The grip of the 'invisible hand' on water pollution

D. T. O'Sullivan

Queensland Environmental Protection Agency, Economics Branch, Policy Division, 160 Ann Street, Brisbane, 4000, Australia
(E-mail: dan.osullivan@epa.qld.gov.au)

Abstract
Free enterprise economies are said to be held by an invisible hand, miraculously handling the complex functions of a market and producing efficient outcomes. The invisible hand has been a little shaky on pollution and the environmental economics discipline aims to steady it using certain tools such as water quality trading. This paper discusses the use of tradeable permits to achieve water quality improvements, particularly from diffuse sources; and explores preferred design options that are emerging for trading and offsetting emissions amongst these sources. High transactions costs and undefined property rights at diffuse sources of pollution affect the current capacity to design water quality trading programs. This paper posits that there are advantages in phasing-in clearly defined 'segments' of the market that represent different functions. The ability to provide a clear ranking of the lowest to highest abatement costs in a catchment produces a marginal cost abatement curve available for all parties. Typically, the more cost effective solutions will be diffuse sources; and occur at the bottom end of the marginal cost abatement curve. The establishment of this market creates an asset for trade and access to these low costs.

Keywords
Invisible hand, Externalities, Environmental Economic Valuation, Water Quality Trading.

THE SHAKY INVISIBLE HAND

Adam Smith produced an extraordinary piece of influential work in 1776 titled *The Wealth of Nations*. His theory, now customary and established in Western society, espouses that, when satisfying the wants of customers or clients, nations produce maximum wealth through competition and the pursuit of greater efficiency. To serve our own interests we will bring to the economy cheaper and better products than those already being produced. If we are successful, we are rewarded with wealth, and if we fail we are put out of business. Thus, argued Smith, the desires of many individuals for their private interest are brought together, as if by an invisible hand, to work towards the public interest. The collective outcome of these individual desires is a prosperous nation which benefits all, even 'the very meanest person!'.

Had Smith been around today environmental economists would ask him, 'what now about pollution?'. Unfortunately, many parts of the economy and society have not been caught in the grip of this invisible hand creating grave inefficiencies such as the impacts of pollution. These have become known as *externalities*: those goods, and bads, that are outside the economy. To be sure, Smith had his troubles back in the 1700s with his theories being questioned on the grounds of equality and other features, but he answered them adroitly and free enterprise has marched on.

Smith's view of nature and development in those times is very distant from today's Ecologically Sustainable Development (ESD) maxim requiring conservation; precaution, polluter and user pays principles; and consideration of future generations. In contrast to these principles Smith saw that our desires to accumulate more and more have: 'entirely changed the whole face of the globe, have turned the rude forests of nature into agreeable and fertile plains, and made the trackless and barren ocean a new fund of subsistence.' For these reasons we have seen significant loss of our forests,

land degradation and wiped out fisheries. Now as we stop and question Smith we ask: to what degree should we still follow Smith; and what reformation measures exist to correct the oversights?

Steadying the hand

Large chunks of Smith's work remain useful. It is obvious as market and free enterprise economics is the economy of choice and we are not going to begin planning to distribute the necessities of life into equal portions; that will be left to the invisible hand. However, any 'rational' economic system would mobilise its resources to produce the things that society needs – better schools, hospitals, transport, ecosystems – and free market capitalism alone has never produced this. There is one simple principle that must underpin the marrying of the economy to the environment: better valuation of the environment. The single best way to compel firms and individuals to learn the new skills in pollution control and remain energetically engaged in the protection and enhancement of the environment is to provide incentives: rewarding good behaviour and penalising the bad. Competing for efficiency gains inside these realms can be the centrepiece of free enterprise economies and occur on the grounds of ESD. It is necessary to recognise the invisible hand is shaky and certain markets are failing us. We require new tools to steady the hand and perhaps leverage the whole arm. Today, we question the turning of more forests into 'agreeable plains' and have the challenge to define, measure and internalise externalities. Thus, there are two arms of economics that will provide the impetus for change: how we value things; and the markets used to exchange those values. A section on Water Quality Trading below discusses design options and the remarkable potential of market-based instruments to bring about this change.

