Stern, the largest market failure of all time is being created (2006). In large part carbon emissions are the by-product of replacing human and animal labor, which underpin the economy at large. Therefore, carbon is an integral part of the modern

industrial economy as currently designed. The question is, can society alter this economic design in order to avoid the market failure that Stern warns us of?

In order to stave off Stern's warning a policy paradigm shift is needed. Leverage points are fulcrum points in a system in which small changes can bring about systematic over haul (Meadows, 1999). It will be argued here that money is the instrument to leverage systematic change. Eventually we will need an economy wide approach to climate change (Moniz, 2016). If we are to capture the entire economy, then doing so through monetary policy creates that ubiquitous mechanism, because money underlies all economic transactions. All relationships between people involve exchange, in this way exchange is the most developed interaction humans possess. "Every interaction has to be regarded as an exchange… Human life is comprised of loss and gain, the diminution of life's content" (Simmel & Frisby, 2011, loc 2904-2924). In large part, the concept of sacrifice is embedded in the notion of economic values, the ability to exclude a resource from a consumer to make it scarce and therefore valuable and more profitable.

In essence, the tragedy of the commons is the inability to prevent use, thereby destroying the resource. It is thus the theory that underlies putting a price on carbon, thereby making it expensive to pollute and incentivizing cleaner modes of production. Stephen Gardner's Perfect Moral Storm argument states there is a moral imperative that the poor do not bear the cost of climate change mitigation (2006). That is the spatial dilemma that the poor in developing countries who did

not create the pollution that causes climate change be harnessed with the cost of remediation.

As a result, I propose examining the means of targeting monetary policy as a mechanism for spreading the cost of climate change mitigation as broadly as possible, and in so doing making the tiniest fraction of each dollar linked to carbon. In theory, this would aggregate the cost of climate change mitigation; those possessing the fewest American dollars would thus pay the least, while those holding the most would pay the most.

The feasibility of such a scheme involves researching the rules that underlie the Federal Reserve central bank, the currency holdings they possess along with the cost of linking the dollar to the price of carbon and the risk of doing so. This is the cost analysis of linking carbon to monetary policy. It is through addressing the rules that we seek to bring about systemic change.

2.8 Institutional Theory

We often think about institutions as organized groups, but Institutional Theory refers to institutions as the durable manmade rules that govern human interactions, essentially the rules of the game by which society plays (Kingston & Caballero, 2008; North, 1990). Institutions can have many meanings focusing both on the rules used to structure patterns of interaction within and across organizations (Kraft & Furlong, 2013; Ostrom, 2007). The "rules" may be formal, like purposefully designed laws and constitutions, or informal, such as tacit cultural norms and conventions. Institutions include any form of constraint that

human beings devise to shape human interaction (North, 1990, p. 4). This thus makes institutional theory particularly useful for addressing the value of carbon emission permits, a humanly constructed market mechanism for addressing climate change mitigation.

Institutional Theory is a sprawling discourse that in large part integrates approaches from sociology, political science and economics (Goodin, 1998). It offers the flexibility necessary to encompass complex social problems. Its use in economic history, transition economics, and economic development has impressed both the importance and complexity of institutional change. However, even within this narrower framing, the relevant literature is vast and diffuse, and plagued by a profusion of terminology, much of which is used in different ways by different authors. This leads to a dilemma since empirical research focusing on theory and informed by theory runs the risk of isolation within the discourse. Conversely, scholars who take a panoramic approach inevitably face "a mismatch in the conceptual tools used and [that] makes it difficult to engage with theory in a satisfactory way" (Kingston & Caballero, 2009, p.152). For this reason this proposal intends not to be theoretical but rooted in a comparative case study.

The flexibility of IT is necessary for this comparative analysis since societal rules like norms change over time. Take for instance the use of gold. Gold used to be the base metal that underpinned nearly all currency. However, gold has gone from a "formal rule" (the gold standard) to an "informal rule" (a currency reserve.) Although once used as currency, and still entirely fungible (i.e., transferable into

cash), gold is used for its cultural value as jewelry, as a hedge against economic instability, and in dentistry, but it has few industrial uses. Its value is largely symbolic and traditional rather than useful. When Nixon ended the dollar's attachment to gold in 1971, the dollar became a currency governed entirely by fiat. Still the U.S. Treasury is the world's largest holder of gold.

Furthermore, the price of gold has a tendency to increase when interest rates are very low.[3] Because of this cultural complexity, and questionable value, narrow economic theories are insufficient. I question the value of gold and its usefulness in the economy therefore it is necessary to delve philosophically into to the meaning of value and not just the evidence of supply and demand. From a theoretical perspective, economics does not question the consumer's preference is just that the preference for a product [like gold] exists. (Bromely & Paavola, 2002; Broome, 2002). To this day gold is perceived as valuable although it has only a tangential link to GDP, whereas GHG emissions tend to increase with economic growth because economic output is most commonly tied to energy input in an industrial economy.

2.9 A Question of Value, a Matter of Perception

The value of gold is a human construct just as carbon emission permits are a manmade rule to make CO2 expensive for producers to pollute. It is rational then

[3] Please see appendix 3 Fig. Interest Rate Margins and Gold Rates for the empirical data demonstrating the link between interest rates and the price of gold. In this way gold still has a tangential link to monetary policy.

that more expensive means of production (i.e., pollution) that are of equal quality are less efficient and of less value. In this analysis value is tied to usefulness, not cultural norms. The assumption that gold is valuable just because its history does not serve the purposes of a market based economy that is floundering due to the burden of negative externalities.

Given GHG pollution is so directly linked to industrial output (which has been the backbone of the global economy), and given that it has been determined that markets are the best way to address the negative externality of GHG pollution, then it follows that we should value things that are economically useful.

Currently we live in a different era, long gone are double-digit interest rates, at present zero and negative interest rates are the norm. Without interest rates to use as a policy tool, central banks are reduced to providing information about economic growth. As the Gordon S. Rentschler Memorial Professor of Economics and Public Affairs at Princeton University, Alan Binder has stated, When interest rates are at zero, conventional monetary policy is out of bullets (2010).

In our current era of zero interest rates, the Fed uses a term called "forward guidance," which is when the central bank informs investors of their future intentions to raise interest rates or not. Hence, this "news" of *forward guidance* takes on the power of an institutional rule; it has the power to move markets. In 2013, then Fed Chairman Ben Bernanke sent the markets into turmoil by eluding to the end of negative interest rates, or quantitative easing; an incident known as the

Taper Tantrum (Giugliano, 2015). This demonstrates the power that perception has in a market driven economy that never sleeps and is always available via electronic trading.

2.10 Market Forces

Electronic trading means that markets never close, but also that they can be accessed at any place. One no longer needs a broker attached to a trader in New York to place an order to buy or sell on the New York Stock Exchange (NYSE). This spatial complexity, in which markets can be accessed anywhere in the world, combines with technological complexity that allows high frequency trading to perform millions of transactions in fractions of seconds to create an opaque and tightly coupled system, which sociologist Charles Perrow warns is rife for *Normal Accidents* (1999, p. 385). A Normal Accident is an event of cascading failures when the interactions between variables in high-risk technologies interact uncontrollably, frequently with catastrophic effects. In 2010, the NYSE depreciated over 1000 points in a matter of minutes, erasing billions of dollars from investors' portfolios (Shafer, 2012). Such tight coupling of markets come with risks, violent price shifts can represent not just what Bourdieu calls the *symbolic violence* of hegemony (Kerr & Robinson, 2012; Nicolaescu, 2010), but actual violence as the global food riots of 2008 showed (Lagi, Bar-Yam, Bertrand, & Bar-Yam, 2011). However, if policy is designed with the appropriate *buffers* and dampening *negative feed back loops* in place, as Meadows (1999) explains, such risks can be avoided. For instance, a buffer on markets is the daily trading price limit, which

shuts the market down and the price rises or falls more than 60 cents in a day (CME, 2011; McGinnis, 2011). When the market shuts down it cools traders off and provides the opportunity to examine the market information to see if the speculation is warranted or not. In 2008 food prices continued to rise based upon imperfect market information due to the opaque Chinese export ban[4]. Normal Accidents that lead to cascading effects can be lessened by creating mechanisms of redundancy and transparency (Perrow, 1999).

The following figure displays Normal Accident theory in relationship to a selection of systems. The tighter the coupling of the action, the more likely it is to lead to out of control cascading effects. Climate change is complex, but relatively loose in interactions because of the long time it has taken to develop. Climate is slow, but weather is sudden, and extreme storms can lead to catastrophic events. On the other hand, electronic trading is linear, external events and information may impact prices adding complications, but the system is linear, but extremely fast moving and tightly coupled (Lewis, 2015).

[4] See Chapter Five

Tight ←Linear **Complexity→**

Dams Electronic trading	Nuclear power plants
Most manufacturing	Climate change Universities

Loose

Adapted from Perrow, 1999

Figure 2.1: Interactions & Coupling in Normal Accidents

Normal Accidents help us to understand the risks associated with a system and the likelihood of catastrophe. For policy makers frequently having to write rules for unknown circumstances this is insightful. It is not just the information that central bankers provide the markets, but the technological design of markets that make them opaque complex systems prone to Normal Accidents. However, when markets reflect real conditions in the economy, they also become providers of information to policy makers about economic conditions. In this way markets are economic indicators. When considering linking emission permits to monetary rules it is imperative that one perform risk assessment, otherwise the tight coupling and speed of present day financial markets will lead to the cascading effects of normal accidents.

At the same time, markets through price changes can affect economic behavior creating dramatic societal change. For instance, the ethanol mandate to blend 10% of ethanol into conventional gasoline did more to increase the price of corn than 20 years of haggling over agricultural subsidies at the World Trade Organization[5]. According to institutional theory, markets facilitate efficient transactions, because transaction costs are reduced.

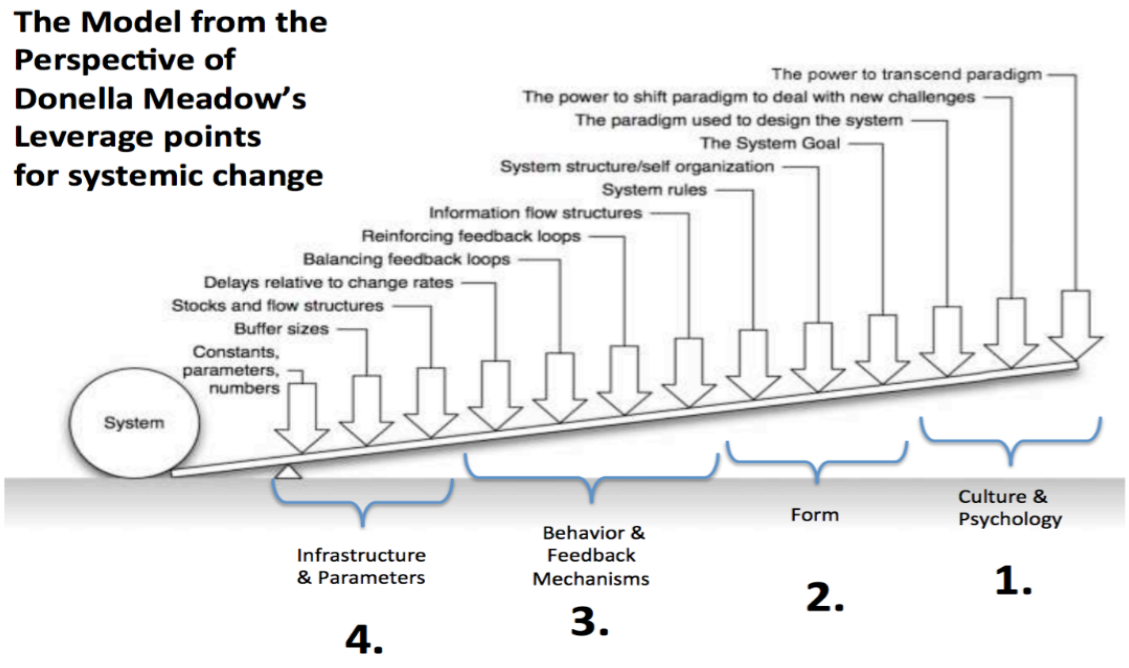
Cap and trade markets within which emissions are traded provide systems to leverage change to alter societal behavior. In the case of climate change the behavior to change is the emission of anthropogenic GHG which typically happens through industrial activity and land use changes. Being able to leverage the price of carbon effectively is therefore an important goal of policy makers.

Within climate change governance state negotiators are weak because at the global level there is no overarching government authority; the governing structure is dependent upon the consensus of representative nations. The problem with consensus based decision making is that policy actions that can be agreed upon may not be the most innovative and effective policies to implement (Coglianse, 1999; Koontz et al., 2004). The cap and trade market offers a rigid linear system with which to price carbon, if the supply of permits is appropriate, under ideal conditions the demand for emissions should be a valuable indicator

[5] See Graph 4.2, Leading Global Exporters of Corn

to policy makers by reflecting economic growth towards or away from industries with intense emissions.

Using leverage points, present opportunities to bring about systemic change in a manner not possible in collaborative policy approaches. Just as a properly strung tennis racket has a spot where if the ball hits there its rebound potential is magnified, so too do we have a spot within a policy system that has exponential potential. Seeking leverage points is about finding openings in a system and making them work (Klien, 2001). Within leverage points approach there is a hierarchy of places to intervene in a system, the first is the crudest, the place of greatest entrenchment. The last is the most subtle place, it is the paradigm shift – the place where the smallest of changes can have a dramatic impact on the entire system.



Finidori, 2014

Figure 2.2: Leverage Points

Within the "Form" section 2 of the above figure, it is evident that leveraging rules can bring about system change with less force than other actions in sections 3 and 4. Acting at the structural level is where the system is altered so that human behavior adjusts accordingly (Heberlein, 2012). An example of such a change is when hotel rooms' lights switch on and off automatically when the door is open and closed from the outside, thereby automatically relieving hotel guests of remembering to turn the lights off before they leave their room. The operating rules of the system are changed to bring about energy savings. This is the mechanism by which effective policy must engage to bring about societal change when faced with a complex problem such as climate change.

2.11 Wicked Problems

When a policy issue is said to be "wicked," it means that it is an issue that is inherently complex and difficult to solve. The dilemmas of a *wicked* issue include, but are not limited to, scale, responsibility, uncertainty, time lags and compounding effects. Often a wicked societal problem is caught in what Chris Koliba (2015) calls a jurisdictional knot in which one must determine who is responsible for addressing the cause of the issue. Rittel and Webber (1973) state that wicked problems do not have obvious solutions, usually there are many

stakeholders engaged who do not agree, or whose interests conflict and that the solution requires behavior change.

Attempting to solve climate change through collaborative measures, what Anthony Giddens (2011) refers to as dialogic democracy, in which dialogue between opposing sides come to, if not a consensus, at least a way forward, is extremely slow. This is evident since climate change negotiations have been underway at a global scale since the Rio Earth Summit in 1992, despite the urgency to act and remain below 1.5 degrees C of warming.

The scale and complexity of climate change is beyond command and control regulation since there is no global authority with power to enforce such a concept. For this reason, climate change must be addressed by using policy instruments. Policy instruments, or policy tools, refer to the things that government *can* do to solve problems. This may involve regulation, taxing and spending, educating the public, and market mechanisms. Whether any of these actions will work to solve a specific issue depends upon the technical feasibility and the likely economic impact of a specific instrument and whether, or not it is politically acceptable to do so (Kraft & Furlong, 2013).

A policy tool is an instrument "through which public purposes are pursed". The criteria for determining whether a policy tool is appropriate is whether it is likely to be effective, efficient, equitable, manageable, legitimate and politically feasible (Salamon, 2002, pp. 22-24). Equity adds a particular *wickedness* to the climate change problem because it must address fairness on a global scale.

2.12 International Development & Climate Change Mitigation

In the Paris Agreement (2015) article 6, non-market mechanisms are allowed, but the market approach remains the dominate approach to climate change mitigation as the more than 20 current national-regional emission trading schemes around the world demonstrate (World Bank et al., 2016). The Clean Development Mechanism (CDM) under the Kyoto Protocol allows transitional and low-income nations (annex B) to sell their *off-set* low GHG development credits to firms and individuals with substantial carbon footprints. The Joint Implementation (JI) mechanism is the market which allows these transfers from annex B nations to sell their certified off-sets to another annex B nation. The CDM, represents the export of capital from high income countries to low income countries. The price of carbon is based upon the emission permit price, which sets the price for CDM projects. However, with the price of carbon so low, capital transfers to low income countries is diminished. In 2016, the CDM transferred €202 million to low income countries (D'Aprile & Marinella, 2017), however, if the EU-ETS emission permit price had been at the 2005 when the market was launched, this figure would have amounted to €606 million, and if the emission price were at its peak it would have transferred more than €20 million to low income countries.

As such, carbon sequestration could represent a significant amount of foreign direct investment to low income countries. Although the CDM offers opportunities for sustainable development, it is unclear as yet whether it could create a *resource curse*. If common land is transferred into private management and

excludes indigenous people for the sake of carbon sequestration, scarcity situations would inevitable arise. While the transfer of *earned* capital from industrial nations to low-income nations represents an opportunity for sustainable development, it is not without its risks. The ability to *trade* offset certificates (sequestered carbon) is an efficient means of transferring wealth from one region to another.

The marketization of carbon is an artifact of the neo-liberal agenda embedded in the Washington Consensus ideology of development. While this hegemonic approach to development may be chastened in the wake of the financial crisis (Birdsall & Fukuyama, 2011), there is also an opportunity to use markets to move toward sustainability by pricing the negative externalities attributed to climate change. Anthony Giddens has called for a third way Beyond Left and Right politics, perhaps by providing a market opportunity to value "those relationships to nature and man in which his economic [life] was formerly embedded" (Polanyi, 2001, p. 135), is a means to shift towards a more bio-centric way of life designed to maximize positive externalities, like beauty and social capital and limit negative externalities such as inequality and pollution. Markets need not be alienating as Polanyi believed, if they are designed in ways that account for negative externalities.

Summary

The industrial revolution transformed the agrarian and craft based societies of the early 18th century into largely urban economies today. According to Karl

Polanyi (2001) this led to a dislocation, economic progress at the expense of the social. Markets are powerful policy tools to leverage; the rules that govern them are even more powerful. In an attempt to mitigate climate change, policy makers have favored a market based approach to limiting GHG emissions. This entails putting a price on carbon emissions, limiting the supply of pollution permits and allowing the market demand to establish the price in a trade setting. The other market mechanism to price carbon is the fiscal measure of applying a carbon tax. One strategy does not preclude the other and some jurisdictions use both policies side by side.

When emission permits are traded, they adopt similar attributes to currency markets because their supply, and hence their price, is determined by bureaucrats. In this way emission permits have more in common with currencies whose supply is managed by central banks, than commodity markets whose supply is determined by production and extraction. Because GHG emissions correlate economic expansion and recession a higher cost on the right to pollute corresponds with a restriction on industrial output. This raises the question of whether emission permits might serve as a monetary policy tool.

Changing policy rules can have a profound impact on market prices. In the next chapter I demonstrate how a rule change, the ethanol mandate, transformed the global food supply. This provides lessons for the rules governing carbon markets. The fourth chapter examines the feasibility of using carbon as a monetary policy tool. The sixth chapter asks what are the ethical implications of using carbon

as monetary policy. This research has implications for central banking and international development since the IMF and World Bank have central banking characteristics.

Chapter Three: Methods Section

3.1 Method of Inquiry

This dissertation seeks to address three fundamental research questions to address the problem of the insufficient price of carbon, which is impeding the climate mitigation process and diminishing the funds available to carbon sequesters in low-income countries. The over-arching approach is to explore whether it is feasible and acceptable to raise the price of carbon emission permits by increasing demand in the market of the EU ETS; the largest and most dominant of all carbon markets and thus the one that drives the price of the carbon storage markets, like the Clean Development Mechanism. To answer this question, mixed methods are used combining quantitative empirical data and qualitative methods using survey interviews and finally using critiqued ethical reasoning methods including utilitarianism, rights, and virtue ethics; thus providing a holistic, transdisciplinary means of policy analysis. The research approach is inductive, that is that it began with the observed market phenomena that arose due to the ethanol mandate's impact on the commodity corn market and seeks to establish a theory for increasing demand in another commodity market, the emissions trading scheme, which is designed to mitigate climate change most efficiently from an economic perspective.

3.2 Quantitative Methods

Carbon is being traded as a physical commodity, as previously mentioned. This makes it commensurable in a sense to other commodity markets. I use the commodity corn market as a case study comparing the impact of rule changes, or mandates, on the price of that commodity. The events that followed the rule change, in this case the ethanol mandate within the 2005 Renewable Fuels Act, provide the empirical data with which to demonstrate the impacts of creating demand in a market. Markets produce data through trading volume and price changes. This data provides an objective method with which to analyze the impacts of mandates on price changes in commodity markets.

The use of quantitative data to describe social phenomena dates back to the emergence of Auguste Compte's positivist framework in the mid nineteenth century. Positivism is an attempt to describe society in factual terms rather than subjectively determined by social norms. Positivism thus adds a deterministic approach to social policy. It may not be entirely possible to prove causality through empirical data, but correlations between, let us say, commodity price changes and producer investment behavior may offer the best available knowledge in the complex messy world of policy making. This is why the field of policy administration relies upon the quantifiable methods of cost-benefit analysis and risk assessment.

3.3 Cost-Benefit Analysis

Cost-benefit analysis is the most widely used decision making means both in public policy and in daily lives (Stone, 2002). It involves tallying up all the positive and costly implications of an action in a form of calculous to determine whether the action is worth taking. The action with the most benefit and least cost invariably wins, however, social and environmental costs are not always easily measured (Birkland, 2016).

Although climate change is a *wicked* complex phenomena, the goal here is not to do a cost-benefit analysis on climate change, but to perform the analysis on what would be the cost of having a central bank purchase emission permits and use them as monetary reserve. The appropriate target price for the polluting cost of GHGs has already been set, but getting the market to meet that price has not happened for some time. According to U.S. Secretary of Energy Ernest Moniz (2016), it will be impossible to create a de-carbonized economy without a lot of progress on the demand side [of emission permits]. Although there is no official price ceiling on the EU ETS, the price in 2006 exceeded € 32/tCO_2e. The appropriate price for carbon has already been determined to be €30/tCO_2e, or £17/tCO_2e. Other markets set a price ceiling ranging from $40 in California to $20 in Australia (Whitmore, 2017). However, the current price is well below this target. This means that there needs to be a dramatic increase in the demand of carbon emission permits. On the mitigation side, a higher price for polluting emissions would increase behavioral change to reduce emissions, and on the sequestration side, an investment incentive to finance carbon sinks and green technologies.

The supply and demand of emission permits, which sets the price, is determined not by consumers and producers, but by bureaucrats who manage the "cap," or the number of tradable permits. When the number of tradable permits exceeds the demand in the market, the carbon price will inevitably be low, thus reducing the impact on climate change mitigation, and reducing the investment value of carbon sinks in the CDM.

According to Sovacool (2006), utility companies have already passed the cost of €30/tCO_2e emission permits on to customers. Therefore, consumers are already paying the target price. As a result, the cost that needs to be determined is the cost of increasing the demand in the market. In this regard, the ethanol mandate provided the increased demand necessary to raise the price of corn above the cost of production. The cost therefore to be determined is how much it would cost to create demand in the market. As proposed in the literature review section, I suspect the most efficient and effective way to accomplish this is by managing emission permits as a monetary policy tool as opposed to a physical commodity. Just as central banks manage the value of money, and hence economic spending through purchasing currencies, or increasing the money supply through printing money and setting interest rates. Given the correlation of increased emissions to industrial output, increasing the price of carbon would be akin to increasing interest rates, but would be a more subtle tool, since interest rates hit all consumers (especially mortgage holders) whereas increasing the price of emission permits would only target polluting industries and polluting consumers.

If central banks used emission permits as they manage the money supply to curb inflation by making it more expensive to borrow money through interest rates, they could in effect increase the cost of industrial production. Using emission permits in this way provides central bankers with an addition tool beyond interest rates. Interest rates impact all consumers, from home owners, to bankers, farmers, to industrialists. Whereas increasing the cost of emissions would only make it more expensive for industrial production from which the negative externality of pollution arises. Non-polluting information technologies need not be impacted. Therefore, the cost to be determined is how much it would cost the central bank to tighten the market by taking emission permits out of circulation. Based upon the principle of supply and demand this would increase the market demand by reducing the supply of available emission permits.

This cost benefit analysis is necessary to ensure that the price is high enough to be effective as a mitigating tool, but not too high as to strangle the economy. Cost-benefit analysis is a weighing of the costs to society in relation to the benefits accrued by a policy. It assumes a policy target, in this case the amount of GHG emitted into the atmosphere, or the "cap," in market jargon. The target is a pollution abatement level, the analysis seeks to discover the most efficient means to manipulate production to meet the target (Bardarch, 2011). In one sense the target regarding carbon dioxide is an atmospheric concentration of 350 ppm, in terms on market price on the EU-ETS it is €30/tCO_2e. However, currently the price of carbon hovers around €6.50, in the US$ 12.50 in California & Quebec (a price

initially determined through auction,) and in the Northeastern USA RGGI market at US$ 5.25. Therefore, the question is, what is the most efficient way to increase demand in the emissions market so that the permit price reaches the target determined by policy makers?

3.4 Comparing Commodity Markets

The commodity case study of the corn market provides the quantitative data to make the comparison between carbon and corn markets. Market data gathered from the Commodity Futures Trading Commission and the U.S. Department of Agriculture will show how demand was created in the corn market through the implementation of the ethanol mandate within the 2005 Renewable Fuels Standard Act.

