Lessons on the Design and Implementation of Renewable Energy, Greenpower and Greenhouse Emissions Abatement Markets from the Financial Markets and Experimental Economics.

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Financial markets are large, well informed, highly liquid, well developed markets for that most fungible of all commodities – money. Even so, the financial markets suffer from non-ideal characteristics that have required the development of considerable regulation and market intervention by regulators. In comparison, environmental markets are tiny and illiquid – and as such are far less likely to meet the theoretical requirements for an efficient market. The argument for monitoring and intervention is if anything stronger in these markets.

Environmental markets have generally been implemented by government agencies different from those traditionally associated with the oversight and management of markets. While using markets to facilitate least cost implementation of environmental policy has real theoretical and practical benefits, lessons from the financial markets should be remembered. Areas for particular consideration would include: the roles of Over The Counter and Exchange Based trading, the treatment of risk, the linkages between spot markets and forward markets, and the role of the regulating authority to set targets and conduct market intervention.

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1 Designing regulatory markets – looking to experience and experiments

Markets and auctions have been in use for millennia. The Greek historian Herodotus, described the sale of women to be wives in Babylonia around the fifth century B.C, and the Roman's held auctions of plundered booty. (Milgrom and Weber 1982) Since the early 1980's the use of "market based instruments" to facilitate least cost implementation of environmental policy has enjoyed rising popularity, with theorists such as (Montgomery 1972) outlining the potential efficiency benefits of such markets.

It is surprising then to realise that the theory of market design and behaviour remains a considerable distance behind the practice. This theory lag is discussed with some elegance by (McMillan 1994) in the context of the US Spectrum Auctions[1]. "Theory has limits" he wrote, and "theory sometimes shows that there are effects that work in opposite directions from each other … implementing a particular theory may require information that is unavailable."

As yet there is no profession of "Market Engineer", capable of predicting market performance "post-construction" with a similar level of forensic certainty as that expected from Civil Engineers when constructing bridges. Hence the environmental regulator seeking to implement environmental policy through a "designer" regulatory market is well advised to look closely at the techniques used in other larger and more established markets and to consider the comprehensive use of experimental economics techniques to test proposed market designs before going "live".(Rassenti, Smith et al. 2002)

Despite the problems the gains from implementing environmental policy via a market instrument can be significant. (Ellerman, Joskow et al. 2003) suggest that using a market can deliver a cost reduction of more than 50% compared to traditional "command and control" type regulation.

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[1] The US Spectrum auction were among the world's most theoretically analysed auctions prior to their implementation. However as (McMillan 1994) points out the actual performance was vastly different to the still performed in reality very poorly compared to theoretical predictions.

2 Some size perspective

Even the largest environmental markets are tiny in comparison to the financial markets. In the Australian context Over the Counter (OTC) financial market turnover in 2002-03 was AUD 42.5 Trillion[2], with exchange traded turnover of AUD 13.8 Trillion, giving a total financial market turnover of approximately AUD 56.3 Trillion – of which approximately 40% is Foreign Exchange (FOREX) related. (Australian Financial Markets Association 2003).

The largest environmental market currently trading in Australia is the Mandatory Renewable Energy Target (MRET) market – where the traded instrument is a Renewable Energy Certificate[3] (a REC). In 2002-03 the turnover in the MRET market was 2.2 Million RECs (Australian Financial Markets Association 2003). In late 2002 RECs were trading for slightly above AUD 40 each, giving a book value turnover for the MRET market of approximately AUD 90 Million.

Thus the largest environmental market in Australia has a turnover representing around 0.0002% of the turnover of the financial markets as a whole, or about 0.0005% of the turnover of the Foreign Exchange market. Other Australian environmental markets would be another order of magnitude smaller.

3 Lessons

So what lessons could an examination of the financial markets provide to implementers of environmental markets?

3.1 Develop the Over The Counter and then the Exchange Based trading.

Transaction costs are a major impediment to market efficiency, an issue theoretically covered by (Stavins 1995) (among others) in respect of environmental permit markets. A real life Australian example of the impact of search cost existed with the Hunter River Salinity Trading Scheme (HRSTS)[4],

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[2] Trillion being $1x10^{12}$

[3] A REC represents 1 MWh of electricity generated from a designated "eligible renewable generator" within the meaning of the scheme.

[4] Refer: http://www.epa.nsw.gov.au/licensing/hrsts/index.htm

where the responsible government department (the New South Wales Environment Protection Authority) discovered that trading volumes increased dramatically after the introduction of an electronic bulletin board feature to the scheme, allowing participants to post bids/offers to a centralised location.

Environmental regulators have tended to consider transaction costs – and secondary trading as a whole – as an afterthought to the issue of designing the economic instrument to be traded.

In the financial markets this process has been reversed, with the development pattern being for the OTC market to develop first, evolving the commodity being traded as the market participants negotiate bilateral trades – and in the process lay down the foundations of settlement systems, standardised documentation and market conventions around parcel sizes and the terms of trade. Frequently private brokers enter the market providing firm two-way pricing, thus improving liquidity. As the market consensus develops and liquidity improves it then becomes possible for an exchange based contract of a single defined instrument (normally based off the defacto OTC standard) to be launched.