Embedded within this concept of increasing market demand, three more specific research questions arise. The first question: What market mechanism would increase the demand for carbon emission permits? For this, I will use the data of the commodity corn market and how it responded to the ethanol mandate, in which corn prices rose by 300% in three years. A follow up question: "Is there something that the carbon markets can learn from the ethanol mandate?" I anticipate that this will demonstrate that a market mechanism could be used to create demand in the emission trading market. However, that due to price volatility it might be better to view carbon emissions more as a currency rather than as a commodity. This leads to the second question: If carbon is treated as a currency, is it suitable for a monetary policy tool used by central banks? The third

question: What are the ethical implications of using the policy proposal that the market price of carbon must be raised and how best to increase its price? It thus follows, can higher carbon prices satisfy ethicist Stephen Gardner's (2006) dilemma of the *Prefect Moral Storm*, in which he describes the ethical dilemma of climate change as being a problem of agency, a spatial concern, and a problem of institutional inadequacy?

By combining a triad of quantitative and qualitative methods along with ethical analysis this research seeks to address the implications of a carbon price in line with policy makers' intended target price. I will now describe each of the methodological approaches in detail. Starting with the quantitative approach, which uses quantitative methods to examine the historical empirical data of the U.S. policy change that disrupted the entire global food supply between 2007-2008. It is this case study that will shed light on the policy implications of a higher carbon market price.

3.5 What Can the Carbon Market Learn from the Corn Market?

To begin with I will analyze the secondary data of commodity corn markets gathered from the USDA Economic Research Service and CFTC to demonstrate how the ethanol mandate created demand in the commodity corn market. Then I will ask what the carbon markets can learn from the market mechanism to increase the price of a commodity: Is it feasible to use such a market mechanism?

Changing the price of emission permits will inevitably have tradeoffs so I will use cost-benefit analysis within Institutional Theory incorporating the Institutional Analysis Design Framework to determine the key actors and which of them bears the costs of price changes. It is intended that this approach will bring a rigorous and reasoned critique to policy alternatives to address the strategies proposed for climate mitigation. The second approach involves qualitative methods through a survey interview of thought leaders in the market approach to climate change mitigation. Lastly, the ethical analysis will rely on risk assessment; Can raising the price of carbon satisfy ethicists Stephen Gardner and Andrew Light's concerns that focus on the inability of current methods to address the problems of dispersion, agency and institutional inadequacy in climate change mitigation strategies? To answer these three questions, it is necessary to use a method of analysis that can deliver a broad scope in order to address the complexity of market rules and climate change mitigation strategies. By approaching climate change as an ethical problem I will analyze the market mitigation approach using utilitarian, deontological and a revised method of virtue theory to determine the acceptability of market-based strategies. Markets are institutional entities that are made up of rules that determine their activity. Therefore, the rules become the foci for institutional analysis.

3.6 Institutional Analysis and Development Framework

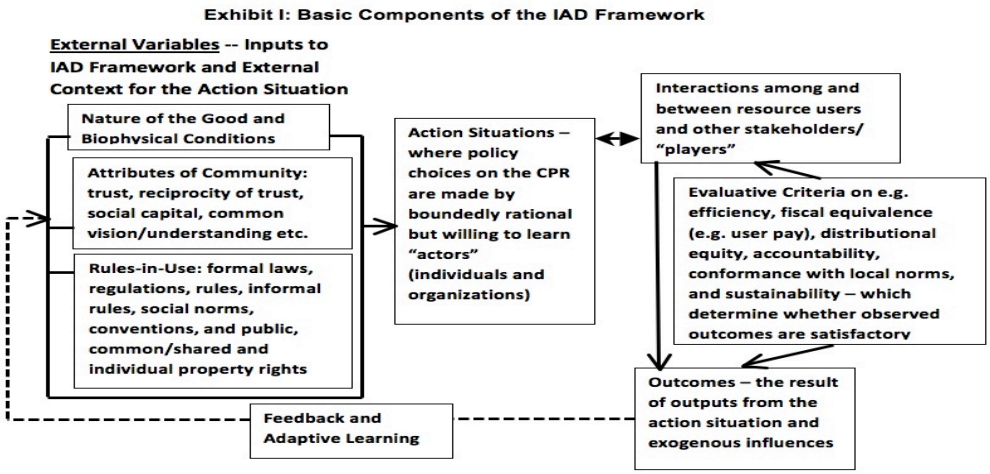
The IADs framework provides subtlety of detail to determine the vulnerability of actors in the system, beyond the simplistic deterministic approach

of *paereto efficiency* that treats all producers and consumers in the economy as having the equal capacity to trade (Daly & Farley, 2004, p. 133; Gaudy, 2010, p. 13).

Approaching markets through the IADs framework create a more dynamic method than merely analyzing prices through supply and demand alone. The ethanol mandate that was the initial rule change that increased demand in the corn market is an example of how formal rules act as a market mechanism.

3.7 Using an Institutional Policy Map to Create a Framework of Analysis

The basic components and networks of the Institutional Analysis and Development framework can be used to demonstrate how rule changes through the ethanol mandate interacted with the traditional market dynamics and supply chains of the corn industry that resulted in the tripling of the price of corn between 2005-2008. For example, the corn industry is made up of producers, middlemen, processors and consumers, the flows between these network actors are what make up the market and their efficiency affects prices. The following chart shows the IAD Framework in context.



Source: Hoffman & Ireland 2013, adapted from McGinnis (2011); Ostrom (2009)

Figure 3.1: The Institutional Analysis Development Framework

Using the corn industry within the IAD framework maintains the experimental design associated with Ostrom. Placing corn and carbon into the IADs framework allows one to determine nodes of weakness, positions of strength and leverage points for the economic actors that will be impacted by tightening the market, (increasing demand). Actors have a characteristic, which puts them in a network position in a place of strength or weakness.

3.8 IAD & The Federal Reserve

It may seem incongruous to use the bottom-up IAD framework to an obviously top-down strategy such as the Fed purchasing carbon as a currency reserve, but I argue that it is precisely the top-heavy position of the Fed that makes it suitable because it is an organization that manages another common good, the money supply. Central bankers do not act as competitors within a market; they are managers and cooperate with other central bankers to maintain stable currency values and suitable lending rates relative to the health of the economy (FRB, 2015).

At the macro-economic level of central banking money is treated as a commonly held resource (good) (Birner, 2012), this makes it similar to another resource the commons, the atmosphere. The difference is that money is a manmade common resource. It faces the same tragedy of the commons scenarios in the sense that mismanagement can make it worthless, which is why central

bankers fear inflation. Inflation is when overall prices are rising (Daly & Farley, 2004). This then explains why politicians, not wanting the conflict of interest between economic expansion, which tends to correlate with inflation, and the political cycle, have granted greater central bank independence since the 1980s (Miller, 1998).

In his article, *If Bad Money Is a Collective Bad, Isn't Good Money a Collective Good?* Jack Birner demonstrates that at the institutional level of central banking, money is a Common Pool Good, we see that at the macro scale money is managed in a way similar to a natural resource. However, money is distinct from natural common pool resources, where the IAD framework application originated, because money is a cultural artifact (a social construction, or an institution) its relevance depends upon the "theories" individuals hold about it (Birner, 2012,). Framing commodities as CPG within the IAD framework provides a method of policy analysis that allows one to expand the complexity of cost benefit analysis because one can increase the network of actors associated with economic flows. Thus, it becomes possible to separate actors such as producers from middle men; we see the entirety of a system with more detail. Typical policy approaches of cost-benefit and risk assessment, tend to analyze quantitative data to the detriment of qualitative analysis. Whereas combining qualitative methods creates a holistic ethical critique of carbon as a monetary tool.

Within the IADs framework I create a comparative analysis of the mechanisms within the carbon market and how the ethanol mandate impacted the corn market.

3.9 Market Mechanism

During the 1960s a policy theory emerged demonstrating that markets are the most efficient means of tackling social and environmental problems (Coase, 1960; Crocker, 1966; Dales, 1968; Montgomery, 1972). According to the Coase Theorum, the level of an externality, like pollution, is independent from institutional factors such as the assignment of responsibility for damages, that is unless there are transaction costs applied. In order to apply transactions costs, the externality is treated as a commodity (Hurwicz, 1995). Transaction costs consist of measuring the valuable attributes of what is being exchanged and the costs associated with protecting and enforcing rights of use (North, 1990). Once a pollution limit is set, permits are issued and then competing firms trade the permits in order to determine a willingness to pay, thus establishing what is believed to be the most efficient price. What was once a common pool problem is thus transferred into a tradable commodity. This is the principle upon which cap and trade systems are built.

The driving force behind such markets is the belief that they are more cost-effective and efficient than alternative forms of command and control regulation (Sovacool, 2011). This research does not explore the efficiency of markets as a pollution mitigation tool compared to command and control regulations; rather it

proposes a way to manage the carbon price through the mechanism of increasing demand in the market. By performing a comparative analysis of the market mechanism that created demand in the corn market, I present a case study for market mechanism use in the emission trading market. Secondary data will be collected to demonstrate this demand increase taken from the USDA and corn market data from the Commodity Futures Trading Commission. Using the corn market's performance relative to the ethanol mandate provides the empirical data combined with statistical analysis which will demonstrate how prices react to rules that increase demand in a market. This strategic approach will then be tested by expert opinion in an interview survey.

3.10 Qualitative Methods: Survey of Expert Opinions

The mixed method approach which combines quantitative and qualitative methods allows one to understand a research question more completely (Creswell, 2003). While the quantitative methods provide statistical analysis with a predictive element to the research problem, the qualitative method of a semi-structured interview provides contextual depth and generates primary data. In a policy area such as climate change mitigation, the policy territory is rapidly changing, the primary data reflects recent opinions of how carbon markets are emerging. In an area as nascent as carbon markets experienced experts are few and far between, so the population of experts is inevitably small.

The interview survey is designed to garner expert opinion of using market mechanisms to increase demand in a market. Because this dissertation reflects on the meaning of a monetary policy, the experts that are interviewed are from the banking industry, or are policy experts in multilateral environmental agreements such as the Montreal Protocol, which contained a market mechanism. The questions that are asked of the experts refer to the importance of climate change mitigation. What they think about leveraging a mandate in a market context, and whether it is acceptable for the Federal Reserve to hold carbon credits. The interviews are semi structured and the conversation is guided by the instrument found in Appendix 2.

I conducted the interviews via Skype and recorded them. I then held them as a secure digital file, until they can were transcribed. Six interviews of expert opinion were completed.[6]

Experts are identified as thought leaders in the policy of climate change arena, banking-finance sector, or both. They are either Canadian or American because carbon market design is still under construction in these two countries. It is also a way of accessing expert opinion from two countries that were historically recalcitrant in the implementation of the multilateral Post-Kyoto climate change treaty. The US not being a part of the Kyoto process was a significant limiting factor to its success (den Elzen & de Moor, 2002).

[6] Please see Appendix 1 to view the research questions and participant list.

Most of the interviewees have global scope and experience in negotiating international treaties, such as the Montreal Protocol, the North American Free Trade Agreement, World Trade Organization agreements, or international banking. After completing the survey participants are asked if they can recommend another appropriate participant, this is the manner in which participants are recruited.

3.11 Method of Survey Analysis

Sentiment analysis is performed on the transcribed interviews. Like with content analysis, sentiment analysis is a research technique used to make replicable and valid inferences by interpreting and coding textual material. By systematically evaluating text documents and oral communication, qualitative data can be converted into quantitative data (Krippendorff, 1980). This thus melds qualitative and quantitative methods. Themes will be coded according to the experts' opinions regarding the "feasibility" of carbon as a currency, and the "acceptability" of using a market mechanism to increase the price of carbon. The results will be coded and used for statistical analysis of common themes. Although the population is too small for conclusive results, it will determine whether future policy research in this area is worthwhile. It will also create a picture of what experts think about a nascent process.

The interview method is adapted from the "Off the Record Expert Consultation" work pioneered by the New York Quaker United Nations Office and further adapted by the Quaker International Affairs Programme in Ottawa,

Canada. These consultation methods are normally conducted in person and as a group. It is a method of expert stakeholder engagement, in which participants' views are protected by anonymity, thus allowing them to speak freely. I am conducting this research not as a focus group, but as interviews. This method allows for greater flexibility in scheduling because gathering many experts to a single event is difficult, plus it reduces travelling costs and the GHG emissions associated with travel. In this manner although the format is different than the previously mentioned QUNO process, the principles are the same.

Because anonymity of opinion is guaranteed participants can be frank in this process since it is ensured that they will not be quoted, or named unless their expressed consent is given in the final document, similar to the Chatham House rule; this assures participants can be entirely open. The results will be used to inform the policy alternatives proposed in the final policy proposal. This approach of using expert interview surveys is an additional method to inform the theoretical proposal of using carbon as a monetary policy tool. It applies an external critique questioning the feasibility of using carbon as a currency and it adds external depth to the notion of feasibility and acceptability.

3.12 The Ethical Critique

Asking experts in finance and policy their ethical views of a policy is obviously superficial without a critique grounded in ethical theory. Ethics are considered to be one of the three key aspects of philosophy, namely; ethics,

metaphysics and epistemology (Schmidtz & Willott, 2012). I ground my ethical approach primarily in the pragmatic philosophy tradition.

Pragmatism is flexible and its origins are rooted in many different disciplines; chemistry, logic and Immanuel Kant (through Pierce), medicine, psychology and J.S. Mill (through James), philosophy, education, economics and democracy (through Dewey) to name just a few. Pragmatism is anti-metaphysical; it is intended to tackle legitimate philosophical problems with an empirical method (Haack, 2006). Italian pragmatist Giovanni Papini likened pragmatism to a hotel corridor off of which many rooms contained separate philosophers each working in their own way, but each having to pass through the same corridor (Haack, 2006). Essentially pragmatism is a philosophy of method.

As Pierce said, "If we find out the right method of thinking and follow it….. then truth can be nothing more or less than the last result" (Haack, 2006, p. 26). Naturalism, a subset within pragmatism, is concerned only with assertions about something that is empirically observable (Hook, 1961). This interpretation is also used in virtue ethics where a standard of nature is viewed upon as being "good." Goodness in this case refers to a measure of an inanimate living thing or ecosystem doing what it is supposed to do. The rose that does not flower, the tree whose bark is cracked is determined a poor specimen (Sandler, 2007). This is a means of establishing a pragmatic ethics acceptable for addressing the ethical concerns within the context of climate change. Therefore, the empirical facts of climate change, the fact that the atmosphere is now polluted with more than 400 ppm of

CO_2 compared with the preindustrial concentration of about 280 ppm in 1750 is an indisputable fact. So too, is the acidification of the oceans. As a result, I do not argue from the predictive elements of climate change modeling of what future conditions might be like because uncertainty inherently accompanies such models. My argument stems from the perspective that the natural abundance and carrying capacity of the earth has an intrinsic virtue to it because those conditions allow for human flourishing and wellbeing. Therefore, using that abundance beyond a certain unsustainable carrying capacity is deemed unethical from a pragmatic perspective.

Using ethical pragmatism avoids many of the contestable arguments that complicate ethical discussions, such as nature's agency, which is a value-orientated dilemma that can have no empirical conclusion. This then narrows considerably the ethical framework with which to address climate change mitigation strategies. For instance, I do not address ethical issues such as the agency of nature, or the rights of animals, since these are purely normative considerations, not lodged in objective fact.

Ethics, sometimes referred to as 'moral philosophy' concerns substantive and analytical questions of what is right and wrong, good and bad, with regards to character and conduct (Maunter, 1993.) Ethics can be divided into subfields such as the study of: *normative*, rightness and building of theories; *descriptive*, involving what one believes to be right and wrong; and *metaethics*, seeking to ask what we hope to accomplish from those moral theories (Schmidtz & Willott, 2012). While

this research focuses on the realm of normative ethics within an economic and ecological context, it does so by establishing a positivist approach in a similar way to medical bioethics. It deals primarily with rules, expressed as policy, as opposed to ethical behavior of individuals who act within the economic and environmental sphere.

3.13 Three Ethical Approaches: Virtue, Deontology & Utilitarianism

Three philosophical theories offer a foundation for this deliberation:

Historically **Virtue** ethics are the oldest relying heavily upon Aristotelian natural law theory and virtuous conduct. It is the tradition of such documents as the Hippocratic Oath (although the Jain tradition of ancient Indian's concept of "do no harm" predates the Greeks). The concept of virtue and natural law is frequently associated with Christianity through the writing of Thomas Aquinas. An action can be right without being virtuous, but a virtuous act must be motivated by the right intent of the actor. This denotes 'right feeling,' but we know that not all virtues, like discernment and integrity, are motivated by feelings (Beauchamp & Childress, 1994). Virtue ethics fell out of favor with the emergence of deontology and utilitarianism, and did not really re-emerged until the 1980s with voices such as Carol Gillian and Nel Noddings who espoused the ethics of care in response to the ethic justice perspective laden in human rights (Sander-Staudt, n.d). Virtue ethics include the ethics of care and social justice since these

are both ethical theories that propose a "better" sort of life. Within virtue ethics I use the concept of "naturalism" to establish a standard, or principle. Nature as a standard is a nascent idea, first put forth by Wendell Berry and Wes Jackson who complain that scientific regulatory procedures too often measure based upon existing standards and not to the nature of the original thing that it is being compared to (Cayley, 2012). For instance, in agriculture genetically modified crops are measured against existing chemical laden crops and not compared to either the natural ecology of the plant, or its organically produced counterpart. "According to this natural goodness approach, scientific naturalism provides a distinctive evaluative structure for assessing" ….The rhododendron that never blooms despite the right conditions is defective (Sandler, 2007, pp. 52-54). It would be wrong to extend this argument too far, without bringing up concerns over agency and rights if applied to animals, etc. However, for the purpose of this work it is useful; the best available science informs us that when it comes to the atmosphere, 350 ppm of CO_2 is a safe concentration, even if the natural state is closer to 300 ppm. Thus, this standard of between 300-350 ppm CO_2 becomes a virtuous standard to meet.

Deontology: Associated primarily with Immanuel Kant (1724-1804) who is considered to be one of the fathers of modern philosophy, it concerns primarily the respect for the good (Schmidtz & Willott, 2012); it is the principle of rights. Positive rights: the obligations we can expect to be done for us, or that might be expected of us. The right to protection under the law, and the duty to pay taxes

would be considered positive rights. Conversely, rights also involve freedoms, generally called negative rights, the right to be free of coercion (Maunter, 1993.) The philosophy underpins human freedom, the concept that moral obligation stems not from God, or some external authority, but from rational reason (O'Neill, 2000.) Central to Kant's ethic is the precept that each person be treated as an end in his or herself (Callicott, 2002).

Utilitarianism emerged shortly after the establishment of rights and generally involves the decision making process that leads to the most amount of good being produced by a certain action. Utilitarianism tells us that we ought always to do whatever has the best consequence (Pettit, 1993.) The maximization aspect lends it to the chief decision tool of economics, and is a key approach to policy through cost benefit analysis (Kraft & Furlong, 2013.) Measurement is key to determining utilitarian action; however, unless the action interferes with individual or collective rights, the value of that action tends to lead toward liberty.

These are the three ethical theories which will form the basis of the ethical critique. However, these theories are still too broad even within the pragmatic tradition and so the context of analysis is further refined by lodging it in the recent emergence of environmental pragmatism.

3.14 Environmental Pragmatism

Environmental pragmatism emerged as a subfield of ethical theory because a number of theorists before the new millennium thought it was difficult to see what practical effect the field of ethical theory had had on forming environmental

policy (Light & Katz, 1996). Although Baird Callicott (2002) refutes this, pointing to the Earth Charter. It is obvious that environmental ethics has not reached the same degree of prominence as medical ethics or business ethics (Schmidtz & Willott, 2012).

> The new attention to applied ethics (particularly medical ethics) has done much to dispel the miasma of subjectivity that was cast around ethics as a result of its association with anthropology and psychology. At least within broad limits, an ethics of "need" and "interests" is objective and generalizable in a way that an ethics of "wishes" and "attitudes" cannot be. (Toulmin, 1982)

Just as medical ethics became an established discipline through the 1970s and 1980s, I propose that implementing quantitative and qualitative methods allows me to use ethics in a rigorous manner to address a policy "need" such as climate change mitigation.

One problem that arises in addressing this need is the dilemma between economic growth and GHG reduction, because GHG are correlate closely with industrial growth and trend with economic growth. According to the Stern Report, mitigating climate change would cost just one% of GDP, but even this is proving a political obstacle. To overcome this Dieter Helm suggests that we need to persuade people of climate change ethics, although he admits the time scale and likelihood are "remote" (2009). Changing peoples' values is not like introducing a new technology. In his theory of environmental attitudes Thomas Heberlein (2012)

argues that the *technological fix* is easy because it does not require humans to change behavior, but not all environmental problems have easy technological answers. The *cognitive fix* in which people change their attitudes (values) takes a long time. Whereas, the *structural fix* changes the social environment that influences what people do; this is where policy alters the way people behave; people change their behavior in reaction to a policy change. This is paradigmatic leverage point in which a small change can have a big impact.

Policy and rule changes provide the framework for societal change. Changing a rule can leverage human behavior and bring about a structural fix which creates new normative standards. Progress then, in the broadest sense, is a function not just in the development of new technologies, but also the development of rules that make sure that we design a better way of life (Romer, 2012). I propose, that by changing the rules of what a central bank, in this case the Federal Reserve uses as a monetary policy tool might have significant societal changes toward mitigating climate change. Therefore, in the environmental pragmatist tradition, the goal is agreement on *action*, not on *values* (Briser, 2012).

Changing the rules by invoking a market mechanism is a fulcrum point. The ethanol mandate's impact on the corn market demonstrates dramatic change through creating market demand.

There is no point raising the price of a commodity unless it addresses the intended mitigation strategies. Whether this institutional change is ethically acceptable will be critiqued in terms of Stephen Gardiner's (2006) article: *A Perfect*

Moral Storm: Climate Change, Intergenerational Ethics and the Problem of Corruption in which he argues that ethics must address:

- Dispersion of Causes and Effects- the spatial problem
- Fragmentation of Agency- the intergenerational problem
- Institutional Inadequacy- the negotiation problem (p. 399)

This is the standard to which the institutional rule change of using carbon as a monetary reserve must answer.

By using the ethanol mandate's impact on the corn market as a case study we provide empirical evidence of a reaction to a market mechanism rule change. Institutional Theory, specifically the Institutional Analysis Development framework, allows me to delve deeply into the potential impacts of using a market mechanism to increase the price of carbon to make it a more effective climate change mitigation tool. I analyze the ethical implications of a higher carbon price addressing the dispersion of cause and effects, fragmentation of agency between different generations and the institutional inadequacy of current approaches to climate change negotiation. It is hoped that this transdisciplinary approach, using ethical analysis combined with empirical economic evidence and expert interview surveys will contribute to the discourse of climate change mitigation strategies.

It is not enough to ask is it feasible, "can," the Federal Reserve purchase carbon as a monetary reserve in order to mitigate climate change more effectively? One must go further to ask "what are the implications of doing so?" The

implications of higher carbon prices will no doubt have effects that mean tradeoffs between populations, but are these tradeoffs acceptable, and to whom?

In attempting to answer the question is it ethical for the Fed to purchase emission permits, the rule proposed must demonstrate, at least in theory, a degree of efficacy. Already philosopher Stephen Gardiner (2006, 2014) has proposed that current strategies do not address the dispersion of cause and effects, fragmentation of agency between different generations and institutional inadequacy. Therefore, I will examine whether using carbon as a monetary policy tool can address these moral dilemmas of climate change.

In doing so I am essentially performing risk assessment based upon the pre-cautionary principle. The precautionary principle aims at least for a "risk neutral" outcome, the action in question should not increase environmental and public risks. In situations of choice the precautionary principle would favor the option with the lowest degree of risk (Goklany, 2002). The Precautionary Principle has been particularly influential amongst policy makers concerned about the possibility of major human impacts on the global environment (Gardiner, 2006b). I will utilize the "maxim" application of the precautionary principle to avoid the criticism that in application it is used in ways that make it too weak or too strong. Some have argued that how regulators choose to weight different risk factors make the precaution principle meaningless. On the other hand, an overly strong application of the precautionary principle prioritizes nature to such an extent that it rules out all other possible benefits (Soule, 2000).

The maxim approach invokes Rawls by creating a weighted scale of least-worst possible outcomes. Essentially one maximizes the minimum by focusing on the worst possible outcome of each course of action and choosing that action which has the least bad worst outcome (Gardiner, 2006b).

I use this approach to analyze how using carbon as a monetary policy tool might address the *moral spatial dilemma* of climate change: those people furthest away from the industrial economies that create climate change will bear the brunt of its negative impacts. The second dilemma to be addressed is *intergenerational agency*: due to long term persistency of CO_2 the effects of climate change will be felt by future generations, thus our current actions put a burden on those not yet born. The third and final dilemma to be addressed is the *institutional inadequacy* that despite multilateral agendas to mitigate climate change dating back to 1988, GHG emissions continue to rise.

I expect that using carbon emissions as a monetary policy tool will at least make an impact on each of these fore mentioned dilemmas because this policy leverages the U.S. dollar, which is the global reserve currency, and, as previously mentioned, 60% of all U.S. dollars are held outside the US. As a result of its widespread global use, this ties emissions to the global economy via the U.S. dollar (it may also capture global shipping). I hope to show that by leveraging the U.S. dollar, this approach captures international trade addressing in part the spatial dilemma by applying a transaction cost to all trade in dollars. If this is indeed the case, and if this market mechanism can be shown to not impress undue hardship

on the poor by increasing end consumer prices too much, then it follows, does the Fed have a moral obligation to purchase emission permits?

Summary

Climate Change is a collective action problem because it affects everyone on the planet, albeit some to a lesser extent than others. Negotiations on climate change have not reduced CO_2 output. In this dissertation proposal, I intend to research a policy alternative that may be able to improve the effectiveness of the carbon emission market.

This research so far has focused on the human earth relationship; the fact that through industrial pollution and land use changes humanity is altering the earth's atmosphere to the extent that, according to economist Sir Nicholas Stern (2006), the largest market failure of all time is being created. In large part carbon emissions are the by-product of replacing human and animal labor, which underpin the economy at large. Therefore, carbon is an integral part of the modern industrial economy as currently designed. The question is, can society alter this economic design in order to avoid the market failure that Stern warns us of?

We have previously described leverage points as fulcrum points in a system in which small changes can bring about systematic over haul (Meadows, 1999). It will be argued here that money is instrumental to leverage systematic change.

Eventually we will need an economy wide approach to climate change (Moniz, 2016). If we are to capture the entire economy, then doing so through monetary policy creates that ubiquitous mechanism since money underlies all

economic transactions. All relationships between people involve exchange, in this way exchange is the most developed interaction humans' possess. "Every interaction has to be regarded as an exchange… Human life is comprised of loss and gain, the demunition of life's content (Simmel & Frisby, 2011, loc 2904-2924). In large part, the concept of sacrifice is embedded in the notion of economic values, the ability to exclude a resource from a consumer to make it scarce and therefore valuable and more profitable.

In essence, the tragedy of the commons is the inability to prevent use, thereby destroying the resource. It is thus the theory that underlies putting a price on carbon, thereby making it expensive to pollute and incentivizing cleaner modes of production. Unfortunately, as Gardner's *A Perfect Moral Storm* states, there is a moral imperative that the poor do not bear the cost of climate change mitigation. That is the spatial dilemma that the poor in developing countries who did not create the pollution that causes climate change be harnessed with the cost of remediation.

As a result, I will examine the means of targeting monetary policy as a mechanism for spreading the cost of climate change mitigation as broadly as possible, and in so doing making the tiniest fraction of each dollar linked to carbon. In theory, this would aggregate the cost of climate change mitigation; those possessing the fewest American dollars would pay the least, while those holding the most would pay the most.

The feasibility of such a scheme involves researching the powers of the Federal Reserve central bank, the currency holdings they possess along with the cost of linking the dollar to the price of carbon and the risk of doing so. The research completed leads me to think that monetary policy is a leverage point at scale of paradigm, which Meadows (1999) argues is at the root of revolutionary change. Simmel and Frisby (2011) argue monetary transactions underpin the relationships within society. While Birner (2012) concludes that at the macro-economic scale money is part of global commons and is managed by central bankers as such. Therefore, since climate change is a problem of global scale, it is a collective action problem and must be addressed as such. This puts climate change mitigation beyond the simplistic strategy of polluter pays, since such an approach would burden the development of the world's poorest desperately in need of economic expansion.

I suggest that using carbon as a currency reserve, managed by the Federal Reserve, might be a market mechanism that improves market effectiveness in mitigating climate change. This approach bypasses the political process since central banks operate with a degree of independence. In this case, the Federal Reserve would purchase carbon emission permits just as it purchases other foreign currencies, like the Euro, Pound, Yen, Mexican peso, and Canadian dollar. I propose that carbon emission permits once commoditized have similar qualities to a currency and I will explore whether as a monetary policy tool they have more utility than gold and thereby might make an effective monetary tool. I will use the

case study of the ethanol mandate's impact on the corn market to demonstrate how a policy creates demand in a market.

Although complicated, the price increase in corn had far reaching effects impacting the global food system; therefore, it is imperative to explore the ethical implications of creating demand in the carbon emissions market. If prices rise too quickly, vulnerable populations could be unduly affected. In addition, I will address three other ethical concerns associated with climate change those being the: *spatial dilemma*, that the people most vulnerable to climate change are not the people responsible for it; *intergenerational dilemma*, that the inability of present generations to reduce CO_2 emissions is deleterious to future generations; and *institutional inadequacy*, that the present institutions achieve meaningful action on climate change.

I will explore to what extent carbon, as a currency reserve, can address these three ethical dilemmas that current approaches to climate change mitigation have been unable to address. In this manner I aim to add to the discourse on climate change mitigation strategies. To try to direct this industrial economy in a more sustainable direction within the biophysical limits we must now acknowledge exist. Although many have warned of the need to do this, feasible actions are wanting. Without meaningful change in the emission permit market there can be no change in the carbon credit market of Clean Development Mechanism that seeks to deliver income to people producing stored carbon, those that manage the positive externalities from which we all benefit.

Chapter Four Scholarly Article: Policy Insight: What Can the Carbon Market Learn from the Ethanol Mandate's Impact on the Corn Market?

Abstract

The market mechanisms of the Paris Agreement, previously the Kyoto Protocol, which are designed to mitigate climate change, are limited in scope due to the challenge of managing the supply of emissions permits and sequestration credits. At present the excess supply in both market scenarios leads to low prices, and as a result, a reduced incentive to mitigate faster. This paper examines the market mechanism and the challenges of price optimization is explored. This examination uses the ethanol mandate's impact on the commodity corn market as an example of policy intent and market reaction.

This research reveals that market mechanisms are powerful policy tools. Pricing pollution to reduce emissions is an effective strategy under optimal conditions. However, designing optimal conditions is difficult. I conclude that emissions permits are more like a currency than a physical commodity, and should be managed as such to mitigate climate change more effectively.

Introduction

The Kyoto Protocol was the initial international means to reduce Greenhouse Gas emissions in the atmosphere, the current Paris Agreement to mitigate climate change is based upon its architecture. In the Kyoto Protocol, pricing carbon, the chief mechanism to reduce GHG atmospheric pollution, is achieved by nations agreeing to set a limit on GHG production, transferring that

supply into emissions permits and then allocating, or auctioning those permits to discover the optimal price that will reduce pollution without undue harm to the economy. This is the recipe used to price pollution most efficiently.

Previous pollution reduction schemes that used this approach are the 1980 and 1990 Clean Air Acts (Schmalensee & Stavins, 2012). It was also one of the policy tools used to eliminate ozone depleting CFCs in the Montreal Protocol (C2ES, 2015). This policy approach to reduce pollution is based upon the Coase (1960) theorem, which states that it is most efficient to trade the right to pollute in a market setting. This was believed to be the best way to discover the optimal price that would reduce pollution without putting excessive restrictions of economic growth. Prohibitive costs would lead to economic decline, which from a welfare economic perspective would harm the poor (Pigou, 1951).

4.3 The Problem

The concept which underwrote Kyoto was that by pricing emissions it would make it more expensive to pollute, thus reducing the GHG which warm the atmosphere while incentivizing sequestration projects through the Clean Development Mechanism, this allows low and middle income countries to sell Certified Emissions Reduction certificates (UNFCCC). The European Emissions Trading System, begun in 2005, remains the most prominent of all carbon pricing markets. However, after a successful start, the bottom fell out of the market, first in 2006 when it emerged that there was an excess supply of permits, then again in

2007 with the financial crisis (Hintermann, 2009; Vasa & Michelowa, 2011). Prices on the EU ETS are still in the depressed range of US$5-9 (€4-7).

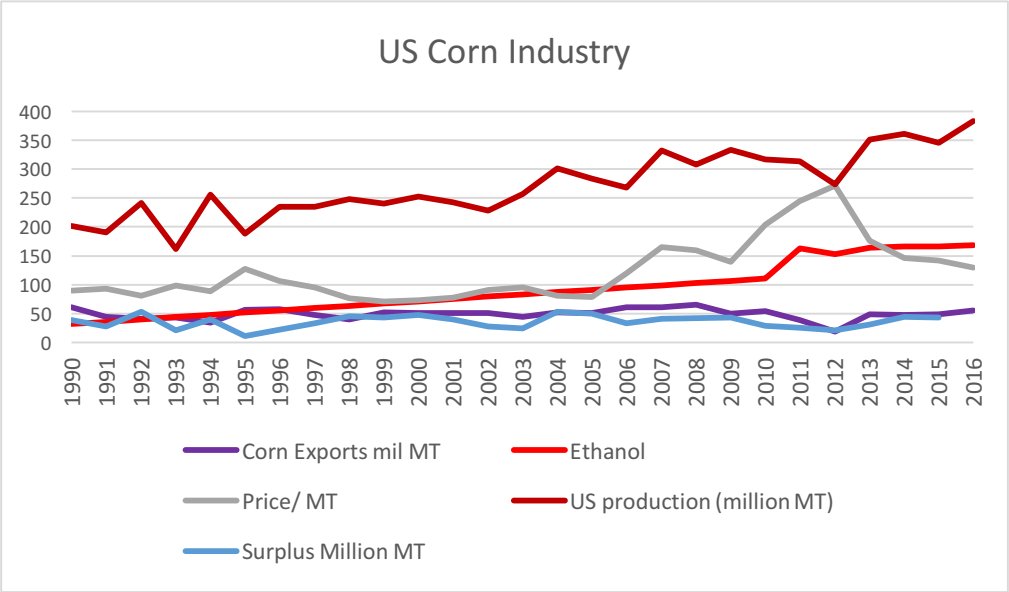
Without the demand from the EU ETS market mechanism, the Kyoto credit prices hit historic lows in 2013 and 2014, with Certified Emissions Reductions (CERs) worth just US$0.51 (€0.37) (World Bank, 2014). Sequestration credits trade at a 90% discount to emissions permits suppressing the investment incentive. To provide an investment incentive in North America forests the off-set price needs to be above $11/Cte (Russell, Keeton, Pontius, & Kerchner, 2014). It is expected that prices will fall when a product, or resource is turned into a tradeable commodity (Munden, 2011).

The low-price commodity scenario of emissions permits is comparable to another commodity, corn. All agricultural commodities fall under this scenario. The ethanol mandate within 2005 Renewable Fuels Act increased demand in the corn market making corn more valuable; therefore, it is a useful case study to demonstrate how rule changes lead to market responses.

The ethanol mandate to blend 10% of corn ethanol into the conventional gasoline was a part of the 2005 Renewable Fuels Act. The following graph demonstrates in metric tons:

- The increased demand for ethanol from 2006-2010.
- The near tripling price increase as a response to increased demand.

- That production increased at the same time as prices resulting in increased supply.
- While exports and Surpluses remained within historic trends



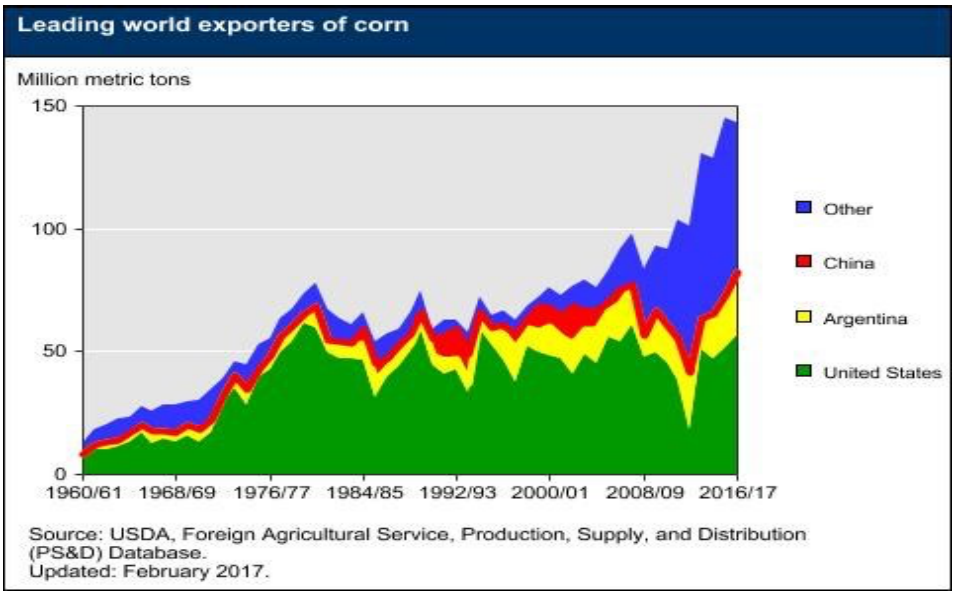
USDA (2017)

Graph 4.1: U.S. Corn Market (million metric tons)

U.S. corn surpluses declined by 40% from 2004 highs, demonstrating how much surplus there was in 2004, rather than how little there was in 2006 when corn prices started to climb. 2004 represented an unusually high level of surplus corn stocks at 53.69 million metric tons compared with 2006 levels of 32 million metric tons as the above graph demonstrates. This should not be surprising since in 2006, 3.46 million fewer acres were planted in corn than in 2005. In turn, reduced acreage correlates to a low price for corn and long-term lack of profit for framers. This

indicates that there was abundant supply to absorb the increased demand of the ethanol mandate, still the news of increased demand drove corn's price upward.

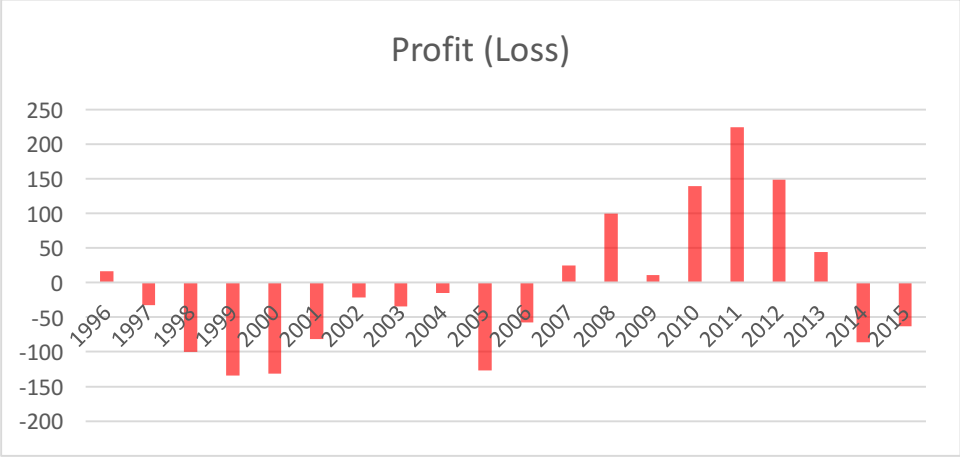
The following graph shows how farmers in developing countries increased production in response to higher prices. Even though U.S. exports fell by 25 million metric tons in 2010, overall global corn exports increased.



USDA (2017)
https://www.ers.usda.gov/webdocs/charts/18556_cornexportersjpg/cornexporters.jpg?v=42780

Graph 4.2: Leading World Exporters of Corn

In 2016 prices, corn diverted to ethanol represents about 50% of corn production and prices have reverted back to historic norms due to oversupply. Farm incomes are again threatened. Corn prices have fallen from a high of $7.79 per bushel in 2008 to around $3.65 per bushel in 2016.



USDA (2017)

Graph 4.3: Cost and Returns per Planted Acre

The above data demonstrates how price impacts behavior. As corn prices increased, corn production from outside the U.S. increased and entered the export market. Overall global corn output grew from 708 million metric tons (USDA, 2005) to 869 million metric tons in 2013 (USDA, 2014). The entire global corn export trade is now about 150 million metric tons, up 50% since the introduction of ethanol (USDA, 2017).

Although the ethanol mandate is often blamed for the 2008 food crisis, prominent scholars know the global situation was more complex than the ethanol mandate change. The crisis was driven by many factors including trade bans, poor weather, quantitative easing and market speculation (Abbott, 2009; Abbott & Battisti, 2009; Abbott, Hurt, & Tyler, 2011; Gilbert, 2010; Headey, 2010; Headey & Fan, 2010; Lagi, Bar-Yam, Bertrand, & Bar-Yam, 2011; Mitchell, 2008; Trostle 2008, 2014). Although the price of corn in Chicago rose over 270% between 2004-2008, it is estimated that the ethanol mandate was responsible for 23% of this price

increase (Irwin, 2013). What Irwin does not account for in his model is the unreported Chinese export ban on corn. This represented a 10% disappearance from the export market as Table 4.1 shows.

Table 4.1

2003-2011 Chinese Corn Production & Exports per 1000 Metric Tons

	2003	**2005**	**2006**	**2007**	**2009**	**2011**
Production (1000 MT)	115830	139365	**151600**	152300	163974	192780
Export (1000 MT)	7553	3727	5269	549	151	91

USDA Foreign Agriculture Service, 2013

Chinese corn production continued to increase, but exports fell in 2007 by 90%. This resulted in imperfect market information about supply that explains the steep price fall in late 2008 when it was realized that China was not importing corn either and that there was not a shortfall. Global supply information impacts the US commodity corn market, because 75% of global corn contracts are traded in Chicago (USDA, 2017).

The data presented here demonstrates the impact of the ethanol mandate on the commodity corn market. By 2006, 40% of U.S. corn production was diverted to ethanol, now a quarter of this diverted amount returns to the livestock food-chain as distillers' grains. This 40% increase in demand plus the export ban in China created the illusion of scarcity. Higher prices led to expansion of production overseas, as graph 2 shows. Excess global production has driven down prices in

the last two years. It is too early to tell what impact this will have on future production.

This commodity corn data is relevant to ETSs because it indicates how a market mandate can increase demand in the market, increasing a commodity's price. It is important to remember that when comparing the ETS market mechanism with the corn market that the ETS is a virtual market. The market may experience shortages, but not due to the physical delivery of corn stored in warehouses. The permit supply in the ETS does not face supply-chain problems, its supply is determined politically.

4.4 **Methodology**

In this comparative analysis between the impacts of the market mandate in the corn market and the excessive permit supply in the ETS, the Institutional Analysis and Development framework is used as a policy analytic tool. The IADs framework is unique, it allows for collaborative evolution through mapping feedback loops, but maintains the contextual bio-physical restraints that collaborative models lack. Collaborative governance models, one could argue, are the frameworks utilized at Conference of Parties (COP) summits to address climate change; thousands of stakeholders gather annually to seek agreement on targets and actions. However, the binding targets of Kyoto expired in 2012, and the Paris Agreement (2015) is based upon individual nation commitments (UNFCCC, 2015). Collaborative models are not mandates and do not require specific actions (Blomgran Bingham, 2009). Since this research focuses specifically

on mandates and rule changes, a collaborative policy framework is not the appropriate tool for this comparative analysis.

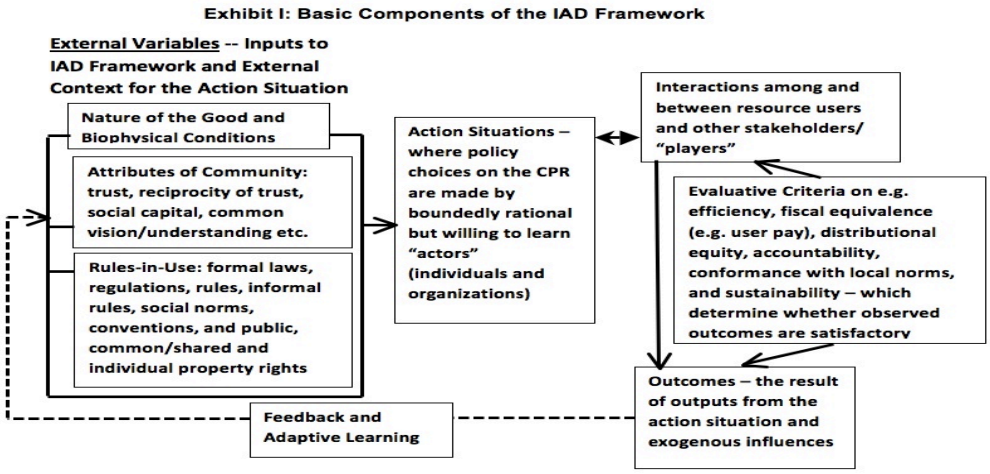
Because this research focuses on institutions more than the players who make up the institution and the rules by which they operate, it is appropriate to use an institutional model. Institutions can have many meanings focusing both on the rules used to structure patterns of interaction within and across organizations (Kraft & Furlong, 2013; Ostrom, 2007). The "rules" may be formal, like purposefully designed laws and constitutions, or informal, such as tacit cultural norms and conventions. Institutions include any form of constraint that people use to shape human interaction (North, 1990).

These rules form operation systems, such as markets. Analyzing the commodity corn market in the IAD framework simplifies the system complexity. Charles Perrow (1999) warned that complex-tightly coupled systems would be prone to failure, in this context market crashes. Modern digital markets fit into this category of system, due to the speed at which they operate, it is an additional characteristic that must be addressed as a risk factor.

4.5 The IADs Framework in Use

The basic components and networks of the Institutional Analysis and Development framework can be used to demonstrate how rule changes through the ethanol mandate interacted with the traditional market dynamics and supply chains of the corn industry that resulted in the near tripling of the price of corn between 2005-2008. For example, the corn industry is made up of producers,

middlemen, processors and consumers, the flows between these network actors are what make up the market and their efficiency affects prices. The following chart shows the IAD Framework in context of its network connections and flows.



Source: Hoffman & Ireland 2013, adapted from McGinnis (2011a), Ostrom (2009)

Figure 4.1: Basic Components of IAD Framework

By placing the commodity corn market into this framework, the complex interactions that led to the price increases in the corn market and market tightening are simplified and more easily explained.

4.6 Results: The Corn Market in the IAD Framework

The next chart maps the impact of the ethanol mandate inside the corn market. It demonstrates the importance of information to market behavior. For instance, it is the information about the *biophysical conditions* on farm and in the mid-western region which provide information to the traders about the forth coming harvest. In turn, the *traders* determine whether they believe the supply will

increase or decrease, which then impacts the price of the commodity. At the end of the chart, the *policy reaction* reflects the result of prices; such as, should subsidies be removed or increased, should exports be halted? These reactions provide feedback information and influence the *supply and demand* that then impacts the *market place*. The feedback loops within this system either amplify market volatility or dampen it. Volatility can move prices suddenly in either direction. However, the corn market is buffered by the daily trading limit; if the price per bushel moves more than 30 cents in either direction the market shuts down automatically for the day. This daily limit prevents market crashes. In terms of the physical market, if prices are high farmers will increase production, if they are low their planting decisions will be based upon available subsidies.

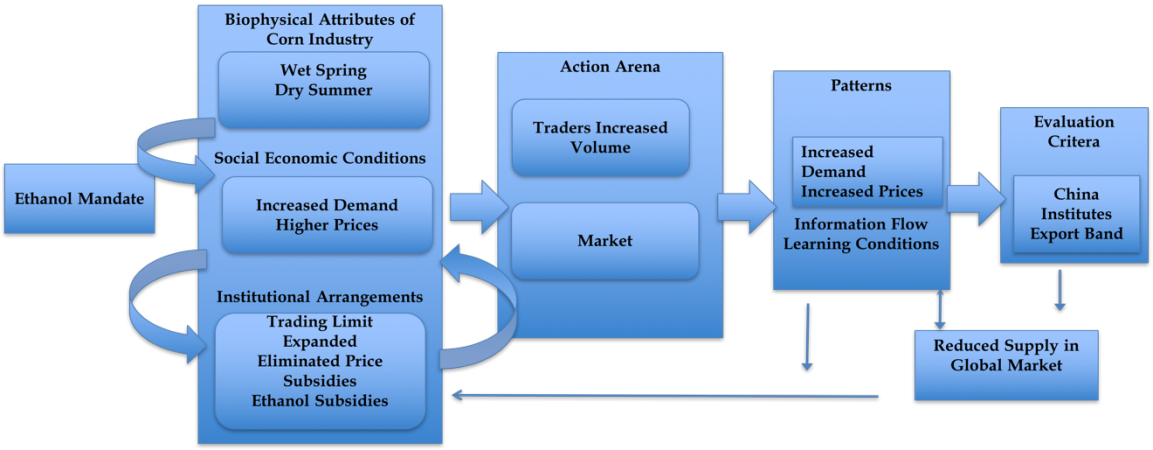


Figure 4.2: Ethanol's impact on Corn Market within the IAD Framework

Certainly the 2005 mandate to blend 10% ethanol into conventional gasoline created a dramatic increase in the demand for corn. In addition, Midwestern spring flooding made traders nervous in 2008. But, it turned out to be a hot dry

summer and lower waterways meant that barges transporting corn to international markets had to carry lighter loads. Meanwhile, increased trading volumes on the corn Commodity Futures markets created an expansion of the daily trading limit. This meant that the price of corn could fluctuate by $.30 per bushel per day instead of the historic $.20 per bushel (CMEgroup, 2011). This all took place in the context of newly emergent high frequency trading.

Because corn prices climbed, price subsidies to corn farmers were eliminated, incentivizing them to plant more corn. Subsidies to ethanol producers incentivized expansion in ethanol distilling infrastructure (Wisner, 2006). These variables created amplified feedback loops within the corn industry and futures markets leading to what is commonly called the 2008 food crisis. News on China's export ban does not exist, only in 2016 did news emerge that China was ending its corn Stockpiling program which was implemented in 2007 (Gale et al., 2009; Wu & Zhang, 2016,).

This demonstrates that the illusion of a 10% disappearance due to the Chinese export ban was not taken into consideration in analysis of the causes behind the 2008 Food Crisis. This is an important distinction in the comparative analysis for ETS markets since it will influence the perceived risk of market speculation.

4.7 The ETS in the IAD Framework

According to Hintermann (2009), market speculation was indeed a concern in the EU-ETS in 2006 when the permit price peaked at €32 in April. Then the price

dropped sharply when news emerged that there was an excessive supply of permits in the market. The price recovered somewhat to range between €15-20, but then collapsed to near zero in 2007. The price has since hovered between €4-6 (Carbon Pulse, 2017). Speculation in a market is difficult to determine (Hintermann, 2009; Sanders, Irwin, & Merrin, 2008) because speculation is a concern and it will be included in the risk assessment.

The following chart displays the ETS in the IAD framework which makes it possible to do the comparative analysis between the impact of the ethanol mandate on the corn market compared with the ETS market design. It must be acknowledged that data on the corn market is historical, and the comparison of ETS is largely a projection of expectations.