In the Australian context, even the largest environmental markets have struggled to pass through this process. Within the MRET market there has been considerable turnover of brokers, where existing financial market brokers have entered, attempting to broker REC trades, and have found insufficient volume to sustain their activity.[5] An early attempt to introduce electronic exchange based trading (the GEM[6]) also suffered from lack of volume, and eventually closed down.

It is interesting to note that the operator of the MRET scheme – the Office of the Renewable Energy Regulator (ORER)[7] did not formally monitor these developments, nor does it have a mandate to undertake consideration of how these developments might have impacted market efficiency and what

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[5] The Australian environmental markets have seen the exit of both the dedicated environmental broker CO2e.com, and the electricity & environmental products desk of Tullet & Tokyo Liberty – the Australian offshoot of the US firm NatSource. There are now around 3 brokerage firms who offer firm two-way pricing on RECs, although these groups offer this "off the back" of more substantial brokering activity in the electricity market or of other commodities – such as Coal.

[6] The "Green Electricity Market" (GEM) consortium developed an electronic exchange with integrated settlement for RECs, and after two years of operation closed in 2003 due to lack of volume. The Sydney Futures Exchange some years previously also attempted to launch an exchange traded "carbon contract", and was forced to discontinue after it became clear that the contract would not trade substantial volumes. Both cases are good examples of the danger of attempting to "lock into" a single instrument before the OTC market has developed.

[7] Refer www.orer.gov.au

ORER may have been able to do to improve market performance following the exit of brokers and the GEM.

This is in sharp contrast to the role of the Reserve Bank of Australia (RBA) in respect of the financial markets, where the RBA has a specific mandate to monitor financial system stability and performance and, if required, to enter the market to support the system. The RBA also actively drives reforms to improve efficiency – such as implementing real time settlement systems to reduce transaction costs and credit risk.

Thus a lesson from the financial markets would be that agencies implementing an environmental market should carefully consider how to assist the OTC secondary trading market to develop – paying particular attention to assisting to lower transaction costs and risks. This may include giving assistance to brokers to participate in the market, directly providing (or supporting private players in the development of) information services to the market, and stating clearly to the market that the regulator would actively monitor market performance.

3.2 The effect of risk – particularly market and regulatory risk on investment

Putting together an environmental market – particularly one that drives significant new investment to solve some particular environmental issue – is a harder task that was initially anticipated. The existence of a spot market instrument to price an externality is not sufficient to ensure the optimal level of investment occurs.

Various financial and commodity markets face this difficulty – for example – base metals – where a decision to build a new mine could not be taken solely on the basis of today's spot price of copper. The potential for a movement in market price between the day the investment decision is made, and the time in the future when production occurs is considered Market Risk, and it is the need to manage such risk which has driven the development of a liquid forward contract market for most commodities, and for many financial products (eg: FOREX futures). The importance of using forward markets to manage market risk is discussed in the next section.

The other major risk facing environmental market participants is regulatory risk. Frequently the investment desired by policy makers (say into renewable energy infrastructure under the MRET scheme)

may be quite long term (about 15 years in the case of renewable energy equipment) – a point made in (Tambling, Laver et al. 2003) when conducting a review of the MRET scheme on behalf of the Federal Government. Unless the scheme is known to continue for at least this length of time into the future then investors will be reluctant to invest, even if the spot market for RECs today carries an attractive price.

Even if the scheme does have a stated life longer than the asset life cycle, the question of regulatory risk arises. This is the risk that at some point during the scheme the government will "change the rules", which as stated in various ways by many submissions to the MRET Review[8] leads to investors being reluctant to participate.

This problem is faced to some degree by many markets[9] but it is much more significant in "regulatory" markets which exist in the first place purely because of government fiat.

The essential difficulty is that since the market is a regulatory creation, participants know that it is quite possible that a future government may change the market design, or even the existence of the market entirely. The rational market participant will factor this risk into their investment decisions, where it appears as a transaction cost. (Australian Financial Markets Association 2003)

At least one financial market does suggest a mechanism to deal with this regulatory risk, being the Commonwealth Government Bond market – where the Australian Commonwealth Government issues bonds for repayment in 3 or 10 years with a known coupon payment. Bonds are sold at auction (by the Reserve Bank in Australia) on a regular basis[10]. Such long term instruments allow the purchaser to know that at least for the life of the instrument (10 years for a 10 year bond) a known (and essentially risk free) cash-flow exists.

This would suggest that one possible approach to overcoming regulatory risk within environmental markets that are seeking to encourage long term investment would be for the

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[8] refer: ANZ Infrastructure Services (2003). Submission to the MRET Review. Canberra, MRET Review, Australian Financial Markets Association (2003). Submission to the MRET Review. Canberra, MRET Review**:** 9, Babcock and Brown (2003). Submission to the MRET Review. Canberra, MRET Review, Eraring Energy (2003). Submission to the MRET Review. Canberra, MRET Review**:** 9, Powercorp (2003). Submission to the MRET Review. Canberra, MRET Review**:** 2.