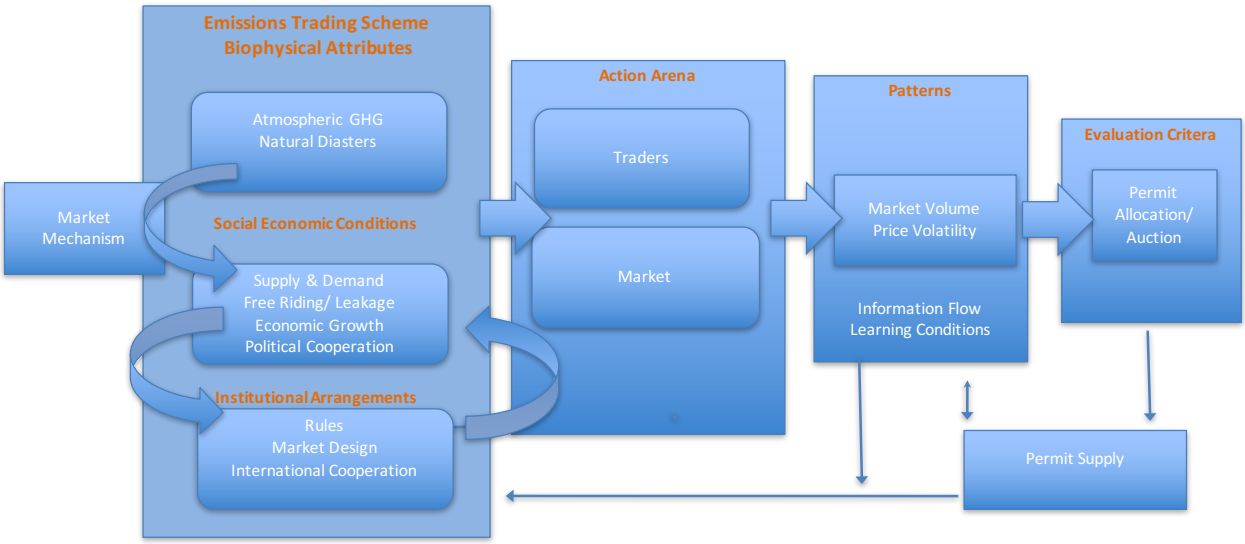


Figure 4.3: Emissions Trading Scheme in the IAD Framework

The *biophysical attributes* in the framework refer to the concentration of GHGs in the atmosphere. The information about this area is determined by

scientists measuring atmospheric concentrations of GHGs. However, since the biosphere is a complex system, modeling and predicting in this field is not straight forward, it is impossible to calculate exactly how much CO_2, for instance, will be absorbed by the oceans, or the impact of a volcanic eruption on atmospheric GHG concentrations in advance. A volcanic eruption in the short term would reduce regional temperatures due increased sulfur release, but in the long term would exasperate GHG concentrations (Robock, 2000).

The *social and economic conditions* may be no less easy to predict. We can assume that demand for emissions permits will be high during industrial expansion, and that leakage will occur for corporations seeking to avoid carbon pricing by setting up in a nation not captured by carbon pricing. Thus, emissions would be reduced regionally, but not globally. Benchmarking within a single market region has shown to prevent some leakage in phase 3 of EU-ETS 2013-2020 (Sartor, Pallière, & Lecourt, 2014).

Political cooperation is the norm of politics, even though free market completion is the driving ideology of proper economics (Stone, 2002). Despite the contested opposition parties of 2016, governments have to cooperate in order to form a policy agenda. The policy span of phase 3 in EU-ETS is seven years, which does not leave an opportunity for changing conditions in the interim. The COPs meet annually, but the first stocktaking of the NDCs will take place in 2018 and nations will be evaluated every five years after on their committed progress

(UNFCCC, 2015). Although this will not impact *market design* directly, it will no doubt impact ETS market prices, as all new information invariably does.

Information flows into the *action arena* where changes in the market place happen. Trading creates *patterns* and produces data from which to *learn* about the system, which in turn establishes the *evaluation criteria*. In ETS this is the point where policy decisions about the system get made. In the EU-ETS this is usually a seven-year cycle, whereas, the Air Resources Board, which facilitates the California-Quebec cap and trade market, auctions are held quarterly allowing for more flexibility (ARB, 2017).

The evaluation criteria are a critical arena because this is where decisions are made. This is the policy area where the initial ethanol mandate was made. It is also the location where the Chinese made the policy decision to stop exporting and to start stockpiling corn. This is the point where the supply of emissions permits was made in 2013 on the EU-ETS and it informs the ARB prior to their quarterly auctions in the California Cap and Trade system.

The allocation of emissions permits in phase 2 on the EU-ETS was made in 2005, prior to the financial crisis. The allocation was set until 2013 when phase 3 would allocate and auction a new permit supply. This left an excess supply in the market for the next five years. Except due to slow economic growth in Europe, when phase 3 was released, policy makers were afraid to reduce supply too much. Policy makers must balance whether to set an ambitious cap (reduced permit

supply), but not too ambitious, which would lead to price spikes, that could threaten the entire scheme (IETA, 2016).

4.8 Discussion: Getting the Price Right

Because most carbon pricing markets are so nascent, it is impossible to measure their success in reducing GHG emissions. After 12 years only the EU-ETS has enough data to provide reasonable measurements. According to Carbon Market Forum, the EU-ETS is succeeding in meeting a 21% reduction in GHG emissions below 1990 levels. It has done so at a very low market cost, and under competitive conditions (Marcu, Elkerbout, & Stoefs, 2016). As of 2015, the EU has reduced emissions by 22.3% (Euro Stat, 2016). As more countries adopt carbon pricing mechanisms fears of leakage are reduced (Marcu et al., 2016).

Despite this short-term success, the trajectory to meet the Paris Agreement's intent to limit warming to "*well below* 2 degrees Celsius of warming" is not sufficient. It is assumed that EU GHG reductions of 45-70% by 2050 will meet this target, but to stay below the 1.5 Celsius warming level GHG reductions of 70-99% are necessary, based upon the CAT global assessment model and modified with UN population projections for 2030-2050 (Hare, Roming, Schaeffer, & Schleussner, 2016).

The most recent accounting of the social cost for carbon is \$31/Cte; however it uses a baseline of 2.5 Celsius degrees of warming (Nordhaus, 2017). The Stern Review (2006) claims a social cost of the \$86/tCO_2. Perhaps the exact price is not important; the EU has reduced emissions at a cost below either estimate.

However, the low hanging fruit has been picked and this indicates a higher price will be needed in the future. A survey from 2013 claimed that a mere presence of a carbon price had GHG reductions on corporations' agendas (Laing, Sato, Grubb, & Claudia, 2013). This indicates the power of *forward guidance*, the monetary policy which the Federal Reserve used to encourage investor confidence during the Great Recession. Forward Guidance is when a central bank makes a statement about the future direction of its monetary policy (FRB, 2015).

The seven-year cycle, that the permit allocation/auctions are set, is not a flexible means to manage the permit supply, as phase 2 indicates in the wake of the financial crisis.

Currently, there is not enough liquidity for the market to function as an investment mechanism. Market rules discourage entry into the market; this is, in part, due to regulators fearing speculation (Marcu et al., 2016).

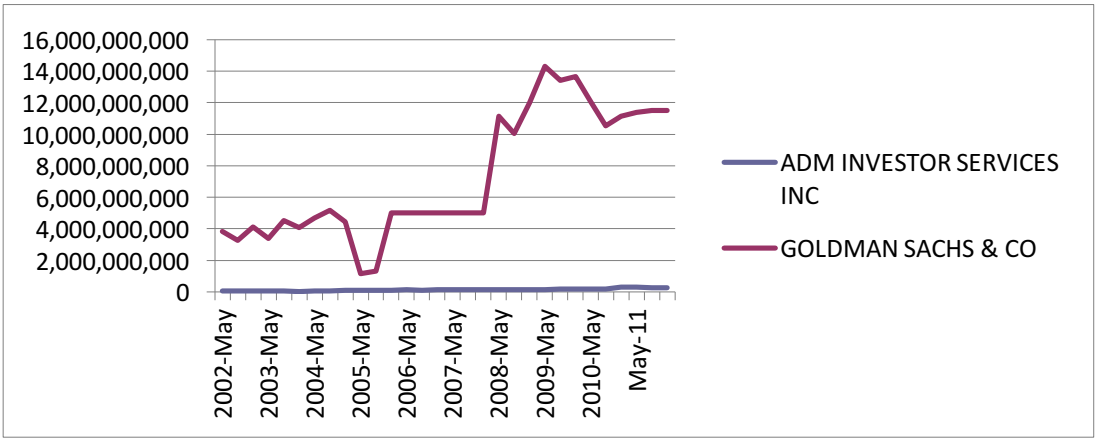
4.9 The Risk of Speculation

At present the market is too tightly regulated to encourage investments opportunities, decreased *open interest* means reduce liquidity and a perception that a good is not going to be more valuable in the future. A little bit of speculation in a market is a good thing because it indicates the value of a good is increasing. For instance, in the US, the Commodity Futures and Trade Commission, has more non-commercial open interest on corn than commercial interest in corn. Commercial traders represent farms who deliver physical corn into the market, and processors who take delivery of that corn. Non-commercial traders are

speculators; they provide the liquidity needed for a market to function in between when a crop is planted and when it is harvested. Without a future contract, every harvest time prices would crash due to over-supply.

The converging effects of the ethanol mandate and bad weather in 2008 lead traders to speculate that there was a shortage of corn and that because of spring flooding there would be a shortage at harvest time. Chinese stockpiling of grain had not yet been accounted for and the corn market peaked in the summer of 2008, but fell 40% in October when it was realized there was ample supply in the market (Kraus, 2008).

As previously mentioned, it is difficult to determine a bubble, and this example demonstrates the grey area between information about a market and the supply within a market. If all the news points to a shortfall, then commercial traders like processors and livestock producers will scramble to store corn before the prices increase. This is business, not speculation. This degree of price increase would not be possible in the in the EU-ETS, unless a large institutional investor took a position to speculate that they could be a *price maker*. The following graph uses FCM data to demonstrate.



FCM data, 2002-2011

Graph 4.4: Selected Commercial vs Non-Commercial Capital on CBOT

On the Chicago Board of Trade in 2002, Archer Daniel Midlands Co.'s (ADM) account contained $70 million, compared to Goldman Sachs' investment account which contained $3.8 billion. By September of 2008, ADM's account was worth $162 million, whereas Goldman had reached $11 billion. ADM is primarily a commercial trader, although it does have the ability to trade contracts without taking delivery. Whereas, Goldman never takes delivery of an agricultural commodity contract. The following table provides an insight to capital leverage available in agricultural commodity markets.

Table 4.2

Exchange Traded Commodity Funds

Symbol	Index Traded Fund	Worth	Agricultural Weight	Grain	Recent
DBC	Powershares DB Commodity Index ETF	$4.4 billion	unknown	15%	
DJP	iPath Dow Jones-UBS Commodity Index	$2.0 billion	36%	21%	

GSG	iShares S&P GSCI Commodity Index ETF	$1.5 billion	19%	10%	
RJI	ELEMENTS Rogers International Commodity ETN	$450 million	unknown	17%	
GCC	GreenHaven Continuous Commodity Index	$280 million	59%	19%	
UCI	UBS E-TRACS CMCI TR ETN	$84million	33%	15% (2005)	
		$4.9billion*			17.04% corn *
DJP	iPath® Bloomberg Commodity Index	9 billion*			5.81%*

Sources: Ackworth (2005), Barchart (2010), Cole Asset Mgt (2005), iPath (2017)*

The market leverage capacity of investment funds under current market conditions is beyond imagination. Based upon investment flows into the corn market from 2006-2008, I estimate that it would take $150-200 million dollars to create investment demand in the EU-ETS, which would send market investment signals to other investors. This could lead a hostile investment, as Sumitomo Corp and Winchester Commodities positioned themselves in the copper market in the 1990s (Murphy, 2014), in which a single transaction produced profits of $100 million for Winchester (Cicutti et al., 1996). Or, a price maker might be altruistic; climate activist and former hedge fund manager Tom Steyer reportedly worth more than $1.6 billion would be in a financial position to move the permit price upward trying to encourage faster mitigation. Without policy buffers the carbon markets are vulnerable to speculation, which would threaten the entire marketplace.

However, it is important to remember that the corn market is a physical commodity governed by supply and demand, compared with the ETS whose supply is determined by policy makers. While standard commodities such as wheat and oil have a value due to their utility, the carbon permit-credit, like paper money, is essentially made up; its value comes from the cap, which limits its supply (Button, 2008). In 2003, the International Financial Reporting Interpretations Committee, a committee of the International Accounting Standards Board, stated that an emissions permit is akin to, and should be accounted for as monetary currency (Button, 2008). Hence the emissions market is more like trading a currency than eliminating a pollutant (Victor & House, 2004). This is because the supply of the market is set by policy, not by production, as it is in mining and agriculture.

4.10 Summary

The evidence presented here demonstrates that there was always enough corn production in the corn market to absorb the ethanol mandate. Even so, the price jumped more than 270%. Yes, the commodity was undervalued before, but U.S. carryover stocks (surplus) never fell below 30 million metric tons, one third of the entire annual global corn trade. Even though the news reported surpluses declining by 40%, there was never a shortage. Still it would be wrong to say that the market was speculative, because it was trading on the best available knowledge at the time, it was only in hindsight that the supply was determined to be adequate.

Policy makers fear price spikes, and especially in the emissions market which is so closely linked to industrial output. As the first emissions market, the EU-ETS has been successful reducing GHG emissions, by 2015 emissions were down 23%, five years ahead of the 2020 schedule. However, going forward, further reductions will likely mean a stronger stick, i.e., higher prices, because the low hanging fruit has been picked.

As inevitable demand is anticipated, and given the tight coupling of market transactions, there is a significant risk that a highly capitalized price-maker could move the market upward. At present, the loss of liquidity and low volume within the market make it comparable to the corn market prior to 2006. It is unclear if governance within the EU-ETS would have the policy tools to manage a significant price spike without destroying the market entirely. It is clear that the permit system is not a physical commodity, the fungiblity of permit assets are more like a currency. Therefore, emissions permits should be managed as such and a permit reserve should be established so that the supply within the market can be managed on an ad hoc basis, not once every seven years.

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Chapter 5: Policy Inquiry: Seeking Expert Opinion of Carbon as Currency Standard

5.1 Abstract

Pricing carbon using market mechanisms through carbon taxes, or tradeable permits, are the dominant mitigation means of the Paris Accord to fight global climate change. Pricing carbon in the tradeable marketplace turns Greenhouse Gas emission permits into a fungible asset by purchasing the right to pollute. Some argue that bureaucratically determining the emission permit supply makes such emission trading schemes like the money supply. Therefore, they argue, it is more like a currency than a physical commodity. Some scholars argue that carbon could be used like the gold standard once was, turning carbon into the currency reserve standard by which the money supply is determined. This idea is tested using a small but in depth interview survey of experts in climate change, market design and macroeconomics. It is found that a carbon tax is the preferred policy instrument. The idea of carbon as a currency standard is unrealistic because the gold standard was fraught with problems. The experts interviewed fear that if the money supply is tied to carbon, flexible monetary policies would be lost. However, there is uncertainty among the experts whether engaging central banks to mitigate climate change is feasible. While these experts favor a carbon tax over the tradeable permit approach to climate change mitigation, they do not offer strategies to implement a carbon tax from a political perspective. This poses a

problem; governments are reluctant to impose new taxes on the polis. As a result, politically feasible strategies to price carbon effectively still need to be found.

5.2 Introduction: Policy Approaches to Pricing Carbon

Pricing carbon is deemed imperative in reducing Greenhouse Gas emissions. There are two ways to price carbon, one is to apply a direct tax, which is a fiscal instrument that determines a fixed price for emitting GHGs. To introduce such a tax, it must be politically acceptable and once it is in place the tax is inflexible due to the political process needed to alter it. The revenue garnered from the tax therefore depends upon economic conditions, but without specific mechanisms, the tax does not vary with the economy. For instance, British Columbia, Canada became the first North American jurisdiction to implement a carbon tax in 2008. The tax was politically feasible because it is revenue neutral; that is that for every increase in carbon tax, it is offset by decreasing another tax. While this approach makes a carbon tax politically palatable, the problem is that it does not generate revenue with which to invest in climate change adaptation (Ragan, 2016).

The fixed price of a carbon tax poses a problem if the economy falls into crisis, if the price is too high it will become politically vulnerable to repeal (IETA, 2016). However, if the price is too low, mitigating firm behavior away from GHG intensive activities is reduced. In British Columbia the carbon tax, set at $30 CND/Cte, is now set to rise because it is not deemed expensive enough by the relatively new Trudeau government. The new NDP provincial government has

proposed schemes to increase the tax by $5/Cte per year to meet proposed federal standards (Keller, 2017). Potentially this increase was only politically possible because of new federal policies.

5.3 Cap and Trade Approach

The second approach to price carbon is the tradeable market mechanism, commonly called Cap and Trade. The carbon price is set by 'the cap' – the supply of emission permits and then the price is derived in the marketplace by firms competing to purchase permits. This approach creates a variable price based upon emission permit demand, making it reactive to immediate economic conditions. In times of high demand the supply of available permits shrinks and the price increases.

However the supply is managed, in a *tight* market, with too little supply, the permit price will be too high and pose an excessive price on energy costs. Conversely, if the supply is too large, the emission permit price will be too low to incentivize firms to reduce emissions quickly enough to mitigate climate change effectively. One policy approach does not exclude the other. In Europe some nations use both carbon taxes and market mechanisms as policy tools (EU, 2017).

Commonly called Emission Trading Systems, the price of emission permits is determined by the supply and demand in the market. The EU-ETS has been in place since 2005, it is the most mature and largest of global ETSs (EU, 2017).

The EU-ETS has demonstrated successful GHG reductions at relatively low cost and has already met the 21% reduction target of 2020 (Euro Stat, 2016; Marcu,

Elkerbout, & Stoefs, 2016). While the low cost of achieving this reduction despite the depressed price in emissions has been *efficient* for the European economy, the low permit price translates to lower sequestration prices, which means developing nations in the stored carbon sector don't realize optimal profit on the offset markets.

5.4 Offset Markets

Tangential to the emission markets, the *offset* markets are designed to pay firms to either sequester CO_2, or to avoid producing it through generating non-carbon energy production. The low permit price on the EU ETS market means that Kyoto credit prices hit historic lows in 2013 and 2014, with Certified Emissions Reductions (CERs) worth just US$0.51 (€0.37) (World Bank, 2014). This trend has continued, current emission permits trade for US$5-9 (€4-7), while the average price for CER sequestration credits $3.3/Cte (Hamrick & Goldstein, 2016), a 50% or greater discount from the emission permit price. While a ton of carbon emission, and its GHG equivalent, is standardized at a regional market price, *offset* prices vary depending upon the quality and sustainability of the sequestration-avoidance project.

Decarbonizing the economy will require strong incentives to invest in green technologies and sequestration projects (Campiglio, 2016; Ceres, 2014; McCollum et al., 2014). The low price means a reduced capacity to finance projects (Campiglio, 2016). The emission permit price, which drives the price of off-set credits (CERs), has been in a slump since 2007 (Euro Stat, 2016; Hintermann, 2009).

In a weak investment environment (World Bank, 2017), this does not bode well for stored carbon projects and investment flows to low income countries where most of the sequestration projects are located[7]. The problem is that policy makers fear reducing the supply of permits, which would increase the price, because the risk of getting the supply wrong could dismantle the entire ETS market if it were to cripple the economy (IETA, 2016a). Because energy consumption is closely tied to economic growth, it is possible to measure the increase in atmospheric CO_2 with an expansion of GDP. When the economy goes into recession, CO_2 concentrations decline (York, 2012). The question then is, given the close correlation between economic output and energy consumption, what is the most effective strategy to combat climate change?

5.5 The Cost Dilemma to Mitigate Climate Change

The correlation between energy consumption and economic growth presents a policy problem. As former president George W. Bush famously said as he refused to sign the Kyoto Protocol, "I will not accept a plan that will harm our economy and hurt our workers" (CNN, 2001). Even though today job growth in the "green" economy far exceeds that of the fossil fuel industry. According to the U.S. Department of Energy (2017), the renewable and energy efficiency sector now employs five times more people than the fossil fuel sector, climate change mitigation is still associated with economic harm rather than economic growth as

[7] Industrial nations do not receive payment for offsets under the Kyoto Protocol.

the 2016 U.S. presidential election discourse demonstrated (Ettenson, 2017).

The Stern Review (2006) reported that the negative externalities of climate change will impose a social cost of at least 5% of Global GDP and as much as 20%. The report argues that the price of carbon would need to be at least €128/T ($170 US) to affect the behavioral change necessary to combat climate change in the long run (Heffernan, 2008; Stern, 2006). More recently, Hsaing et al. (2017) claim that each degree increase of warming will reduce GDP by 1.2% in the US. Following this logic, under the current conditions which NASA calculates as 0.8°C. of warming roughly 1% of 18. 87 US GDP amounts to $188 billon. This has led Sir Nicholas Stern to call climate change the largest of all market failures.

Geoff Garver of McGill University has suggested that the best way to combat climate change and environmental degradation is to link the money supply to the Earth's carrying capacity (2009). Some have gone further to propose carbon as a currency standard as gold once was (International Institute of Monetary Transformation, 2012; Porter & Wratten, 2014; Porter, Howden, Smith & Schiller, 2017). Building upon these novel ideas, this research survey asks experts in climate change and macroeconomics to deliberate on the idea of a *carbon standard* along with whether they believe tradeable permit approach or fiscal tax approach to climate change mitigation is best.

When the interview survey was begun, both Canada and the US had stepped away from the Kyoto Protocol because of the burden it would place on the economy. Since that time regional carbon pricing strategies have emerged. A

carbon tax has been implemented in British Columbia and Alberta, while Quebec and California have established a joint carbon market of tradeable permits, and nine Northeast States use auctioned permits under the Regional Greenhouse Gas Initiative (RGGI). Because Mexico has instituted a limited carbon tax, this means that nearly 30% of the North American economy is operating under carbon pricing schemes.

5.6 Problem Statement

Although some regional carbon pricing schemes have been established, less than half of the economy pays the negative externalities of GHG pollution. Two main market mitigation policies exist – a fiscal carbon tax and the tradeable permit scheme commonly called Cap and Trade. Given public and political opposition to new fees, which policy approach do experts prefer? What is the expert response to the concept of carbon as a monetary standard to better mitigate climate change? Is there a consensus about utilizing the nonpolitical institution of the central bank as a means to overcome political impasse on climate change?

5.7 Seeking Expert Opinion on a Radical Proposal

Anthony Giddens (2011) claims that "radical policy making" will be required to address the dilemma of climate change (p. 74). Although far-right conservatives oppose any new economic costs, the majority of the electorate recognize the need to fight climate change (the popular vote went to Clinton). However, politically the structure of Congress makes action on climate change

nearly impossible. Thus, radical policy making, *beyond left and right* ideologies, might offer the best hope for effective policy strategies. To discern policy alternatives a series of interviews were conducted with thought leaders representing experts associated with climate change, macroeconomic policy and market design. Participants were asked to respond to the fiscal and market based approaches to climate change mitigation, and their reflections helped guide this research going forward.

5.8 Methodology: Interview Survey

Participants in this survey were made up of elite thought leaders, including academics, a retired politician and non-governmental organization researchers. The survey respondents were identified by their activist publications in the media, then using the snowballing method to identify other respondents. Snowballing entails identifying a suitable candidate to interview, then asking the interviewee at the end of the interview if they can recommend another potential interviewee. The limitation of the snowballing method is that the interviewee may identify only like minded additional people to interview. My attempt to control for this bias was to identify people from both left and right wing political persuasions. Participants were determined to be left or right based upon informal content analysis of their published work. Right or left wing opinions were determined based upon the use of adverbs, because adverbs frequently present bias in scientific writing (Krippendorff, personal communication). For example, the participant's publication refers favorably to market-traded strategies. Market strategies are

deemed to be a rightwing strategy and since this approach was initially supported by Republican George H. Bush it is deemed a politically right-wing strategy.

Snowballing, or chain referral sampling, is a method used in sociological qualitative research where the population is identified as difficult to reach, either because they are deprived, socially stigmatized, or elite (Atkinson & Flint, 2001). The population of this study are difficult to reach because they are elite and few in number. Climate change may be a vast field of study, however, the population that is deeply involved with climate change mitigation policy combined with macro-economics and central banking is very few. The snowballing sampling method yields a sample population from people who share particular knowledge and who know others who possess these characteristics particular to the research topic (Biernacki & Waldorf, 1981).

The criteria for respondents was that they had to believe that climate change is an urgent policy issue. They had to either have connections to central banking, or to emission market development, for example the Montreal or Kyoto protocol. All the participants were either from the US or Canada because at the start of this research both these countries had stepped away from the Kyoto Protocol. At the time, the US and Canada were seen as *free-riders* on the international community's attempts to mitigate climate change. Part of the initial goal of this research was to determine potential strategies through rule changes to bring these free-riding nations back into the fold of climate mitigation strategies assuming political recalcitrance.

Seeking elite opinion may be viewed as an anti-pluralistic method, however climate change is a policy problem tailored to elites. First, the issue is complex and this complexity makes specific outcomes uncertain and unpredictable. For instance, the rate at which the oceans absorbed CO_2 was underestimated in some previous climate models, which led to a slower than expected atmospheric warming, leading some sceptics to question warming altogether. Although the climate hiatus has been scientifically explained, the damage to public opinion was already done (Sanders, 2017). Therefore, education level and understanding is key to participate in climate change mitigation policy formation. Second, climate change is a remote, abstract construct and is not experienced as weather is experienced. As a result, a plebiscite on climate change would likely not result in an effective policy outcome. This may lead some to declare that mitigation policy formation is anti-democratic; that elites are the domain of special interests (Birkland, 2016). Democracy though is a national construct; the tyranny of the majority in the US may trump most of the global population who bear the brunt of extreme weather associated with climate change. Consequently, this research approach is unapologetically elitist from a North American perspective; collective common-good ethics necessarily must prevail in this circumstance. It only examines North American opinion of those thought leaders battling climate change. It does not engage with leaders who think climate change is not an urgent issue. It attempts to go very deeply in the policy topic in order to seek the best opportunities for achieving meaningful, effective and pragmatic policy options for

combatting climate change. The sheer magnitude and complexity of climate change as a policy issue make expert opinion vital to effective policy formation.

5.9 Interview Style Background

The elite interview approach used was developed by the Quaker United Nations Office, it is a process of high-level consultations and off-record dialogues. This method is designed to use "quiet diplomacy" working with elite knowledge sources with an aim to help build communication and understanding by providing a safe, off-the- record space where participants can listen, explore issues and exchange ideas on how to move forward (QUNO, 2016).

It also invokes the Quaker method of scrupling as a means of deepening academic scholarship and methodology so that better efforts might be achieved. Ursula Franklin (2010) describes the need for scrupling, if you need clarity beyond your own private concerns you better scruple, because it is a problem that is bigger than all of us. Scrupling is the concept of collectively deepening and sharing the understanding of problems. Climate change policy is such a problem and it is a collective action problem that involves us all.

In the QUNO process participants can speak freely, since their quotes will not be attributed unless their explicit permission is granted. This quiet deliberative method of engagement was the approach used as a framework for the interview survey. Respondents were informed of this anonymity protocol in advance and at the beginning of the interview. Normally these off the record dialogues are conducted face to face and in groups. This was not possible given scheduling and

the spatial range of participants, which is why the dialogues were conducted by telephone or video conferencing. The research protocol was submitted to The University of Vermont Committees on Human Research Protocol Exemption Review and Determination (IRB). IRB exempt status was granted by the committee on August 15, 2013. The interview questions which helped frame the dialogues is included in Appendix I.

The sample size of experts was six, although this number is extremely small and not statistically significant, the length and in depth dialogues still revealed interesting and helpful insights that helped guide the research into the future. When this survey instrument was created, both Canada and the US had stepped away from the Kyoto Protocol. As a result, the idea behind the interviews was to ask experts who are experienced with central banking and climate change if it was possible to use central bank independence as a means to engage these free-riding nations in emission reduction schemes. Therefore, the experts had to be Canadian or American and they also had to be expert in two very specialized and arcane disciplines. For this reason, the sample size was inevitably very small. As such it is the quality of the data produced by this survey method, not the quantity of data generated, that makes this methodology useful in forming climate change mitigation policy.

The experts are classified in the table below, sometimes an expert might be classified in multiple areas, for instance, a survey participant may have at one time been a political leader, or an academic, and later in their career been associated

with an NGO, that individual would be classified under more than one type.

Table 5.1

Respondents Classified by Background

Type	Number identified with classification
Academic:	3
Education: PhD	5 (4 economics)
NGO	4
Business Executive	2
Professed Environmentalist [*question not asked*]	2
Former Elected Politian	1
International Market Design	3
Central Bank Connections	3

The participants reflect a broad range of backgrounds and opinions. Although all of them are currently tied to North American institutions, by birth they represent three continents. Perhaps it is not meaningful, but two participants have become sheep farmers in retirement, I disclose this because I too was a shepherdess in a former life.

5.10 Results

The interviews were conducted from January 2013 through November 2014 via Skype either by video or audio recording. Attempts to contact additional prominent participants were made until February 2017 given the changing political and policy environment. However, no new participants responded to interview requests.

The completed interviews were recorded and are stored in a password protected digital file. In one interview the recording failed and the interview notes were used as the source of the dialogue. Six interviews were conducted in total, four by telephone, two by video conference. The shortest interview was 24 minutes long, the longest interview was 84 minutes long, the average interview time was 45 min, and the median time was 38:30 minutes.

The interviews were conversations, pre-formulated questions were used only when the conversation stalled (please see appendix for the pre-formulated questions). The interviews revealed a pattern of sentiment on a series of topics pertaining to addressing climate change mitigation policies, such as carbon taxes, tradeable permits, carbon as a currency, carbon as a monetary reserve and as a monetary standard. Five key themes emerged from the dialogue process that revealed sentiment about policy alternatives to purse research that mitigates climate change more effectively. Content analysis was then used to determine how participants felt about each policy alternative.

Table 5.2

General Sentiment about Climate Policy Approaches

Policy Approach	Approve	Disapprove	Skeptical
Cap and Trade Style	2	4	0
Carbon Tax	6	0	0
Using Carbon as a Currency Reserve (Carbon Standard)	0	4	2
Engaging Central Banks	2	2	2
Local/Regional Initiatives	3	N/A	N/A

The results in table 5.2 indicate that the participants all favor a carbon tax over the cap and trade market approach. This is ironic since the Kyoto Protocol focused entirely on the market approach to GHG reductions. I say ironically because two participants were instrumental in the design of the Kyoto Protocol market approach. An additional two participants were architects of the Montreal Protocol, which also had a market approach attached to it.

The chief reason for favoring the fiscal tax approach over the market mandate was design simplicity. This is in opposition to general economic theory, which according to Coase (1961) states the most efficient way to reduce social harms is through the market mechanism. This was a surprising out come since four of the five respondents are PhD economists.

Three respondents said the tax must not be regressive and hurt low income individuals, a tax rebate for those on the margins was stressed. The concept of a currency linked to carbon was foreign to all participants, four indicated that it was

a novel idea, but could not see how it could be implemented politically, one economist saw that eventually a currency that took into consideration the biosphere would be needed, while another economist could not see the benefit of linking natural capital to a currency at all. Only two respondents liked the idea of a market mechanism in addition to a carbon tax. One, favored markets because it was perceived as a means of transferring money to developing countries where so many of the carbon sinks are located.

Three participants brought up the importance of local and regional mitigation initiatives even though this was not a question on the interview survey. One economist stressed that regional initiatives were "politically more realistic than national and global" protocols. Another mentioned that the local level was "where the creativity is located". Two respondents thought using a central bank to mitigate climate change might be a good idea, but they could not envision a situation that would make it feasible. One respondent said, "If everyone agreed with you about a new idea, someone else would have thought of it, and done it already." This comment provided me with confidence to continue pursuing the concept of using central bank independence as an institutional leverage point to engage recalcitrant nations in climate change mitigation.

This single comment of encouragement persuaded me to use the interview survey as a guide to further explore the role of central banks and using monetary policy as a policy leverage point. It was clear from all the interviews that the management of the money supply is an extremely sensitive leverage point. That

freely traded markets are complex and risky, while they offer investment opportunity, when things go wrong, they can go very wrong. The concept of attempting to use carbon as a currency standard like gold once was, as Porter and Wratten (2014), Porter and colleagues (2017), and the International Institute of Monetary Transformation have proposed, was thoroughly repudiated and rejected. The respondents perceived creating a rigid monetary standard as being regressive, that it would reinstitute the boom and bust cycle of the nineteenth and early twentieth century, that fiat monetary policy would lose its flexibility and that constraining the money supply to a standard would lead to perverse and unintended outcomes. The results will now be further discussed in the following section.

5.11 Discussion

The results of the interviews were surprising since three of the interviewees were directly responsible for the architecture of the market based mechanisms in the Montreal Protocol to mitigate ozone hole expansion, or the Kyoto Protocol to reduce GHG emissions. Thus, one would expect that they would be in favor of cap and trade protocols. This turned out not to be the case. Economists are supposed to favor the most efficient policy, and economic theory tells us that tradeable permits are the most efficient way to reduce negative externalities like pollution (Coase, 1960; Crocker, 1966; Dales, 1968; Hurwicz, 1995; Montgomery, 1972). Despite the economic theory that taxes are less economically efficient and apply

dead weight losses to the economy, most of these economists and finance professionals preferred fiscal tax approaches to tradeable permits.

It was widely thought that the European experience had not achieved the intended result (even though evidence now suggests otherwise), only one respondent thought at the time of the interviews (2014-2015), "It was too early to tell" whether the EU-ETS was successful or not. Since the EU has met its 2020 GHG reductions five years ahead of schedule (Europa, 2017), it seems that the expert opinion of what was happening in the market in 2015 was normatively driven compared with data driven. However, it is important to remember that the early mitigation strategies to reduce GHG emissions represent *low hanging fruit*, and that future targets will be harder to meet.

Despite the overwhelming approval of a carbon tax, two respondents specifically referred to the important role tradeable permits have in strengthening the CDM which transfers investment to developing nations. They also stressed the important investment incentive opportunity that happens when property rights are applied to tradeable permits. The power of profit seeking motives is powerful; if one equates the increase in demand and price changes that followed the ethanol mandate embedded in the 2005 Renewable Fuels Act, this is evident. The ethanol mandate was a policy that increased corn production and raised prices out of their three decade slump (McCowen, 2017a). The key is balance, how to create increased demand and hence higher prices, without encouraging speculation? In 2006, when the EU-ETS price exceeded €30 speculation was a driving concern (Hintermann,

2009), and it remained a concern of those interviewed.

There was ubiquitous concern that either a carbon tax or the emission permit price not be regressive; that it should not reach an expense that it be harmful to people of marginal incomes. The concept of tax rebates to low income people was widely put forth as the solution to high carbon prices. Of course, in the US, this approach inevitably bumps up against the politically infeasible and vulnerable ideology of a government *handout.*

Having a constantly increasing carbon tax was put forth as providing the correct *forward guidance* that would incentivize firms to change their operating behavior long into the future. Although it was widely acknowledged that making a carbon tax politically palatable would be difficult, revenue neutral taxes were generally perceived as the only feasible option. The problem with the revenue neutral approach[8] is that it does not generate new revenue for adaptation and sequestration projects (Ragan, 2016).

The respondents seemed to assume that once a carbon tax was instituted it would not be easy for different political parties to revoke it once in power. In the current unpredictable climate of the Trump Administration and Brexit votes, I am not sure if this is an appropriate assumption. The advantage in a Cap and Trade market scenario is that once property rights are attributed through the emission

[8] Revenue Neutral Taxes apply a tax in one area; i.e. pollution, but reduce taxes in another area such as income tax reductions so that government revenue does not increase. See British Columbia's carbon tax approach.

permits, individuals holding those permits for investment purposes will seek to protect the value of those assets. Thus, stressing the importance of market design, liquidity and the legal respect for property rights.

It was felt that a fluctuating market price on emissions would encourage firms to pass additional costs on to consumers rather than to change firm behavior in the long term. When prices fall there appears to be some evidence for this; in Europe utility companies did not reduce electricity prices when the EU-ETS price collapsed in 2007 (Dempsey, Bought, & Hough, 2016). Therefore, in my opinion, it is likely that utility companies which usually operate as regional oligopolies or monopolies will price gauge consumers when prices fall in the absence of further government regulation. However, I have found no evidence that firms do not change behavior in response to higher fees and that they merely pass these costs onto consumers. Though it still remains that policy makers and market designers have not solved the problem of price management.

Price collapse can result from investor confidence or because of government action. Just as a fiscal carbon tax is vulnerable to political ideology, a market can be undermined by regulatory changes. In 2008, court rulings concluded that tightening the SO_2 cap and trade market was not legal, the price of SO_2 permits fell by nearly 60%. The Obama Administration's 2011 amendment to the Clean Act caused a complete failure in the sulfur dioxide market (Schmalense & Stavins, 2012). The emission permit spot price to pollute to a ton of sulfur dioxide fell from an average of $883.10 in 2006 to $0.06 average price in 2017. (EPA, 2017). This is

flagrant violation of property rights, since the new rules made the asset value of emission permits worthless. This demonstrates that while taxes may be vulnerable to political change, markets are vulnerable to regulation changes and court decisions. Therefore, neither a carbon tax nor a cap and trade mitigation system is entirely impervious to risk so advocates for current fiscal or market policy alternatives are both ideologically motivated. Policy resilience is an area in which policy makers should focus more attention.

When asked whether a central bank's independence could play any role in climate change mitigation, one macro economist explained, "You would have to demonstrate why it would be in a central bank's interest to use emission permits as a currency reserve." This response directed me to explore emission permits more as a policy tool rather than as a currency the way Button (2008); Dalsgaard (2013); Descheneau (2013); Porter et al. (2017); and Victor & House (2004) suggest. It was clear from the interviews that the ideal of using carbon as a monetary standard was out of the question. However, there was enough uncertainty about the role of central banks in climate change mitigation to warrant further investigation. Therefore, the role of central banks as institutions for climate change mitigation will be explored further in the next chapter.

5.12 Limitations of the Study

The limitations of this study are many. First, the small sample size means that the results are not representative. Second, the participants were located either in Canada or the US. The reason for this, as previously, stated was because when

the study was started both Canada and the US were not signatories to an agreement on climate change mitigation. Part of the interview strategy was intended to find ways to engage freeriding nations by overcoming political recalcitrance using market mandates and carbon taxes.

A third limitation to this study is the methodology. Contacting and interviewing elite people is problematic due to the time constraints and response rates. Twelve elite people were contacted, two died, four did not reply. Even when contact was made, for half the respondents it took between three and four months to schedule an interview. There also appeared to be a cultural bias, elite participants from Canada were far more likely to agree to the interview survey than elite Americans. Because American responses were low, it was felt that continue obtaining Canadian participants would skew the study. The insights gained from the elite interview method into this inductive research were enlightening and helped to frame and inform the research going forward, however the timeframe, i.e. the time it took to engage participants in the interview is perhaps not realistic for future research.

5.13 Summary

Pricing carbon through a tax instrument or through tradeable permits remains the two top policy mechanisms with which to curb GHG emissions. However, these two policies may be difficult to implement for political reasons. Both policies have their weaknesses – carbon taxes are politically vulnerable, while tradeable permits are subject to speculation and regulatory interventions that can

erode their price structure.

By using an interview survey to seek the sentiment of policy leaders experienced in climate change, market design and macroeconomics, this chapter sought to discover policy options beyond the tax and trade initiatives. A number of scholars have proposed that carbon should be used as a monetary standard, to mitigate climate change by tying it to the money supply. This idea was put before *thought leaders*, experts in the policy approaches to climate change and macroeconomic policy. It was discovered that they all thought it a terrible idea because the flexibility of fiat monetary policy management would be lost. One individual saw its potential many years into the future that the economy one day would have to consider the earth's biophysical carrying capacity.

All survey participants favored a carbon tax as a mechanism to reduce GHG emissions. It was thought that this was the most easily managed and orderly mechanism to reduce emissions. Generally, all of the participants were wary of Cap and Trade markets because it was thought there was no way to control price volatility.

The idea of using central bank independence as a means of obfuscating political recalcitrance to carbon pricing was the area with the greatest variation of response. This is reasonable because without a concrete policy about what is meant by central bank engagement in climate change mitigation the policy alternative is abstract. Therefore, the intent of the next chapter will be to determine what this central bank role might look like. Whether it is feasible and acceptable for a central

bank to act to mitigate climate change.

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Chapter 6 Policy Reform: Emission Permits as a Monetary Policy Tool

6.1 Abstract

Putting a price on carbon through tradeable permits is the premier instrument of Kyoto Protocol to limit climate change. It is therefore the strongest instrument of the 2015 Paris Climate Agreement. Pricing carbon through the market mechanism turns emission permits into a fungible asset, like traded commodity contracts such as corn and oil. Some scholars argue this politically determined supply makes emission permits more like a currency than a physically traded commodity. Picking up on this premise, if emission permits are like a currency, and given the correlation between economic output and GHG emissions, this paper asks whether emission permits may act as a monetary policy tool?

Monetary policy, through the management of interest rates, is key to economic stability by controlling inflation; however, rate increases are blunt economic instruments that impact all consumers. This article proposes that a central bank can use emission permits as one of the tools to manage inflation. This would also manage the price of tradeable emission permits. Cost-benefit analysis is used to explore this policy alternative. Using emission permits as a monetary policy tool suggests that it is an effective means to manage the carbon price, and a low risk way to curb inflation. However, further economic modeling should be performed before policy action is taken.

6.2 Introduction: Carbon Tax or Cap & Trade?

According to the UNFCCC, pricing carbon is deemed imperative in reducing Greenhouse Gas emissions. There are two ways to price carbon, one is to apply a direct tax which is a fiscal instrument that determines a determined price, commonly called a carbon tax. It is applied to the purchase of products with intense carbon footprints. For such a tax to be implanted it must be politically acceptable and once it is in place the price, and its rate of change, are inflexible without further political intervention. For instance, even if the tax rate is scheduled to increase over time, its rate of increase is determined, not by market conditions, but by bureaucratic foresight, or political reaction to conditions. This is what is meant by an *inflexible* price structure. Changing the price of this tax is slow due to the political process. In booming economic times a carbon tax may be perceived as inexpensive, but during economic recessions the tax will inevitably face political pressure. Therefore a carbon tax will always be vulnerable to political pressure. The carbon tax approach presents a potential problem in economically turbulent times, when an additional tax may impede economic growth of certain sectors. The revenue garnered from the tax depends upon economic conditions, like a gas tax, governments potentially come to rely on its income and therefore this presents a potential conflict of interest when it comes to GHG reductions. An example would be governments that rely on gas taxes may be hesitant to support lower fuel standards. Governments may favor the short-term incentives of tax revenue versus the long-term costs associated with disaster associated with climate change. This is the concept of discounting the future.

The second approach to price carbon is the market mechanism, commonly called Cap and Trade. The carbon price is set by 'the cap' – the supply of emission permits in the market. The price is then derived by firms competing for the right to pollute by trading emission permits in a market setting. Unlike the fiscal carbon tax method, this approach creates a variable price based upon emission permit demand from the market place. This is what makes the price reactive to immediate economic conditions. When the demand for permits is low during economic downturns, the price will be low, but when demand is high during economic expansion, the price will inevitably be high because more firms will be competing for the same amount of emission permits. Over time the government retires emission permits to encourage firms to increase their GHG reductions. The weakness of this approach is that managing the permit supply is not easy. In cycles of high demand when prices are high it is not always obvious to know if the supply is low because of physical demand, investment demand, or price speculation. Markets with low volatility do not offer investment opportunities, generally in commodity markets, and only 2% of contracts end in physically delivery (Kleinmann, 2005), efficient markets need investors not just producers and consumers.

However the supply is managed, in a *tight* market, with too little permit supply, the permit price will be high and pose an excessive price on energy consumption. Under current economic conditions, with economic growth linked to energy inputs, this would add an additional cost to production, putting

downward pressure on the economy just as an increase in interest rates makes it more expensive to service debt. Conversely, if the permit supply is too large, the emission permit price will be too low and not incentivize firms to reduce emissions quickly enough to mitigate climate change. Under the trading approach to pricing carbon, the pricing mechanism is adjustable based upon supply and demand. Therefore, the price can fluctuate relative to economic conditions. The carbon tax policy approach does not exclude the emission trading strategy. In some European countries both carbon taxes and traded permits are used as policy tools (Europa, 2017).

The traded permit approach to climate change mitigation was the dominant policy instrument of the Kyoto Protocol. Although the US was a driving force behind this policy approach, in the end the US never ratified the protocol. Likewise, Canada, although a signatory, withdrew from the Kyoto climate accord.

Although both fiscal carbon taxes and traded permits are feasible mechanisms for reducing GHG emissions, the rest of this article focuses on tradeable permits. In previous research, it was noticed that experts in macroeconomics and climate change did not favor the uncertainty of the market mechanism to climate change mitigation (McCowen, 2017b). Ironically, the Coase (1961) theorem dictum professes that the market is the most efficient way to control negative externalities like pollution. Furthermore, in the US, due to the political Grover Norquist ideology, taxes are viewed as a pariah. In an era in which new taxes are difficult to implement, it is imperative to seek alternate means by

which to mitigate climate change despite what politicians believe. Current peer reviewed scientific research calculates that in the future each degree centigrade of atmospheric warming reduces economic growth by 1.2% (Hsiang et al., 2017). Since we are already at 0.7 C of atmospheric warming this translates to significant economic costs in an economy struggling to meet 2% targeted growth expectations of central banks. Climate change mitigation therefore is not just a moral action, it is an economic one too.

The political contention associated with carbon taxes in some jurisdictions makes pragmatic climate change action impossible, therefore this paper focuses on the traded permit mechanism. In the US 25% of the economy is already under regional carbon pricing; RGGI in the North East and the Californian exchange capture the two largest state economies, California and New York. However, because these exchanges are nascent, we must rely on the older more comprehensive European market for evidence of economic effectiveness. In the trading approach, commonly called Emission Trading Systems, the price of emission permits is determined by the supply and demand in the market. In Europe, the EU-ETS has been in place since 2005, it is the most mature and largest of global ETSs (EU, 2017).

6.3 Emission Trading Systems

The EU-ETS has demonstrated successful GHG reductions at relatively low cost and has already met the 21% reduction before the target date of 2020 (Euro Stat, 2016; Marcu, Elkerbout, & Stoefs, 2016). The low cost of achieving these GHG

reductions refers to the depressed price in emissions permits. While this low price has been efficient for the European economy, the low permit price translates to lower sequestration prices. Sequestration refers to the *off-set* market in which transfer payments from industrial countries are made to developing and transitional nations for storing carbon in places like forest and for energy projects that avoid new emissions. This is the Clean Development Mechanism within the Kyoto Protocol, where developing nations are paid to sequester and store carbon in forests, oceans, peat bogs and agricultural lands. These transfer payments represent important revenues to isolated populations that previously were not paid for the sequestration services they provided to the industrial nations polluting the atmosphere.

These reduced payments are due to the excess supply and resulting depressed price of emission permits in the EU-ETS market. Consequently this low price means that the Kyoto carbon credit prices have hit historic lows. In 2013 and 2014, Certified Emissions Reductions (CERs) were worth on average just US$0.51 (€0.37) (World Bank, 2014). This trend has continued, current emission permits trade for US$5-9 (€4-7), while CER sequestration credits trade at the discounted price of $3.3/$Ct_e$ (Hamrick & Goldstein, 2016). There is no reason for carbon credits to trade at a discount from emission permits since GHG are a pollutant of the global commons.

GHG emissions are not like a physical commodity, where the grain must be delivered to a specific place and therefore trades at a discount due to

transportation. The aim should be that emission permits and CERs should be transferable at equal value. Decarbonizing the economy will require strong incentives to invest in green technologies and sequestration projects (Campiglio, 2016; CERES, 2014; McCollum et al., 2014). The low price for CERs means a reduced capacity to finance non-polluting technologies and stored carbon projects (Campiglio, 2016).

The emission permit price, which drives the price of off-set credits (CERs), has been in a slump since 2007 (Euro Stat, 2016; Hintermann, 2009). In a weak investment environment (World Bank, 2014), this does not bode well for stored carbon projects and investment flows to low income countries. The dilemma is that policy makers fear reducing the supply of permits, which would increase the price, because the risk of getting the supply wrong could dismantle the entire ETS market if it were to cripple the economy (IETA, 2016a).

This article first defines the policy problem behind the low price of carbon. Second, it describes the institutional context of central banks and the Federal Reserve, in particular. Third, it explores the context of using emission allowances aligned with monetary policy.

6.4 Problem Statement

The traded emission permit strategy is the policy of choice to achieve an appropriate pricing mechanism for GHG emissions of most regions seeking to mitigate GHG emissions. Getting the price right though has proven a problem. The fiscal approach of using a carbon tax puts the pricing problem in the hands of

bureaucrats. The tradeable permit trading system allows the market to decide what the price should be, but ultimately bureaucrats are still involved since they determine the supply of emission permits in the market place. The supply is set at the beginning of each trading *phase*, and each phase lasts seven years (EU, 2017). In general, the emission permit price is determined by the demand in the market place. And it is assumed this demand will fluctuate according to industrial economic output resulting in a price movements that reflect conventional industrial demand.

The problem is that there is an excess supply of permits in the EU-ETS; thus, it is feared the price of emission permits is too low to encourage future reductions in GHG emissions. There is no flexible market mechanism that can tighten the market when needed that does not pose severe economic risks. To change the supply, a bureaucratic process must be launched and bureaucrats fear getting the price wrong because of the correlation between economic output and GHG emissions. Bureaucrats know the price is too low, but getting the price too high would hinder the economy (IETA, 2016a).

While European emission reduction targets have been met ahead of schedule and despite the depressed emission permit price, it is expected that further emission reductions will not be met so easily (Europa, 2016). This implies that a higher price of emission permits will be needed to achieve the industrial behavioral change needed to prevent 2° C of warming.

We know that current intended nationally determined commitments to reduce emissions are insufficient to prevent 2 degrees of warming, current trends estimate 3.7 degrees of atmospheric warming (Climate Scoreboard, 2017). Nordhaus argues the current best case scenario under the Paris Climate Accord is likely 2.7° C of warming. Therefore, a higher price is assumed necessary to increase emission reductions, which in turn is connected to a higher price on GHG emissions. Nordhaus (2017) claims currently the social cost of climate change is $36 USD and it will need to reach $69 USD by 2050 under an anticipated economic growth rate of 2.1%. However, reducing the permit supply to increase the price is risky if policy makers get the price wrong because they fear price spikes (IETA, 2016a). The question then is how best to manage the supply of emission permits in an effective manner that allows for optimal price achievement while controlling speculative behavior that can lead to price inflation? Is there a market mechanism that can achieve this policy? Can using emission permits as a monetary policy tool serve this purpose? These are the questions that will be addressed in the following section.

6.5 Issue Context: Emission Permits as Currency

Some scholars argue that emission markets, designed on the principles of supply and demand are more like currency markets than traditional commodity markets like, copper, wheat, or oil (Button, 2008; Descheneau, 2012; McCowen; 2017a; Victor & House, 2004). Just as the supply of fiat currency is determined by central banks, the value of an emission permit is determined by supply and

demand in the market place where the supply is determined by bureaucratic decision. The U.S. dollar became a fiat currency when Nixon closed the gold window in 1971 and the U.S. dollar was no longer convertible to gold (Gowa, 1983). The dollar is managed by politically independent central bankers utilizing interest rates and forward guidance to affect the supply and demand of the dollar and hence its value against other currencies. This is how central bankers manage price stability and economic expansion. Most modern currencies are fiat based currencies. Likewise, the supply, and hence the value, of emission permits is determined by a bureaucratic body, except these bureaucrats only make supply decisions at the beginning of a new trading auction phase. Similarly, the EU-ETS, and the U.S. exchanges have many of the same attributes to central banks; bureaucrats do for the emission supply what central bankers do for the money supply.