[9] The government could for example ban the use of copper for some reason, although this is clearly unlikely.

[10] The US Treasury issues bonds with maturities of up to 30 years

environmental instrument to be in the form of a guarantee to purchase some environmental product (eg: MWh of Renewable Energy) from the instrument holder for a known price on stated dates going forward for 10 or more years. The price of the instrument achieved at auction would then represent the perceived NPV of that string of payments, given the presumed costs of generating that power for delivery. This is of course a form of forward contract, which brings us to the discussion of the importance of forward markets.

3.3 The importance of forward contracts and other derivative products

Generally ignored by designers of environmental markets is the trading of forward and option contracts on environmental instruments. Again, the regulators of the major Australian environmental markets do not monitor forward prices or volumes, and take no account of these markets. This is despite that in all major environmental markets in Australia – including both the MRET market and the NSW Greenhouse Gas Abatement Scheme market, forward and option trading is actively occurring - and at least in the case of the NSW scheme, forward trading was occurring well in advance of the actual launch of the spot market.(Australian Financial Markets Association 2003)

Further, in respect of driving new investment into environmental problems – such as new investment into renewable energy plant, it is the forward market that plays the primary role in allowing project developers to secure funding for new plant.

The performance of the forward and derivatives markets also will impact on the market dynamics of the spot market – although theory is poorly developed on the nature of these interactions.

It is also sometimes argued that whatever problems exist in the spot market structure (such as the indefinite banking and the information problem around the timing of REC creation in the MRET scheme – discussed in (Nolles 2003)) can be overcome through the price signals from the forward market. This appears to put considerable faith in the forward market to correct underlying market design difficulties, particularly since the forward market has been almost totally ignored by policy makers, and is entirely outside of their view.

3.4 Reserve Bank style targets and market interventions

The market for foreign exchange comprises a large and sophisticated pool of market participants, with access to a well developed range of information products and a full suite of both spot, forward and other derivative products. Such a market is as close to the theoretical ideal as any practical market is ever likely to achieve.

However, since the float of the Australian dollar in December 1983, the Reserve Bank of Australia (RBA) has frequently intervened in the foreign exchange market through open market operations.

(Rankin 2001) enumerates three broad reasons why the Reserve Bank intervenes in the foreign exchange market to influence the Australian dollar exchange rate – only two of which are relevant for our purposes:

- first, to help reverse an apparent overshoot, in either direction, in the exchange rate;
- second, to calm markets threatening to become disorderly; and
- third, on some occasions, to give monetary policy greater room for manoeuvre.

The first of these – managing market overshoot – implies belief that the exchange rate can appear to be misaligned with its equilibrium level even though the market in which it is determined is deep and liquid.

As (Rankin 2001) states, such interventions challenge the efficient markets hypothesis (EMH), which says that all of the information relevant to determining the equilibrium for an asset price will be included in the actual market price by the activities of rational traders. This implies that asset markets will always be in equilibrium and that market participants always act in a stabilising way. On this model, there would be no role for intervention.

Experience – both in a number of financial markets and in laboratory experiments, is that markets are not perfect in this way. Again (Rankin 2001) identifies that there is a growing literature dealing with trading behaviour which is inconsistent with the EMH – including phenomena such as speculative bubbles, herd behaviour and fads. A variety of experimental economics studies (including one described in (Nolles 2003) specifically concerning the MRET market) also show that markets can

produce results in which prices depart significantly from their equilibrium levels, particularly when there are information problems.

Under this circumstance, there can be justification for intervention, particularly if the regulator is in possession of information beyond that available to market participants. As part of the design and implementation of an environmental market the regulator should explicitly consider how the market will be monitored, under what circumstances they would consider a market intervention, and how that might be performed.

Again, considering RBA interventions into the FOREX market, the best known test of a beneficial intervention is the Friedman "profits test". (Friedman 1953) argued that a central bank which was successfully stabilising the exchange rate would tend to buy foreign exchange when its price was low, and sell when its price is high, and hence its operations would be profitable.

4 Conclusions

The points to be taken from this brief comparison between some financial markets and the major environmental market in Australia are:

- Regulatory and to a lesser extent market risk are significant problems in environmental markets that are intended to attract new investment into a given environmental problem.
- Where possible environmental markets or auction designs should be **experimentally tested** before being implemented.
- Market performance should be formally reviewed by an appropriate regulator, with particular consideration given to any changes over time in the secondary market dynamics and the forward market.
- The performance of an environmental market is the output of all the components, including the primary issuance of the environmental instrument, any forward market that may exist, the secondary trading market of that instrument, and the market institutional issues.

Simply concentrating on the design of the environmental instrument and a registry to record ownership is not enough to ensure than an efficient and effective environmental market is the result.

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