6.6 The Role of Central Banks

Central bank board members act as non-partisan bureaucrats, mandated to act in the interest of the economy, free from political interference. This independence is important because, when a currency is no longer tied to a physical entity like gold, (which dictated its value,) politicians must resist the temptation to inflate the currency before elections, since in the short-term inflation makes an economy appear to be growing. As prices increase, consumers spend before items become more expensive because under inflationary conditions the currency is worth less; for example, it takes more money to buy the same good in the future

than in the present. For centuries leaders have feared runaway inflation because once started it is very difficult to stop.

To avoid political interference in monetary policy, in the 1980s many central banks were granted greater independence because it was believed that "the government has an incentive to inflate the currency to impose a *tax* (my italics,) presumably with lower political costs than would be associated with other, more direct forms [of taxation]." The general understanding was to use independent central bankers to maintain price stability and control inflation (Miller, 1998).

In short, appointed central bank directors don't face short-term election cycles. Therefore, the assets of central banks that are used to manage the money supply can more easily be preserved with central bank independence, since politicians have an incentive to print money to make it appear the economy is growing faster than it really is. This is the reason why many democracies granted central banks unprecedented power, but with limited mandates, so to maintain price stability and full employment.

6.7 The US Central Bank

The Federal Reserve, commonly called the Fed, is the central bank of the US. The Federal Reserve is generally perceived as a "decentralized" central bank because of its cooperative relationship amongst its regional private members. However, its monetary policy is as centralized as any other nations'. The committee that oversees monetary policy is the Federal Open Market Committee, while the international reserves are held and transactions performed by the

Federal Reserve Bank of New York in the System Open Market Account (SOMA) holdings (FRB-NY, 2017).

Congress oversees the Fed, but the FOMC is relatively autonomous, under the Federal Reserve Act of 1913. Section 2A states the monetary policy objectives:

> The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.[9]

This directive toward maximum employment and price stability is often referred to as the dual mandate (FRB, 2017). The Federal Funds Rate, or short-term interest rate, is one of two policy tools the Fed uses to fulfill the dual mandate. Low interest rates make it cheaper to borrow and thus spur investment, development and economic growth. Conversely, a hike in interest rates tightens the money supply making it more attractive to save, and costly to borrow.

The second policy tool of the Fed is *Forward Guidance*, a message released by the Fed indicating the future *path* of interest rates to improve economic conditions (FRB, 2015). It is associated with a commitment towards very low

[9] 12 USC 225a. As added by act of November 16, 1977 (91 Stat. 1387) and amended by acts of October 27, 1978 (92 Stat. 1897); Aug. 23, 1988 (102 Stat. 1375); and Dec. 27, 2000 (114 Stat. 3028)

interest, or even negative rates, such as quantitative easing. As the Gordon S. Rentschler Memorial Professor of Economics and Public Affairs at Princeton University, Alan Blinder (2010) has stated, when interest rates are at zero conventional monetary policy is "out of bullets" (p.466). This demonstrates the limit of the Fed's mandate; it only has two tools, interest rate changes and forward guidance.

The Federal Reserve's mandate is simple, although its task is complex. Small shifts can have dramatic results In 2013, then Fed Chairman Ben Bernanke caused the *Taper Tantrum*, when stock markets went into turmoil because he eluded to the end of quantitative easing (Giugliano, 2015). Like the king on a chessboard, central bankers are limited in scope but can move in any direction in small increments.

The power of forward guidance as a monetary policy tool demonstrates the sensitivity of *global* markets to Fed decisions and discourse. Announcements from the Federal Reserve act as signals to market participants. This is also called a "nudge"; *nudging* is an action that significantly alters human behavior (Thayer & Sunstein, 2009, loc. 440). In this case the central bank is nudging the markets up or down. For the Federal Reserve these nudges have global reach because the U.S. dollar is the reserve global currency; global markets trade with U.S. dollars, international debt is set in U.S. dollars, and commodities are priced in U.S. dollars. In fact, the dollar is supported by overseas demand; more than 60% of U.S. dollars circulate outside the US adding to the demand and hence the value of the U.S.

dollar (Blinder, 1996; Goldburg, 2011). Interest rates set in America have immediate global impact, by making it more or less expensive to borrow development funds, conduct international trade and service international debt. Therefore, the Fed holds significant amounts of foreign currency for security, to facilitate trade and to assist other nations in these transactions to try to prevent international financial crises. These foreign funds are controlled through the SOMA at the NY-Fed.

6.8 System Open Market Account

International reserves are held and transactions performed by the Federal Reserve Bank of New York through the System Open Market Account (FRB-NY, 2017). The currencies of 14 major trading partners make up the SOMA holdings to protect against "disorderly conditions in foreign exchange markets or to meet other needs" (FRB-NY, 2016, p. 9). The following table displays the approximate average annual holdings of two major currencies which are currently under quantitative easing monetary policies to stimulate their respective economies. The following account values fluctuate with currency values and the agreed understanding and request of their respective home nations.

Table 6.1

Selected SOMA Holdings (in billions)

Foreign Currency	**2012**	**2013**	**2014***	**2015***	**2016***
European Deposits	$8.9	$ 7.5	$ 6.9	$ 6.2	$ 4.2

Japanese Deposits	$ 3.5	$ 2.9	$2.5	$ 2.5	$4.7

Deloitte & Touche Ltd, 2014, KPMG LLP., 2016*

The above table indicates how these foreign reserves fluctuate year after year based upon foreign exchange rates and the economic needs necessary to facilitate smooth trade. The rules governing these transactions are agreed upon by the partner nations to prevent adverse economic events. According to the annual audit of the NY-Fed, foreign debt instruments include mortgages and other foreign fixed assets (KPMG, 2016). These fluid foreign monetary relations demonstrate that there is no reason why emission permits might not be used as a similar asset to reduce the excess supply in the EU-ETS.

6.9 Discussion: Emission Permits as a Monetary Policy Tool

This article suggests that it is feasible and beneficial for the Fed to purchase emission permits on the EU-ETS and to hold them in reserve just as it does other currencies. Through SOMA, the Fed already holds fungible assets in foreign currency, but also debt instruments, like mortgages. Given the Fed's power of forward guidance to move global markets, using emission permits like a currency would prop up the emission price just as housing prices are popped up by the Fed holding mortgages on their balance sheet. The SOMA already holds billions of dollars in foreign debt instruments, including mortgages (Deloitte & Touche, 2014, KPMG, 2016), which are far less fungible than emission permits.

Exchanging emission permits for currency would be in concord with the

European Central Bank's agenda since it is currently practicing quantitative easing at a rate worth €60 ($70.88 USD) billion per month (Jones, 2017). In 2015, it was estimated that there was a surplus of 1.78 billion allowances on the EU-ETS. The EU-ETS has proposed a reserve mechanism to be established in 2018 and to begin in 2019 and has undergone "back-loading" (purchasing back) allowances in the short-term (Europa, 2017). The proposed mechanism is called the Market Stability Reserve and it is designed to act like a central bank managing a currency. However, this is still a slow process; the EU parliament approved the back-loading agenda in 2013 and while it is underway significant price changes have yet to occur (Europa, 2017). This implies that the value of managing emission permits like a currency on the EU-ETS has already been recognized, if not yet implemented. What has not been recognized is the role that emission permits can play in managing economic inflation managed by a central bank.

Unlike private banks, central banks are not profit seeking, their goals are to create an environment of stability so that prosperity and long-term investment can take place (FRB, 2016). Therefore, it is reasonable to suggest that a central bank would manage the permit supply with the due diligence that they manage the money supply. This would not just be a service that the central bank, in this case the FED for the ECB, would be providing to the benefit of the EU-ETS. Emission permits can act as a means of tightening the industrial economy without negatively impacting homeowners' mortgage costs, and low-middle income countries servicing national debt the way increasing interest rates would do. A

stronger U.S. dollar along with higher interest rates puts developing nations at risk of not being able to service their debt (Donnan, 2017).

The Fed purchasing emission permits would act as forward guidance for the emission trading system; it sends a clear signal of the investment path firms *should* take. The signal is to reduce GHG emissions, that the world has changed, and that businesses can no longer operate by not pricing the cost of negative externalities, like pollution. It sends the signal that pollution will no longer be paid for by the public. This would show a commitment toward pricing negative externalities, which harm economic growth in the long run. Recent research indicates that for every new degree of atmospheric warming economic output will be reduced by 1.2% (Hsaign et al., 2017).

Central bank purchases are a mandate – in effect *forward guidance* – and has the potential to reshape the entire economic direction away from polluting industries to green technologies. According to former U.S. Secretary of Energy Ernest Moniz (2016), it will be impossible to create a de-carbonized economy without a lot of progress on the demand side [carbon pricing]. And yet, today in the US, job growth in the "green" economy far exceeds that of the fossil fuel industry. According to the U.S. Department of Energy (2017), the renewable and energy efficiency sector now employs five times more people than the fossil fuel sector. As Lawrence Tubiana, France's envoy to the Paris Summit said, "Markets will follow the same pathway under the correct signal" (Clark, 2015). Market mandates send signals to the investment community and businesses about the

direction of future growth. The Federal Reserve purchasing emission permits would send such a signal just as the ethanol mandate did in 2005 that the demand for corn was about to increase (McCowen, 2017a). It initiates a *treasure impulse,* the initiative to invest (Ali, 2009).

6.10 Mandates Can Move Markets

In 2005, then President George W. Bush announced in the State of the Union address that support of the renewable fuels mandate, which led to the mandate to legislate blending conventional gasoline with 10% ethanol. The three-year price range average of corn per bushel varied between $1.94 and $2.42 before Bush's enthusiasm for ethanol. After his 2005 announcement, the price for corn per bushel ranged from $1.94 to $7.11(Macrotrends, 2017); clear evidence of forward guidance in a physical commodity market (McCowen, 2017a). By 2007, 40% of corn production would be diverted to ethanol production (USDA, 2012). Although the ethanol mandate was not the only factor that moved the price of corn between 2005-2008, forward guidance could do for the emissions trading system what the ethanol mandate did for the corn price.

6.11 Curbing Speculative Risk

However, unlike the corn market there is no risk of price speculation in the ETS if an emission reserve is held since the supply is determined by bureaucrats and not influenced by weather conditions and poor harvests.[10] If the price reaches

[10] For a full explanation of price movements in the corn market see McCowen, 2017$_a$

an untenable level the central bank would sell the excess supply back into the market, thus dampening the price. This knowledge then, that a central bank held in reserve emission permits, would prevent the impetus toward price speculation. Speculative investors would know that the permits held in reserve would fill the market and dampen the price in the event of a price boom. This demonstrates how monetary policy and permit supply policy are the same under market conditions.

6.12 Emission Permits Are Within the Fed's Mandate

It is within the Fed's mandate to address climate change since the future negative cost associated with climate change damage is determined to be 5% of global GDP (Stern, 2006), or 1.2% of US GDP for each degree of warming (Hsiagn et al., 2017). Meanwhile the cost of mitigating climate change is 1% GDP (Taylor et al., 2016). This shows it is within the Fed's mandate to address climate change mitigation since the cost of not doing so would be to act against the *long-term* interest of economic growth and price stability of the country as the Federal Reserve Act of 1913 states.

The policy proposal to use emission permits as a monetary policy tool may seem radical, but if it can be demonstrated to be a useful mechanism it is within the Fed's mandate to apply it. In the wake of the financial crisis the Fed purchased many unorthodox assets to manage the economy (Blinder, 2010, 2013), this would not be the first time the Fed has used unconventional assets to address economic problems. Except if the Fed were to use EU currency reserves in the SOMA, it would not cost the US anything and would add liquidity to the current ECB policy

of quantitative easing. Another alternative would be to dip into the Fed's gold reserves that sit stagnant and useless. Many central banks liquidated their gold reserves years ago (Regan, 2014). It is beyond the initial scope of this research to determine precise costs of how many emission permits should be purchased. This research is to determine whether it is feasible and effective for the central bank to use emission permits as a currency reserve and hence a monetary policy tool.

If ETS markets react in a similar way to the corn market's response to the ethanol mandate, which diverted 40% of the corn harvest toward ethanol production, we would expect this policy approach to cost around $200 million. [12] The cost of doing nothing, that is, the cost of increasing interest rates instead of using emission permits, is more than $ 70 billion and since in 2017 each 0.25% increase in interest rates adds $35 billion worth of annual interest rate payments to taxpayers. The national debt currently amounts to $12 trillion.

$$ND \times .0025 = \$35,000,000,000.00$$

It therefore puts less of a burden on the tax payer to increase the price of GHG emission than it is to increase interest rates.

Under current conditions if the Fed were to hold emission permits as a currency reserve, thereby increasing the price by reducing the market supply, we would not expect to see consumer prices change since utility companies in Europe have already factored in a higher price for emission permits. Since the EU-ETS cap

[12] Please see McCowen, 2017a, for a complete review of the commodity corn market's reaction to the ethanol mandate.

and trade market was established in 2005, electricity prices have risen steadily despite the EU-ETS price collapsed in 2007. In 2006, the permit price peaked at €32 then fell to near zero in 2007 (Hintermann, 2008) however, electricity prices did not fall with the emission permit price. While the emission permit price has not risen above €7 since, and has averaged €4, electricity prices have only increased since 2008 (Dempsey, Bought, & Hough, 2016). This indicates that utility companies have factored in a higher price for emission permits, and if they threaten to raise prices due to an emission price increase, the governments would have grounds for anti-trust legal action. Therefore, it is reasonable to suggest that the EU-ETS emission permit price could quadruple, from €7 to €28, and consumers should not experience an increase on utility bills. Using emission permits as a monetary policy tool would keep the price in the goldilocks zone, not too hot, not too cold.

From a policy perspective using emission permits as a monetary policy tool has two functions, one is to increase the price of emission permits in a manageable fashion without applying harmful costs to individuals. This is designed to make firms endeavor to make further GHG reductions without passing on the rate increase to their customers. The second function is to curb inflation without having to rely exclusively on forward guidance and interest rate increases which under the current debt load of nations has far reaching consequences. Utilizing central banks in managing the price of emission permits is a *system changing* policy instrument; it broadens the authority of managing the emission price. It moves the

responsibility of managing the price ceiling, the highest price emission permits *should* reach, and places it in the institutional hands of central banks, which operate independently from political interference. Bureaucrats of lesser status than central bankers will likely face political manipulation, so it is the leverage that central bankers can apply that makes this the appropriate governing level to target. Because central bankers deal with vast sums of money, they have the power to bring about social change.

When the current governing institutions, working under existing incentives, are unable to produce the necessary regulations that are needed for the long-term wellbeing of the US and of the world, system changing policy instruments are needed. System changing policy instruments assume that current institutions cannot fulfill their purpose with the existing culture or resources, and that broadening the responsibility of the policy goals achieves better public value (McDonnel & Elmore, 1987).

Because Congress has been unable to act on climate change mitigation, despite Supreme Court rulings and bills proposed for the past 30 years, it has proven to be an institution incapable, in this regard, of acting for the public good. Already California and New York, the two largest state economies in the country, operate under carbon pricing. While the third largest state economy, Texas, generates in excess of 8000 MWh of wind energy, more than any other state (Ivanova, 2017). Meanwhile seven states generate more than 80% of their energy use from renewables (DOE, 2017). The U.S. Energy Information Administration

(EIA) expects the renewable energy sector, excluding hydro power to grow consistently by 11% into the foreseeable future (EIA, 2017). This growth across regions is evidence that despite gridlock in Congress there is broad support for reduced GHG energy sources.

In utilizing a system changing policy instrument the authority of emission permit price is transferred out of the political arena to become an economic policy tool. This tool is designed to be another means to limit inflation and to provide forward guidance for an economy in which negative externalities like pollution are priced by those that produce them. The system changing aspect of this policy approach broadens the pricing of carbon through the emission standards authority. Under this regime, existing policy makers manage the *price floor*, as they currently do, that is the macro supply of permits in the market. However, the surplus permits are held in reserve by the central bank, like a currency reserve, to maintain the appropriate *price ceiling* of emission permits. Through this arrangement one institution controls the price floor (the lowest price that emission permits should trade at), while another institution manages the price ceiling (the highest price that emission permits should be), to keep the price in the goldilocks zone, where it is effective but not harmful to the economy.

By spreading the permit supply management across two institutions conflict of interest situations are avoided. Conflict of interest is not a necessarily a question of wrong doing, but the potential that wrong doing could arise (Caplan, 2001). Take for instance the central bank's mandate to maintain price stability and

long-term economic growth. If the central bank becomes ideological and perceives a very low emission permit price as being advantageous, it may be in the bank's interest to dilute the market with emission permits to drive down the price, to discount the future cost of climate change to stimulate economic growth now and not pay for the negative externalities caused by climate change. However, if the macro supply of the market is managed by policy makers whose interest is to manage climate change, then these policy makers need not fear getting the price too wrong, because there is another institution that is interested in doing the micro-managing of the permit price. It would be the emission market bureaucrats' role to manage the macro supply at the beginning of each phase, while the central bank would tweak the price when needed to maintain consistent emission reductions and to avoid price spikes.

6. 13 Limitations and Future Research

The limitation to this policy approach to use emission permits as a monetary policy tool so that if the market reaches equilibrium quickly then the central bank would lose the ability to use the price fluctuation mechanism to combat inflation. Because the supply is managed, the ratio between permit price and demand may reach a static state without volatility and investment returns. In such a situation, speculative investors may not choose to engage in the market, and therefore not provide the necessary liquidity that results in market dynamism.

In order for this strategy to work, it would be imperative for the Central Bank to respect the ETS emission price floor price and not to dilute the market with

the surplus reserve and drive down the permit price. It also is necessary for government regulators to respect the property rights that each emission permit entails. If the government creates new regulations that make the permit price valueless, as the Obama Administration's amendment to the Clean Air Act did in the sulfur dioxide market.

In addition, this policy instrument is appropriate for current economic conditions, in which global economic confidence is low (Harding, 2017), interest rates are nearly zero, inflation is uncertain (Garcia, 2017; Komileva, 2017), and the economy is growing. Using emission permits as a monetary tool limits the industrial production, but it does not constrain financial markets, it is not a silver bullet for all types of inflation. Putting a tax on the time an equity is held would help address inflation in financial markets, but that is tangential to this discussion.

It is beyond the scope of this research to speculate how using emission permits as a monetary policy tool might function under different socio-economic conditions. The time frame of this policy could be short lived, due to the market reaching equilibrium. If it becomes ineffective in tightening the market because the economy de-carbonizes and GHG emissions no longer correlate economic growth, then new instruments will need to be found. However, this would be the result of the policy instrument's efficacy, thus demonstrating the utility of pricing negative externalities in a market setting with central bank engagement.

Finding new monetary policy instruments would entail using new negative externalities to leverage through the pricing mechanism. The strategy upon which

this research is based upon uses GHG emissions, the greatest of which is carbon dioxide, as a leveraged mechanism to manage inflation. Carbon dioxide is a key component of the carbon cycle upon which the global biosphere depends. So, in essence, pricing the negative externality aspect of carbon dioxide is pricing the carbon cycle. Under this scenario carbon dioxide is the polluting by-product of industrial economic activity and photosynthesis is the production element of stored carbon.

Industrial activity produces carbon-dioxide through the burning of fossil fuels, while photosynthetic plants take up carbon-dioxide and emit oxygen. In the process carbon is removed from the atmosphere and stored. This is the key component of the Clean Development Mechanism, which is the market that incentives stored carbon production. This, therefore, is a means of *pricing* the carbon cycle. The economic intent is to decarbonize the economy. If the strategy presented here is successful in *nudging* investment away from conventional industrial output, once the economy is *decarbonized*, then other negative externalities will need to be priced to create the same monetary utility. If successful, in the future, I imagine applying a similar approach to nitrous-oxides, another potent GHG, thereby pricing the nitrogen cycle.

Using negative externality pricing in a market setting can be a way of shifting how the economy is designed, away from harmful economic output with negative side effects (negative externalities) to an economy that incentivizes positive externalities like carbon sequestration. Especially in nations where the

political is such that it is near impossible to implement certain policies, this research claims that the central bank in conjunction with legally governed markets has a role to play where the political process fails.

6.14 Summary

From a policy point of view treaty emission permits as a currency is pragmatic because the supply of permits in the market is managed by fiat, not by production as with physical commodities such as corn, oil and copper. Policy makers fear market volatility and price spikes in the emission market because energy use correlates with economic output. However, this economic correlation must be broken if we are to overcome climate change. Breaking this correlation between GHG emissions (from current fossil fuel energy sources) and economic growth needs strong policy signals to encourage the shift toward low GHG energy production. This way economic growth will not be constrained by the negative externalities and market failures associated with climate change in the long-term.

While strong market signals are necessary to create the *green* energy shift, price spikes are a threat to economic growth. Maintaining optimal carbon pricing values is best managed by using emission permits as a currency reserve. Increasing the price of emission permits, in the current low interest rate and carbon intensive economy, can act as a monetary policy tool to curb inflation. It does so at less overall cost than increasing interest rate increases. This policy instrument targets business operations that are carbon intense, but does not punish mortgage holders

and developing nations. In this way using emission permits as a monetary policy tool acts as forward guidance to a *green* economy. This system changing policy instrument leverages central bank independence to overcome recalcitrant politics that is impeding climate change mitigation. Managing the price of emission permits is not just a means of mitigating climate change, using emission permits as a monetary policy tool gives central bankers a new tool to fight inflation.

6.15 References

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Chapter Seven: Calming the Storm with a Monetary Policy Tool

7.1 A Perfect Moral Storm

Stephen Gardiner (2006) presents climate change as *A Perfect Moral Storm*, that is that despite the facts, society is slow to take effective action to prevent the atmosphere from warming far less than 2 degrees centigrade. Although the 2015 Paris Agreement is evidence that nations are working more cooperatively toward combatting climate change than before; the Intended Nationally Determined Commitments to reduce Greenhouse Gases are estimated to bring about 3.4 degrees centigrade of warming by the end of the century (Climate Scorecard, 2017). So, while national actors are being more cooperative, the effectiveness of that cooperation is insufficient to prevent less than 2 degrees of atmospheric warming.

Gardiner's (2006) claim is that society lacks the virtue to act, virtue he defines as the ability to "resist acting badly" (p. 4). He frames the virtue as being able to address the spatial, temporal and institutional dilemmas associated with climate change. A policy initiative suggests that emission permits, the chief carbon pricing mechanism to reduce GHG emissions, could combat insufficient INDCs by using emission permits as a monetary policy tool to manage the price most effectively (McCowen, 2017). The question thus is can this policy approach satisfy Gardiner's ethical standard? This study asks can using emission permits as a monetary policy tool satisfy Gardiner's tri-part dilemma? This is how it will be determined whether the pricing carbon strategy is ethical or not. In this approach,

what is ethical is not determined by what is necessarily good, in this case the best ethic can be what Michael Ignatieff calls "the lesser evil;" the safety of the polis is the primary rule, and in providing safety, some less than ideal actions may take place. To island nations climate change due to amplified storm surges is not a future problem, it is a current emergency. Therefore, immediate action on climate change is necessary and we must seek ways to transfer finance to impacted nations that lack the means to adapt quickly.

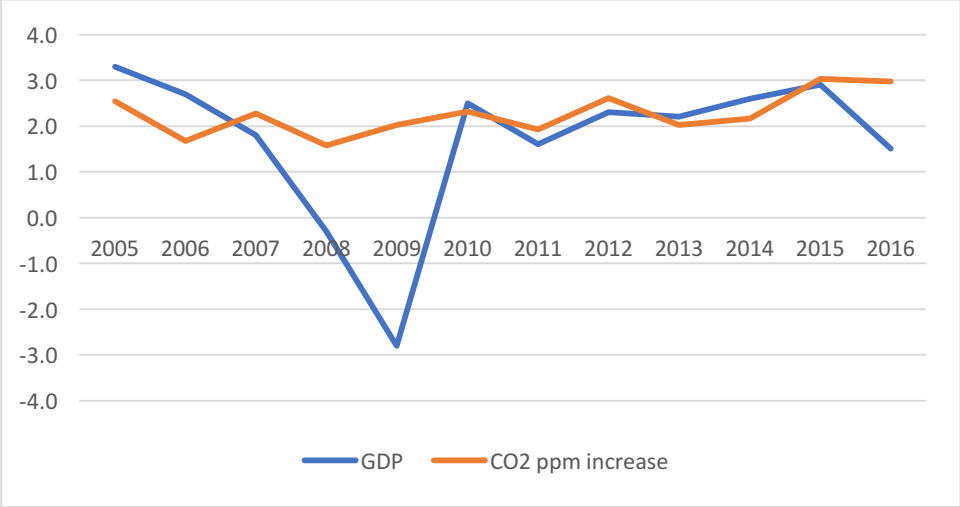
7.2 Emission Permits as a Monetary Policy Tool

It has been argued that emission markets, designed on the principles of supply and demand, are more like currency markets than traditional commodity markets like, copper, corn, or oil (Button, 2008; Dalsgaard, 2013; Descheneau, 2012; McCowen, 2017; Porter et al., 2017, Victor & House, 2004). McCowen claims that if emission permits are like a currency, then they could be used as a monetary policy tool (2017c). A policy tool is an instrument "through which public purposes are pursed" (Salamon, 2002, p. 9). A monetary policy tool is an instrument that achieves this end in the arena of monetary policy. Current monetary policy tools are limited to central bank asset purchases, interest rate adjustments that impact the value of a currency, and forward guidance. Forward guidance is a message the central bank sends to commercial banks about future intended actions (FRB, 2016). Using these policy tools, central banks stimulate economic growth and curb

unwanted inflation which are the foundational measurements of the macro economy.

Traditionally, since the dawn of the industrial revolution, economic growth reflects energy used. Which means that GHG emissions, the result of energy spent, trends economic growth. During times of economic expansion atmospheric concentrations of GHGs increase more rapidly than during economic recessions. The following graph compares the concentration of atmospheric carbon dioxide, as measured by NOAA at their station in Hawaii compared to U.S. Gross Domestic Product changes over a 12-year period. It shows that when GDP drops by a certain percentage, CO_2 concentrations after a lag time also decline in parts per million. The Y-axis in the graph represents percentage of GDP and Parts Per Million. When the economy expands again, annual average CO_2 concentrations increase. Since 2000 we have on average added more than two parts per million of carbon dioxide each year to the earth's atmosphere (NOAA, 2017).

Therefore, the policy goal must be to decouple economic growth from CO_2 output. The pricing of GHG emissions is a policy that attempts this aim by charging firms a pollution fee through emission permits. According to Pigovian economic theory, social harms can be reduced by making it more expensive to do them. The premise is that since GHG emissions trend economic output, increasing the price of emission permits would have a similar impact to increasing interest rates, thereby curbing inflation.



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created 08/19/2014

Graph: 7.1: Economic Growth & Greenhouse Gas Emissions

The preceding figure demonstrates how emissions go up when the economy expands, but the rate that CO_2 concentrations recede during economic downturns is slight. This shows the current coupling of the economy and GHG emissions (York, 2012). The goal then is to find policy strategies that incentivize decoupling GHG emissions from economic growth.

Just as an increase in interest rates makes it more expensive to borrow, and thus combats inflation, so too would increasing the price of emission permits, except that it would make it more expensive for businesses to pollute, but mortgage holders would not be directly affected. This approach combats inflation without harming home ownership and borrowing rates. Increasing

interest rates at the macroeconomic scale also impacts national indebtedness. According to *The Economist* magazine, in 2017 the US is likely to pay $280 billion of interest payments on its 14 trillion dollars of debt. This is greater than the combined budgets of the Department of Education, the Department of Labor and the Commerce Department (*The Economist*, 2017). Each 0.25% interest rate rise adds 35 billion dollars in annual interest payments on the national debt. Therefore, even homeowners with fixed rate mortgages would be impacted by the tax burden of servicing the increase in national debt.

By using the central bank to purchase emission permits to decrease the permit supply and increase the price of polluting is a means to tackle inflation without adding to the national debt. For this policy approach to work, the central bank would purchase and hold in reserve emission permits. Based upon the economic maxim of supply and demand reducing the supply in the market would increase the emission permit price. By increasing the emission price, it becomes more expensive to pollute.

Under this policy scenario it is imperative that the government respect central bank independence to manage the reserve-supply, as they do with the money supply[11]. If governments fiddle with the permit supply, this would be the same as undermining the money supply, which would destroy the fiat monetary

[12] For a comprehensive study of emission permits as a monetary policy tool see McCowen, 2017b

system.[12] Currently the "cap," or supply within the cap & trade emission trading system, is determined by bureaucrats either by auction or allowance (gift). However, after the auction, or allowance-gift, has taken place there is no sensitive way to manage the price. Therefore, if markets are oversold, this will result in a depressed price. Increasing the price to pollute reduces GHG emissions, and incentivizes firms to operate more efficiently (Calel, 2011; Coase, 1960; Crocker, 1966; Dales, 1968; Hurwitz, 1973, 1995; Lane, 2012; Montgomery 1968; Schmalensee, & Stavins, 2012; Stavins, 2009).

Reducing GHG emissions in a market setting is the hallmark to combat climate change. Therefore, making it more expensive to produce GHG in the first place is a necessary step to alleviating the impacts of climate change, the impacts that will harm the poorest people in the world who have the least resources to adapt to the change.

7.3 Gardiner's Tri-part Dilemma

As Gardiner (2011) puts it, at present we have insufficient means to address climate change because we are asking poor people, with small GHG footprints, who did not cause the problem and lack the resources to adapt, to solve the problem. By insisting that poor people, in poor countries not take the development path toward economic development is wrong. Increasing the price of carbon

[12] It is beyond the scope of this paper, however there is evidence in the SO_2 markets in the US were destroyed by the 2011 amendments to the Clean Air Act. Emission permits that sold for $1600 in 2012, fell to $0.06 by 2016 (EPA, 2016)

emissions for poor people, especially in developing nations with weak infrastructure is telling them not to do what industrial nations have done to become rich. This is the spatial problem, where people in other places are having to bear the brunt of climate change, which they did not cause. For the purpose of this paper, I think it is appropriate to refer to this spatial issue as being between rich and poor; since poor people tend to have smaller consumption footprints of that of wealthy individuals. This acknowledges that there are poor people in industrial nations who are vulnerable, just as there are wealthy individuals in non-industrial and developing nations who are wealthy and can afford a price on carbon. Income inequality is a growing problem in many industrialized economies, while there are many millionaires and billionaires in middle income nations. As such, an effective policy alternative to combat climate change must price carbon at a rate high enough to change behavior, but be sensitive to the right of low and middle income nations to develop, at the same time as not harming poor individuals everywhere.

The second aspect of Gardiner's (2011) ethical conundrum is the intergenerational dilemma; that this current generation is willfully and knowingly reducing the quality of life for future generations by not taking effective action on climate change. The current generation has more power over future generations and can determine their future prospect. This is the temporal problem; that the

current generation is likely harming and curbing future generations' ability to flourish.

Gardiner (2011) argues that the third problem is that we lack proper institutions to address climate change effectively. He argues most political institutions are shortsighted because of election cycles. It took 21 climate summits to reach the Paris Agreement and even this collaboration is uncertain to reduce GHG emissions enough to be *well below* two degrees of warming. This is what he calls institutional inadequacy – the inability for institutions to mitigate climate change in a timely manner. The longer this institutional inadequacy extends, the more expensive it will be to mitigate climate change (Broome, 2008, 2012; Jowit & Wintour, 2008; Murray, 2008; Stern, 2006). Therefore, using emission permits as a monetary policy tool must be able to at least address, if not solve, the spatial, temporal and institutional in adequacy of current climate change mitigation policies. The criteria for determining whether this policy tool is appropriate will be whether it is likely to be effective, efficient, equitable, manageable, legitimate and politically feasible (Salamon, 2002).

7.4 Spatial Problem

Most of the world's poor live in low and middle income countries; however, even in wealthy nations it is not acceptable to put the burden of climate mitigation on to low income people. In emitting greenhouse gases the rich [are] perpetrating an injustice on the world's poor (Broome, 2008,). Twenty percent (20%) of the world's richest people consume 86% of the world's resources, while the bottom

20% consume about 1.3% (McMichael, 2012). In pricing carbon it becomes imperative not to put an undue burden on the poor. Although climate change mitigation is costly it is not acceptable to impose a tax on the poor and on low income nations.

Using emission permits as a monetary policy tool provides central bankers with an additional tool instead of increasing interest rates (McCowen, 2017). Interest rate increases harm home owners, marginal borrowers and foreign nations who service debt in U.S. dollars (Donnan, 2017; Giugliano, 2015). By purchasing emission permits and holding them as a reserve, central banks reduce the supply of permits in the market. According to economic theory a reduced supply correlates with higher prices, thereby making it more expensive to pollute. This satisfies the effectiveness criteria since a higher price on pollution will mitigate climate change faster than a low price.

Combatting inflation through increased production costs is a more subtle means to fulfill central bank mandates than increasing interest rates; it constrains producers of GHG emissions, but not investors and borrowers. It alleviates the need for central banks to fight inflation with interest rates alone. Since low and middle income people and nations find it hardest to service their debt, this policy mechanism is more just because it puts the greatest cost on those that can most afford to pay it – large GHG emitters. This is making the assumption that large

emitters are wealthier than low emitters, and therefore have the capacity to alter their behavior more readily.

When emission permits are held by a central bank they become an asset of the bank, just as any other currency reserve or debt instrument is. Currently, the Federal Reserve holds more than 10 billion dollars combine worth of Japanese, German and French debt instruments (Deloitte & Touche LLP, 2014). The European Central Bank even holds auto loans, a depreciating asset on their balance sheet (Barkawi, 2016). According to Alexander Barkawi (2006), of the Council of Economic Policies, this era of unorthodox monetary policy, offers an opportunity to view "green" infrastructure debt differently than debt with large carbon foot print.

Even though emission permits would represent a tiny fraction of currency reserves, (i.e., a maximum ratio of a couple hundred million dollars compared with the hundreds of billions of dollars of currency reserves and debt), every reserve underpins the currency in circulation even if it is very small. Just as the gold reserves held by the Treasury and the Federal Reserve Bank of New York reduces the supply of gold available to the global market, making gold more expensive, but also providing confidence of the U.S. dollars' value, so too, would emission permits underpin the U.S. dollar. This is the economic principle of supply and demand.

> The broader the base for a given carbon price, the more efficiently it operates and the lower the overall cost of managing emissions to the economies within which it is operating. (IETA, 2016b, p. 3)

Since the U.S. dollar is the global reserve currency this creates a vast *base* for emission permits. The demand for U.S. dollars is higher than any other currency because international trade and debt is transacted with dollars; 60% of U.S. dollars circulate outside the country (Blinder, 1996; Goldburg, 2011). The central bank of China in 2011 held three trillion dollars in reserve (Birner, 2012). Therefore, this reduces the cost of carbon pricing because the value underpinning emission permits is spread over such a large base. Firms engaged in international trade using U.S. dollars are in a small way captured by carbon pricing but at an infinitesimally small cost. This then satisfies efficiency criteria because it shows the cheapest way to reduce GHG emission. A policy is deemed efficient if it has the intended effect and if it is cost effective (Salamon, 2002).

This demonstrates how using emission permits as a monetary policy tool reduces the cost of carbon pricing. By utilizing the U.S. dollar, the reserve global currency, firms engaged in trade contribute to the price of an emission permit, even though it is too small to notice, this is the epitome of market efficiency. At the same time, it reduces the cost of climate mitigation to poor individuals in middle and low income countries because it reduces the need for interest rate hikes and it spreads the cost of the permit price across a very large base. Therefore, since most of the world's wealth is concentrated into a small population engaged in

international transactions, this strategy provides the most amount of good- climate mitigation for the most amount of people. This then satisfies the utilitarian ethic of maximizing good and minimizing suffering. It is assumed that firms and individuals engaged in international trade can bear the very small extra cost attributed to a US dollar underpinned by carbon pricing.

7.5 The Temporal Problem

The temporal problem is the intergenerational fact that every generation benefits from the emissions they produce, but project the costs of those emissions on to future generations (Jamieson, 2014). What Gardiner refers to as "tyranny of the contemporary" (2011, loc. 132). While some may argue that future individuals do not have agency because they do not yet exist, and may not ever exist from an individual perspective, the fact that we know that there will be future people, and that our current GHG emissions will hurt them because some carbon dioxide persists in the atmosphere for hundreds of years, means that we have an obligation to "preserve a just basic structure" (Meyer, 2016; Rawls, 2001, p. 159). This obligation is rooted in a rights based argument. Even in the face of uncertainty about future conditions, there is a duty, or obligation, to limit harm for future generations. Within this is embedded a sense of justice for future generations, and virtue; in the sense that to not act to limit warming to below two degrees would be to inhibit the flourishing of future generations. As then President Obama said,

"We will respond to the threat of climate change, knowing that the failure to do so would betray our children and future generations" (Vig & Kraft, 2016, p. 80).

The precautionary principle aims at least for a "risk neutral" outcome, that the action in question should not increase environmental and public risks. In situations of choice, the precautionary principle would favor the option with the lowest degree of risk (Goklany, 2002). In the climate change context the acceptable risk is below 2 degrees centigrade of warming. The Precautionary Principle has been particularly influential amongst policy makers concerned about the possibility of major human impacts on the global environment such as climate change (Gardiner, 2006b). The concentration of CO_2 deemed scientifically safe by the UNFCCC is 350 ppm this therefore is the standard to be met, it is a policy target just as central banks use an acceptable 2% inflation rate. From an ethics perspective, it is an acceptable form of nature, a natural standard that has a lower risk of living with than a higher concentration of CO_2. Therefore, it is virtuous to act in a way that achieves a goal of 350 ppm CO_2 than the business as usual likelihood of 450 ppm.

The problem being is that the earth's atmospheric concentration of CO_2 is currently over 400 ppm. Furthermore, CO_2 breaks down slowly in the atmosphere ranging from 39 years to hundreds of years, depending upon conditions. Whereas methane, a more potent GHG, breaks down relatively quickly in 12 years (Blasing,

2013)[13]. This stresses the urgent need for behavioral change to restructure and redirect the economy if 2 degrees of warming is to be avoided. Even if magically all anthropogenic GHG emissions were halted, atmospheric warming would continue relative to the chemical persistence of atmospheric gases, this creates time lags until chemical decomposition takes place. These are the bio-physical conditions that make action on climate change so imperative. Already at 0.85 degrees centigrade of warming we are witnessing extreme weather patterns which threaten arctic communities, island nations and many of the world's most populated cities located in coastal regions, or reliant on glacial water.

If the conditions are costly at current 0.85 degrees centigrade of warming, then it is logical to invoke the precautionary principle to prevent future warming with policy urgency based upon any ethical argument be it obligation, justice, virtue, or equity. Given the *persistence factor* of GHG in the atmosphere, and the need to allow for a sustainable amount of industrial development in low and middle income countries, the energy-economic growth correlation must be broken, giving rise to a fundamentally different economic system (Brown & Garver, 2009). Situations that present some special danger or crisis call for the greatest attention to secure success and avoid disaster (Dewey & Tufts, 1908). "The urgency of the environmental crisis forces a need for a new form of metatheoretical compatibilism" (Light & Katz, 1996, p. 11), in short society, is facing an existential

[13] see Appendix 3: Figure Atmospheric GHG Concentrations degrading rates

paradigmatic crisis. Even if immediate action to substantially reduce global GHG were possible, the harm to future generations would be inevitable, but the extent of that harm is, as yet, unclear. Still, without a doubt, sooner rather than later, is the more moral action.

7.6 The Problem of Institutional Inadequacy

However, action on a global scale is dependent upon the order of collective behavior. Although action is urgently needed, mitigation has not happened collectively. Although the US has had a task force on the concentration of atmospheric gases since the 1960s (Jamieson, 2014), and despite James Hansen (2015) leading the clarion call to action at the Toronto Conference in 1988 when CO_2 emissions were 350 ppm (NOAA, 2013), the formation of the UNFCCC at the Rio Summit in 1992, the US did not ratify and participate in the Kyoto Protocol to reduce GHG. Other countries like Canada and Japan stepped away from the agreement. Apart from certain European countries, little action on climate change has taken place. Current Co_2 levels are above 400 ppm, and climate change kills more people than terrorism (Leber, 2015). Gardiner (2011) refers to this inaction as institutional inadequacy. It is widely agreed that the appropriate way to resolve a tragedy of the commons, like climate change, "for the parties to agree to change the existing incentive structure through the introduction of a system of enforceable sanctions" (p. 32). Sanctions in this case refer to Nationally Determined Commitments to reduce GHG put forth in the Paris Agreement. But Thomas Heberlein (2012) warns, "If you are trying to solve environmental problems, you

better be afraid of attitudes. Even though they are difficult to pin down and perhaps even harder to change, attitudes are fundamental to environmental solutions" (p. 5). Since the Paris Agreement of 2015 attitudes towards climate change have evolved, but real mitigation action is still elusive and current commitment levels are not expected to prevent the atmosphere warming less than two degrees centigrade (Climate Scorecard, 2017). So while institutional collaboration may have recently improved, the strategies underlying these arrangements, and the commitments to prevent less than two degrees of warming are still weak.

Institutional inadequacy refers not just to groups of policy makers but the design of rules. From a theoretical perspective institutions are more than organizations; they are the durable manmade rules that govern human interactions, essentially the rules of the game by which society plays (Kingston & Caballero, 2009; North, 1990;). Institutions can have many meanings focusing both on the rules used to structure patterns of interaction within and across organizations (Kraft & Furlong, 2013; Ostrom, 2007;). The "rules" may be formal, like purposefully designed laws and constitutions, or informal, such as tacit cultural norms and conventions. Institutions include any form of constraint that human beings devise to shape human interaction (North, 1990, p. 4).

Shaping human interactions is what Thomas Heberlein (2012) calls the "*structural fix*" in which changes in the social environment influence what people do; this is where policy alters the way people behave; people change their behavior

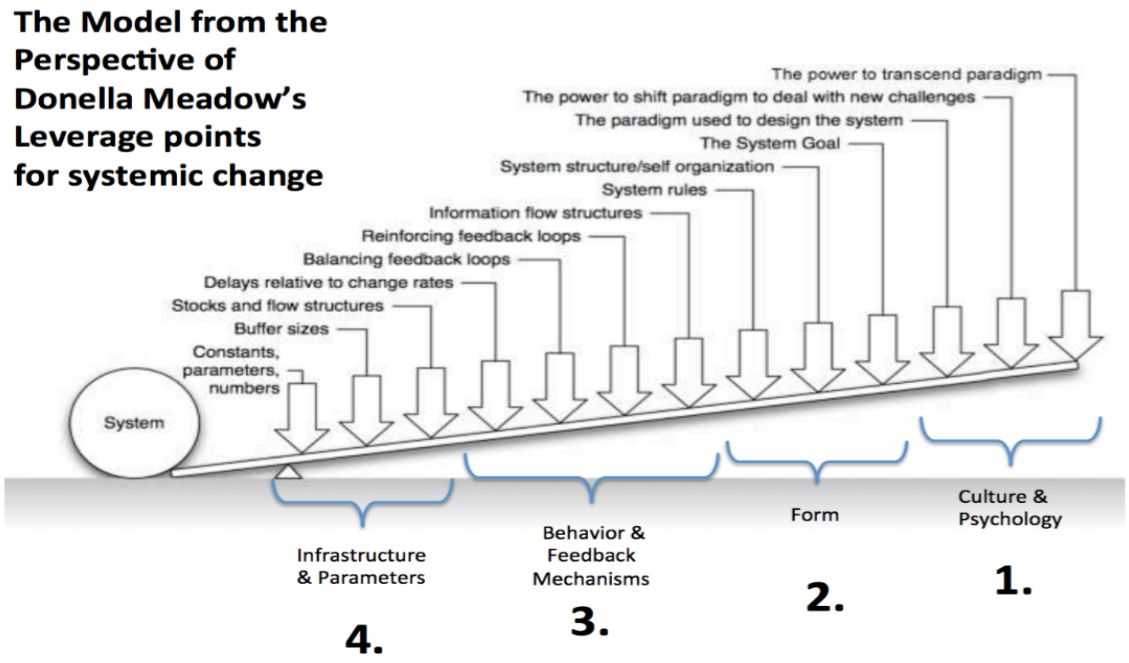
in reaction to a policy change (p. 164). Instead of trying to persuade people to insulate their homes, Heberlein (2012) gives the example: subsidies, tax breaks and grants are offered, even free upgrades. Making structural changes to rules of engagement are a paradigmatic leverage point in which a small change can have a big impact.

7.7 Leverage Points that Address the Structure of Institutional Inadequacy

Using emission permits as a monetary policy tool addresses the structural approach to climate change mitigation, which is currently reliant on the collaboration of nation states' INDCs to reduce GHG emissions, by leveraging the global reserve currency, the U.S. dollar. This is not a collaborative measure, but it is a structural change to pricing carbon. Climate change governance is a weak state actor because at the global level there is no government authority; the governing structure is dependent upon the consensus of representative nations. The problem with consensus based decision making is that policy actions that can be agreed upon may not be the most innovative and effective policies to implement (Coglianse, 1999; Koontz et al., 2004). This is evident in the Paris Agreement as it now stands, since that agreed upon GHG reductions are deemed not sufficient to prevent two degrees centigrade of warming, and this insufficient standard has taken nearly 30 years to achieve. The epitome of too little, too late. Still it is better

than business as usual, and the ability to reach such a global consensus must not be under appreciated.

However, using leverage points as described by Donella Meadows (1999), presents opportunities to bring about systemic change in a manner not possible in collaborative policy approaches. Just as a properly strung tennis racket has a spot where if the ball hits there its rebound potential is magnified, so too do we have a spot within a policy system that has exponential potential. Seeking leverage points is about finding openings in a system and making them work (Klien, 2001). Within leverage points approach there is a hierarchy of places to intervene in a system with the first being the crudest, the place of greatest entrenchment. The last is the most subtle place, it being the paradigm shift; the place where the smallest of changes can have a dramatic impact on the entire system.



Finidori (2014)

Figure 7.2: Leverage Points

Meadows' (1999) approach to leverage points within the context of the climate change and climate change negotiations demonstrates how money as a cultural artifact and central banks as institutions occupy the cultural-psychological leverage point and the form leverage point respectively. This is one way the above figure fits into the context of the concept of climate change and the economic system[14].

The concept of various leverage points corresponding to climate change policy demonstrates where the most efficient and game changing leverage points

[14] Appendix 4 describes the relationship of Meadows Leverage Points in the context of climate change further.

are; remembering that policy inevitably deals with biophysical constraints and flourishing as well as socio-economic conditions. Meadows' systematic analysis moves from the gross physical attributes to the subtle *raison d'etre*, literally: reason for being. Theoretically then, the closer a policy initiative is to the most subtle characteristic of a system, the most impactful that policy will be.

Money is unique in its instrumental value as a leverage point. On the one hand, at the "micro" individual level, money can be destroyed as a material artifact, if one sets fire to a dollar bill that bill is destroyed and the supply is reduced. However, it also underpins the entire economy, the rules that govern its creation and destruction are intrinsically linked to the economies proper functioning. Finally, the *desire* to acquire more money in order to become wealthy, makes it a societal paradigm.

Accessing currency as a leverage point is on the subtle scale of leverage point, doing so is a paradigm shift in climate mitigation strategies. Viewing emission permits like a currency is one sort of paradigm shift, using those permits as a monetary policy tool, or currency reserve, is another. All relationships between people involve exchange; in this way exchange is the most developed interaction humans possess. "Every interaction has to be regarded as an exchange." Human life is comprised of loss and gain, "the diminution of life's content." In large part, the concept of sacrifice is embedded in the notion of economic values (Simmel & Frisby, 2011, p. 86). Money as a means of payment is guaranteed by the collective of society. Money is a cultural artifact (a social construction, or an institution) its

importance depends upon the "theories" individuals' hold about it (Birner, 2012). Money at the macroeconomic scale is managed by central bankers as a common pool resource (non-excludable & rivalrous) to avoid tragedy of the commons scenarios like inflation (Birner, 2012). If the resource is not managed properly, i.e., too much money is in circulation its value is diminished, it bares the same hallmark as over grazing the commons. The relationship between excludable and non-excludable goods and resources is way of categorizing many of life's activities in competitive and non-competitive situations.

Table 7.2

Economic Resource Matrix

	Excludable	**Non-excludable**
Rival	Privatization, pay for service, intellectual property rights: controls who has access of use, usually through monetary means. Pollution when regulated	Tragedy of the Commons. Infrastructure: roads the more people access them the more crowded they become, reducing efficiency macroeconomic money
Non-rival	Potential for privatization, pricing reduces consumption. Ideas, technology	Public goods. Lighthouses, ecosystem services: photosynthesis

Adapted from Birner, 2012; Daly & Farley, 2004, p. 160.

The U.S. dollar, as the reserve global currency, has leverage over nearly all international trade and debt. This is what makes it such a powerful point to leverage, to bring about meaningful climate change mitigation through the pricing

mechanism. Most schemes price carbon emissions either through taxation or through a market based cap and trade system. Most jurisdictions choose one pricing mechanism or the other; however some jurisdictions adopt both mechanisms simultaneously. Side by side policy tools that implement a tax alongside a cap and trade market create additional policy options when the emission permit is used as a monetary policy tool and managed as a currency reserve.

Adopting both market and tax based policy mechanisms in industrial nations allows for maximum policy flexibility[15]. When governments adopt a tax based mechanism as in British Columbia, Canada, which has seen emissions fall 13% since implementation in 2008 (Sponikin & Kooten, 2010), governments are locked into that determined price and price tightening schedule.

However, if governments adopt both mechanisms side by side, the tax supports emission mitigation in the event of a low market price, in weak economic times but during strong economic growth, the market can withstand a higher price, therefore incentivizing firms toward greater mitigation. In a pure market situation, a low market price can lead to price gauging of consumers. For instance, the EU-ETS cap and trade market was established in 2005, electricity prices rose from 2000-2008, the EU-ETS price collapsed in 2007 from its 2006 peak €32 to near zero (Hintermann, 2008). While the emission price has not risen above €7 since,

[15] See Appendix 5

electricity prices have not fallen since 2008 (Dempsey, Bought, & Hough, 2016). This indicates that utility companies have priced in a much higher carbon price than actually exists. Therefore, a central bank could purchase emission permits, thus tightening the market, without any impact on consumer prices, since utility companies have already factored in a higher price.

This innovative approach is well within the mandates of major central banks like the Federal Reserve, the Bank of England and the European Central Bank, who have practiced unorthodox debt asset purchasing schemes in the wake of financial crisis, purchasing mortgages and auto loans, automobiles being a depreciating asset (Barkawi, 2016). Compared to such fixed assets, emission permits are fungible and stable under current market conditions. Some have gone further to propose carbon as a currency standard as gold once was (International Institute of Monetary Transformation, 2012; Porter & Wratten, 2014; Porter et al., 2017). Given that the Stern Report (2006) refers to climate change as the greatest market failure of all time, embedding carbon mitigation policies into monetary policy is within the Federal Reserve's mandate which refers to the economy's long-run potential, and the Bank of England's mandate which cites the right conditions for sustainable growth as mandate objectives (BOE, 2017,)

The social cost of the *do nothing* approach of business-as-usual interferes with "the economy's long-run potential" and does not set "the right conditions for sustainable growth" as previously stated in accordance with the Federal Reserve Act of 1913. The costs of devastating storms like Katrina and Super Storm Sandy

are extreme; by 2007 94.8 billion dollars had been appropriated because of the 2005 hurricane season, not including a 16 billion dollar decline in tax revenues between 2006-2015 (CBO, 2007). Hurricane Sandy cost more than 65 billion dollars (HUD, 2013). The debilitating costs in terms of lost development potential from weather related events to low income countries, where 97% of the deaths associated with such disasters is difficult to measure. Melting glaciers in South America that provide water to over 100 million people are expected to disappear in 20 years (McMichael, 2012). Business as usual is not an option from an economic or ethical point of view.

7.8 Development Opportunities in a Constrained World

While climate change mitigation demands a restructuring of the industrial economy, it provides opportunities for sustainable development in which cost are applied to negative externalities of pollution. The Clean Development Mechanism includes programs such as REDD+ (Reducing Emissions by Deforestation and Degradation), where initiatives are designed as win-win scenarios where indigenous people in low and middle income countries are paid for the ecosystem service of sequestering CO_2 through land management practices. These projects are in the nascent stage, and are far from perfect in design since the costs of standardization and sequestration verification are downloaded on to the local communities (Arora-Jonsson, Pettit, & Temu, 2016). However, I believe they are an improvement on the Rostovian colonial concept of technology transfer to *developing* countries. Although design improvements are needed, REDD+ projects

offer a financial transfer for previously unpaid labor that is more dignified than foreign aid (Lee, 2014,)

As an NGO officer in Tanzania said, "I wish we had more carbon and more money—we would get more cash into the villages and they could do what they wanted" (Arora-Jonsson et al., 2016, p. 74). This demonstrates the producer attitude to maximize production. If the agricultural corn market is compared to REDD+ we see that this is a consistent market response. When prices are low farmers maximize production, but do not increase investment. When prices are high investment increases and new producers enter the market. This was the market behavior that was seen in reaction to the ethanol mandate; under a higher profit scenario the global corn trade expanded by 50% between 2007-2016, where it had remained relatively stable from 1980-2005 (USDA, 2017).

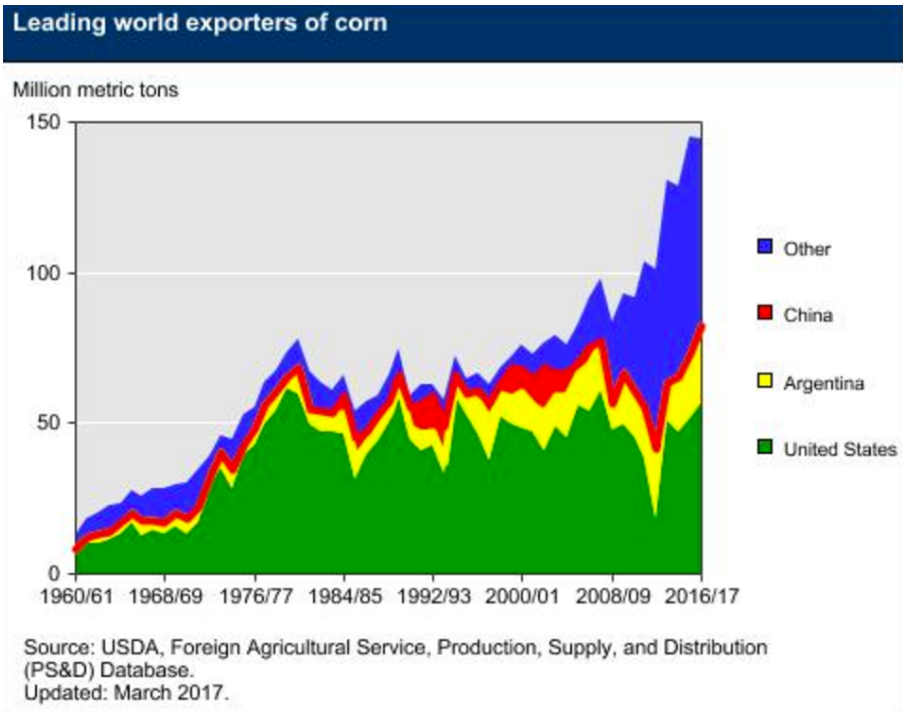


Figure 7.3: Global Corn Trade Expands

What the above figure indicates is that producers respond to price signals, "carbon markets will follow the same pathway under the correct signals," says Lawrence Tubiana, France's envoy to the Paris Summit (Clark, 2015). However, prices tend to decline when a product is launched in a commodity market (Munden, 2011). Without the ethanol mandate corn prices would not have responded to increased demand because there was already too much corn in the

system; it was negative news about ethanol diversion that drove the price changes (McCowen, 2017a).

Thus, to respond to the Tanzanian REDD+ NGO officer, it is higher prices that are needed, not (from his perspective) "more carbon" production. Stored carbon prices trade at a fraction of emission reduction permits. Emission permits have traded as high as €32 in 2006 and have averaged €5 since, however on the UN CDM market carbon trades below €1 per ton (D'Aprile & Marinella, 2017). This amounts to what Bourdieu (1986) called *symbolic violence;* when social domination is normalized into common practice (Nicolaescu, 2010). In this case in a market setting, where the right to pollute carries a greater monetary value than the sequestration of an equal amount of CO_2. It reeks of a neo-colonialist form, this inequality must be rectified, at the International Court if need be. However, in the meantime, increasing the of emission permits on EU ETS, or REGGI markets is a policy that can be immediately implemented, this higher price would then trickle down into the CDM market. It is at least a first step toward a more equitable relationship between the low-income and industrial nations of the world.

7.9 Summary

Leveraging the price of carbon as a monetary policy tool is not a panacea, nor should it be viewed as a magic bullet. It is an imperfect policy tool in the long term, but it is one that is immediately available and achievable within the current political context. In the current conditions of an expanding U.S. economy in which inequality within the consumer demographic is a concern, it makes sense to

increase the price of polluting industries that have high social costs compared to raising interest rates, which benefit the wealthy but harm borrowers at the margins, be they nations, consumers, or small businesses. Using emission permits as a monetary policy tool puts an additional tool in the toolbox of central bankers, and it adds forward guidance to carbon markets.

Using emission permits as a monetary policy tool addresses institutional inadequacy by engaging new rules in an era of unorthodox monetary policy. Emission permits are a more fungible asset than mortgage debt or auto loans, plus the emission market corrected in 2006, therefore is has nowhere else to go than up. This makes it a prudent low risk investment. Central bank autonomy frees permits from becoming a political football kicked between opposing sides. Because of the negative externalities attributed to climate change and the market failure potential if the situation is allowed to worsen, it is within central banks mandates to purchase emission permits to help them manage the economy with a more precise tool than interest rates and to prevent future market failures.

Carbon as a monetary policy tool addresses the intergenerational issue of climate change in that it can be implemented immediately and action sooner is better than action later. From the spatial perspective, increasing the price of carbon may not prevent harm being done to poor people across the globe, but it can help to increase the payments of indigenous people in REDD+ programs and other carbon sequestration projects. Therefore, using carbon as a monetary policy tool addresses Gardiner's (2011) tri-part dilemma of a *Perfect Moral Storm*. I suspect it

is not a strong enough tool to solve the problem and given the complexity and time lags of CO_2 sequestration it is reasonable to assume that many policy tools will be needed. Going forward, modeling the theory behind this research is the next logic step; determining how many emission permits would need to be purchased to increase the price to a desirable level. If the carbon markets behave like the Sulfur dioxide market of the 1990s, or the corn market of the mid 2000s, it might be quite small. Finding the institutional rules to leverage is a practical way of overcoming the systematic roadblocks that block sustainability (Beddoe et al., 2009). From a pragmatic perspective we are called to solve immediate problems, and an approach is determined to be *true* and *right* if it succeeds in solving the problems in question (Rorty, 1999). Time will tell, but time is running out if we are to achieve a just and sustainable socio-economic system that does not destroy the planet.

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Chapter Eight

8.1 Conclusion

We need adaptive institutions that exert pressure favoring rules that nudge economic actors to overcome the systematic roadblocks to sustainability that have resulted from a carbon energy industrial economy, which over shoots the globe's carrying capacity (Beddoe et al., 2009). Pricing GHG emission permits in a traded market allow an immediate way for institutions like central banks to take an adaptive measure. Central banks, due to their political independence, represent institutions that are mandated to act for the public good. At the macro-economic scale, the money supply is managed as a common pool resource, for benefit and stability, not for profit maximization.

Because monetary policy is managed as a public good and as a common pool resource, it is advantageous to examine climate policy in a similar way. Privatizing pollution through emission permits is a policy approach to combat the collective action problem of climate change mitigation. Because the atmosphere and oceans are a part of the global commons they cannot be controlled directly through containment, and they cannot be enclosed and privatized. However, turning the right to pollute into tradeable permits is a means of enclosing the negative consequences of burning fossil fuels. Recognizing the similarity between common pool resources, such as the money supply and the atmosphere is a means of overcoming collective action problems. Central bank mandates require that they act for the common good to ensure economic stability and reasonable growth.

Climate change threatens economic growth and stability and, therefore, a central bank has the responsibility to assist in mitigating climate change.

This dissertation suggests central banks can assist in climate change mitigation by holding a reserve of emission permits to maintain a stable supply in the market setting. In this way it becomes the central bank's responsibility to manage the permit price ceiling. If demand in the market place becomes inflated, the central bank would reduce the reserve size and increase the supply within the market place. Essentially, the central bank would perform the same mandate for the emission trading systems as it does for the money markets, free from political interference. This entails trust and granting new authority, which is *system changing* from a policy point of view. However, unlike the money supply, it should not be the central bank's mandate to manage the permit supply since it is not the bank's expertise. The permit supply would still be managed by the existing authority in the specific jurisdiction in question. The difference is that the existing authority would not be under the same pressure to over supply the market with permits because authorizing too few permits could have dire economic consequences due to the correlation between industrial output, GHG emissions, and economic growth. Therefore, the existing authority would still manage the supply which determines the price floor, but the central bank would manage the demand side, the price ceiling, which would act to control price speculation.

The research presented from chapter four demonstrated how a mandate operating within a market can have a dramatic effect in a very short time. The

ethanol mandate increased demand in the corn market tripling the price. The increase in corn prices did more to increase investment in agricultural development than 20 years of negotiating at the World Trade Organization, which began in 1997. The dark side of increased prices was the price over shoot, which lead to the 2008 food crisis. This was explained by the 2006 Chinese export ban on corn which resulted in a 10% disappearance from the global corn trade. This thus shows that market mandates are powerful tools, but that appropriate buffers are needed to prevent price speculation. Using emission permits as a reserve with a beneficent and powerful non-political institution, like a central bank, is such a buffer mechanism. The total supply of emission permits is still managed by national policy makers, thereby determining the price floor of emission permits, but the price ceiling, the ability to add supply into the trading system if price speculation threatens the economy, is determined by the central bank. This shared responsibility increases market stability and reduces conflict of interest between policy makers, but also puts another tool in the central bank's tool-box to manage inflation.

A side benefit to this arrangement of dual authority to maintain a stable emission permit price is that a central bank could increase the price of emission permits, instead of increasing interest rates that harm mortgage holders, tax payers and indebted developing nations whose debt is held in foreign currencies.

Developing nations face a particular problem under climate change because they lack the infrastructure to protect against adverse weather conditions, such as

extreme droughts and storms that climate change is already amplifying. Developing nations do not have the capital means, the luxury, to pay for protection. Increasing the price of emission permits increases the value of stored carbon credits in the Clean Development Mechanism, thus transferring currency to least developed and transitioning nations.

Paying people who manage carbon sinks is an important new area of international development. The ethical argument for increasing the price of carbon by using emission permits as a monetary policy tool was presented as a stable means to increase the transfer from the industrial world to least developed and transitioning nations. People managing carbon sinks should be paid for the ecosystem service of carbon sequestration that they provide. Stored carbon credits are one mechanism to pay people for managing the global commons. The ethical standard used to determine the risks and benefits of a higher carbon price using emission permits in reserve as a monetary policy tool was not a very high bar. It was simply asked if using emission permits as a monetary policy tool could improve the status quo by satisfying the tri-part dilemma put forth by Stephen Gardner (2011).

It was found that the strategy to engage central banks in holding emission permits as a reserve would get around many of the institutional inadequacies that have resulted in slow mitigation. Because this policy could be implemented immediately, it reduces the intergenerational dilemma since when the longer meaningful mitigation is delayed the worse, the outcome will be for future

generations. Finally, by increasing the price of certified emission credits, more money is transferred to developing countries, this improves upon the current situation in which managers of carbon sinks *want more carbon*; by giving them more money for the same carbon, their situation is improved.

Climate change has been caused by the *rules and traditions* that define the industrial economy. Changing those norms in subtle ways by leveraging the institutional potential of central banks is a means to get the "biggest bang for the buck." Especially in the polarized environment of the U.S. Congress, it is imperative to take the actions that can bring about the best possible mitigation strategies that threaten not only the well-being of the nation, but the well-being of the world.

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Appendix 1- Expert Interview Survey

Interview Survey Questions

These questions were created by Saleem Ali and Tracey McCowen. The interview is semi structured. The following questions are designed to guide the conversation rather than to dictate it. The questions here pertain to this dissertation; the other questions pertain to another scholar's research, and are thus not relevant to using carbon as a reserve currency.

A) How important is Climate Change?

1) Does your position change in your professional setting?
- If yes, is your professional position more or less concerned?

B) How important is climate change in the context of US-Canada regional cooperation?

1) Economically?

2) Environmentally?

Do you perceive a conflict between these two goals?

Do you have any ideas on how these can best be balanced?

C) Neither the United States, nor Canada is a signatory to an international agreement on climate change

1) Do you think their respective positions are responsible?
2) Do you think they are wise/prudent?
3) Does it place them outside the rest of the global community?

D) According to the Stern Report, which is the most comprehensive report so far on the economic impacts of climate change it is estimated that the effects of climate change will reduce global productivity by between 5 -20%. A regulatory Cap in the US, through emission permits is expected to cost energy users at least $100 billion by 2020 and could exceed $300 billion by 2030 -inflation-adjusted to 2006 dollars (Beach, et al, 2008.) Given that US GDP in 2011 was $14.99 trillion, $

100 billion is 0.0066% of GDP in 2011 dollars and is thus far below the Stern Report's lowest estimated climate change cost of a minimum of 5% GDP.

1) What do you think?

E) The US dollar is the global reserve currency, thus policy changes at the Federal Reserve have global reach. If the Federal Reserve adopted a policy to purchase emission permits it would incentivize investment in carbon sinks this would result in capital flows toward investments that absorb GHG out of the atmosphere. Just as the ethanol mandate increased investment in corn commodity markets, dramatically increasing the price of food world wide, so to a shift in monetary policy could shift the perceived value of carbon sinks. Although the initial impacts of increased corn were food riots in urban areas, this quickly reversed to increased investment in agricultural production. Do you think a similar strategy might work for Green House Gases, chiefly carbon dioxide?

F) The Federal Reserve currently uses foreign currencies and gold as reserves. Given the ubiquitous nature of carbon to the industrial economy do you think it is feasible for the Fed to use carbon as a currency reserve?

List of Participants to Date:

Diana Carney: Canadian economist specializing in climate change, research director of Canada 2020.

Stephen Anderson: Director of research at the Institute for Governance and Sustainable Development. He was instrumental in brokering the Montreal Protocol that was the international treaty to put a price on Ozone destroying CFCs.

Dr. Stephen DeCanio: Professor emeritus at the University of California, Santa Barbra. He was a member United Nations Environment Programme, Economic Options Panel, and formerly sat on the IPCC.

Rt. Hon. Paul Martin: Former Prime Minister of Canada, Former Finance Minister of Canada.

Graciela Chichilnisky: Columbia University Economist, advisor: IMF, UNEP, Climate Bonds Initiative.

Christopher Ragan: McGill Economist, David Dodge Chair in Monetary Policy.

Appendix 2- Congressional Activity on Climate Change

Congressional Act	Sponsor	Summary	Outcome
2003 Climate Stewardship Act	McCain R-AZ Lieberman D-CN	Cap & Trade based upon 2000 GHG levels	Voted down in the Senate
2005 Climate Stewardship & Innovation Act	McCain R-AZ Lieberman D-CN	Same as above & promote "green" technologies	Voted down in the Senate
2007 Climate Stewardship & Innovation Act	McCain R-AZ Lieberman D-CN	Cap based upon 2004 GHG level gradually reduced to 1990 levels	Bill died in committee
2009American Clean Energy and Security Act	Waxman D-CA Markey D- MA	Create clean energy jobs, achieve energy independence, reduce global warming	Approved by the House June 2009, defeated in the Senate
2009 Clean Energy Jobs and American Power Act	Kerry D-MA	Proposes cap & trade, emissions curbs of 20% by 2020 & 83 % by 2050	Died in committee
2011 Energy Tax Prevention Act	Upton R- MI	Reverse Clean Air Act amendments	Passed through the House April 2011, died.
2013 Climate Protection Act	Saunders I-VT Boxer D- CA	Requires EPA to impose a carbon pollution fee.	Introduced & referred to Committee. February, 2013
2014 Carbon Pollution Transparency Act	Saunders I-VT	Requires Congressional Budget Office to account for carbon footprint of all bills and resolutions	Referred to Committee September 2014

2014 Climate Change Health Protection and Promotion Act	Markey D-MA	Expresses the sense of Congress of impact of climate change on health systems	Referred to Committee September 2014
2014 Super Pollutants Act	Murphy D-CN	Establishes a task force to reduce short-lived climate pollutants	Referred to Committee September 2014

Updated 10/29/2014. Govetrack.us.

http://www.govtrack.us/congress/bills/111/s1733

The first bill submitted to Congress was S. 1610 (101st): Global Climate Change Prevention Act of 1989 sponsored by D-VT Senator Patrick Leahy. Although H.R. 6669 (95th): National Climate Act of 1977 submitted by D-CA George Brown was the first bill to establish a climate monitoring policy and was signed by President Jimmy Carter into law in 1978. To date this is the only bill to become law that has "climate" in the title. Since then 760 bills which reference climate change have been submitted.

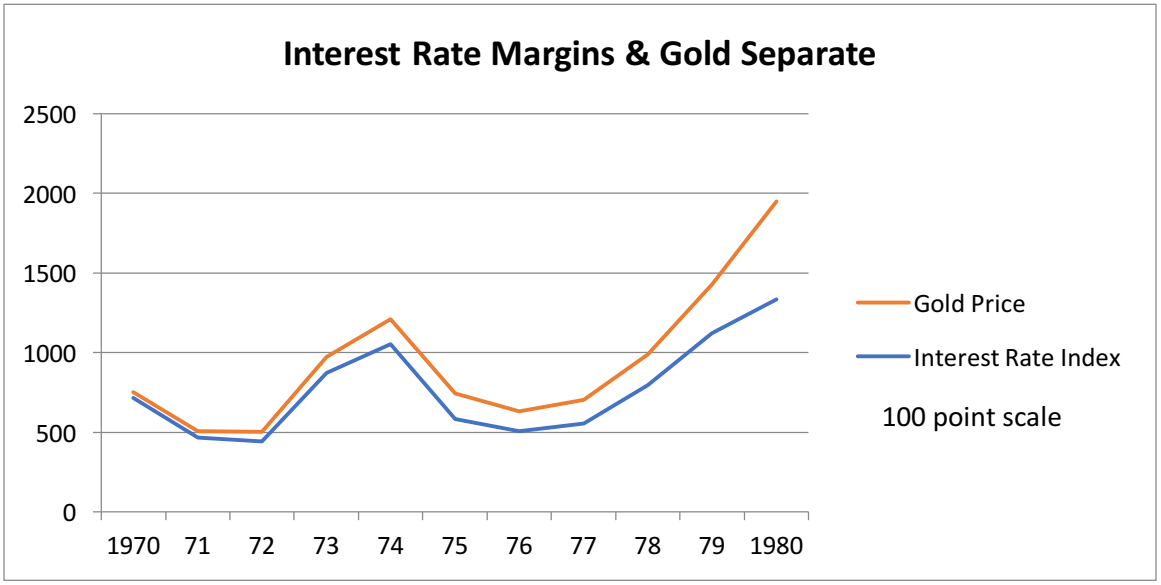
Appendix 3

Table 9.2 Atmospheric Green House Gas Concentrations

GAS	Pre-1750	Recent concentration	Atmospheric lifetime (years)
Parts per million			
Carbon dioxide (CO2)	280	392.67	~ 100
Parts per billion			
Methane (CH4)	7008	18749/17589	12
Nitrous oxide (N2O)	27010	3249/3239	114
Tropospheric ozone (O3)	251	344,1	hours-days

Blasing, 2013

Appendix 4 Effects of Closing the Gold Window



http://www.kitco.com/scripts/hist_charts/yearly_graphs.plx

Fears of inflation caused the price of gold to more than double and interest rates became the driving force of monetary policy. Delinking the US dollar's direct peg to gold allowed the expansion of the money supply. This increased the power of the Federal Reserve who's role it is to determine what interest rates should be. After the decoupling of gold to the US dollar, the correlation of interest rates to the price of gold began to separate, as the preceding graph demonstrates.

Appendix 4

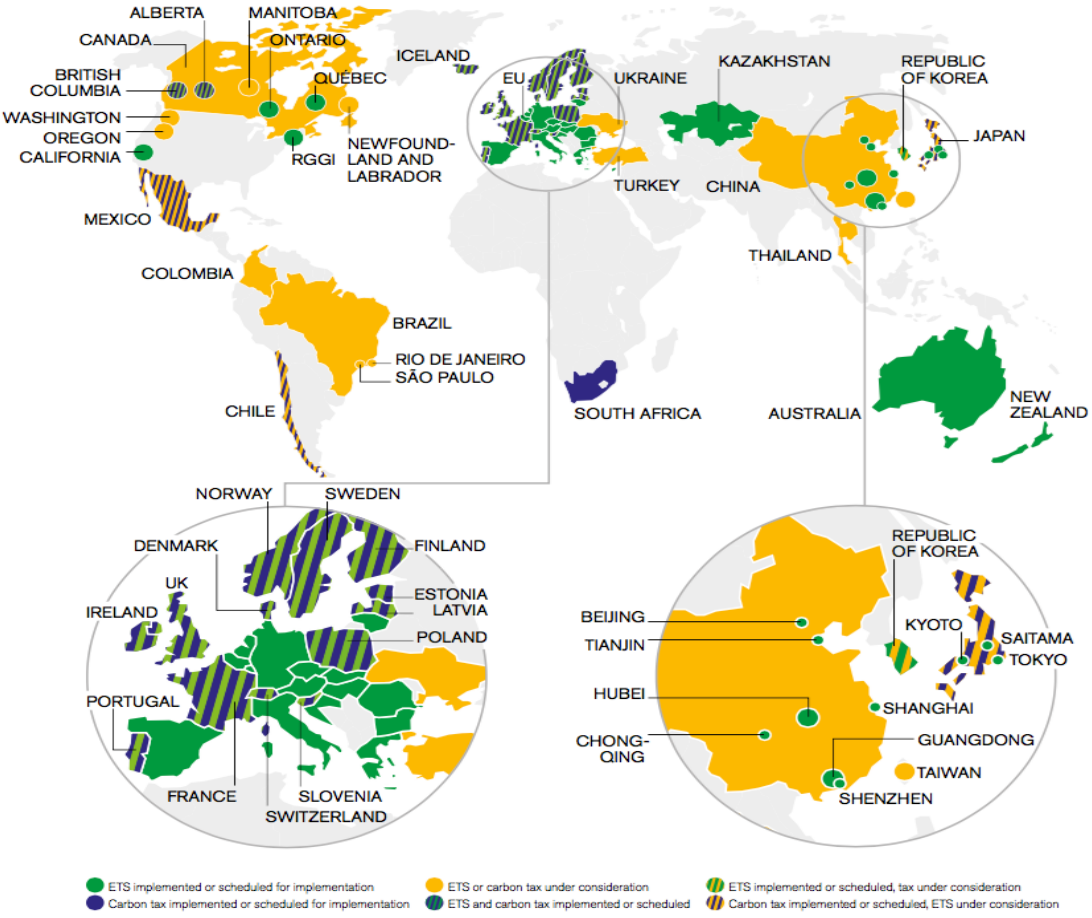
Systemic Leverage Points in Climate Change Policy Context

Places to Intervene in a System	Climate Change Examples
Constants, parameters, numbers	Subsidies, standards, bio-physical properties
The size of buffers.	Surpluses, welfare (Medicare), ecological redundancy, i.e. 250 ppm -350 ppm CO2
The structure of material stocks & flows	Transportation networks, population, energy inputs, money
Length of delays relative to system change	Atmospheric chemical half-life, policy collaboration
The strength of negative feedback loops	Ability & time needed for atmosphere, ecosystem, or market to correct itself
The gain around driving positive feedback	Technology, reinforcing behaviors- market crashes, market failures, natural inputs & gains, i.e. methane release due to warmer temperatures
The structure of information flows	Who has access to information, restricted or open source, how is information obtained
The rules of the system	International agreements, market rules, monetary policy, bio-physical constraints
The power to add, change, or organize the system structure	Lobby groups, unions, access to law makers, politicians, understanding & capacity to alter natural environment
The goals of the system	Economic growth, inventions, development, flourishing
The mindset or paradigm out of which the system arises	Industrialization, wealth maximization, cost avoidance, sustainability

The power to transcend paradigms.	Enlightened state of awareness, alter society's consciousness, social movements

Adapted from Meadows, 1999.

Appendix 5 Global Carbon Pricing Mechanisms



World Bank, 2016, p.25