THE EFFECT OF MARKET FAILURE ON WATER QUALITY

Demand for access and use of surface and groundwater systems comes from a variety of areas including city and town supplies, agricultural uses, industrial demands and recreational pursuits. In addition, water quality is put under pressure from urbanisation, agricultural sources, industrial discharges and recreational activities (see Dennison and Abal, 1999; Qld EPA, 2003). Pollutants reaching waterways come from point sources (for example direct discharges from agricultural drains, sewage treatment plants or industrial drains) or as diffuse (non-point) sources where the run-off after rain collects pollutants over a wide area – for example agricultural run-off or urban stormwater run-off (EPA, 2003).

There is mounting evidence in Queensland and many other parts of the world that water use practices may be unstainable in the future. Discharges of nutrients and contaminants into waterways from point and diffuse sources; land management practices; loss of vegetation/condition; livestock access to streams; sand and gravel extraction; river regulation and water abstraction; and recreation are amongst the major pressures to Queensland waters (EPA, 2003).

In South East Queensland (SEQ), the *Healthy Waterways' Ecological Health Monitoring Program* reports on the health of waterways from A (excellent) to F (fail). In 2003 the health of six freshwater catchments in SEQ ranged from B minus to D minus; approximately half of the rivers and estuaries were ranked C (fair) to F.

REGULATORY INNOVATION – WATER QUALITY TRADING

Trade in emissions has proven to be a useful ancillary tool for regulating air pollution and is now moving into water emissions programs. Trading emissions can dramatically cut the cost of achieving water quality targets. Turning pollution into a tradeable good provides strong incentives

to producers and consumers about improvements to environmental resources and at less cost than the more traditional 'command and control' instruments; they also promote the technological improvements necessary for improving environmental conditions into the future (James, 1994). By deploying new equipment and lowering costs, benefits can be achieved by dischargers and the community. This is particularly important as reducing pollution from licensed point sources becomes more expensive. Such incentives do not exist when command and control technologies are used on their own. Thus, a system of incentives is created encouraging those who have the best knowledge about pollution control opportunities, decision makers in industry, to use that knowledge to achieve environmental objectives at minimum cost.

Studies in the US have shown the potential for trade in nutrients to reduce the costs of nutrient abatement. The World Resources Institute used case studies of three US watersheds to explore the cost-effectiveness and environmental performance of various strategies to reduce phosphorus loads (Faeth, 2000). The study found that policy approaches utilising nutrient trading are dramatically less expensive than conventional point source requirements. It was found that trading could cut costs of compliance by 63 to 82 percent. In the Michigan case, under a trading program the cost of removing one pound of phosphorus was $2.90, compared to almost $24 per pound for conventional point source requirements (Faeth, 2000).

Basic design options

Scheme design can take a number of different forms. The most common forms are 'cap and trade' or 'baseline and credit'.

A 'cap and trade' scheme places a cap on the total pollutant load for a particular area to reflect the agreed environmental objectives. The cap may be established for a catchment, river segment or water body. Emission permits (or credits) are then allocated to participants who are required to hold permits equal to the amount of pollution discharged (Tietenberg, 1992).

Emitters can rely on their own permit holdings or buy permits from others if that is more cost effective. Scarcity gives the permits value, thereby encouraging emitters to reduce emissions where this is cost effective and sell the surplus permits. Since the total number of permits is limited in line with the environmental 'cap', achieving the environmental goal is assured (provided the scheme includes effective compliance mechanisms). Through trading, environmental improvement activity can take place where most cost effective, while ensuring that all nominated responsible parties can contribute to the cost.

Permits are traded in a market subject to any special conditions specified by the regulator. The impact of many water pollutants depends on the location of the emitting source and conditions in the receiving environment. These conditions and the potential for hot spots are taken into account in determining trading rules. Environmental improvements can be made over time through uniform reductions in the size of permits or reductions when a trade takes place, or purchase of permits by the government. Depending on the system, permits can be traded externally (between different enterprises) or internally (between different discharge points of the same enterprise). A trading scheme could incorporate both point and diffuse sources.

Another form of trading scheme is a 'baseline and credit' scheme in which each participant is assigned an emissions baseline, setting out allowable emissions over time. The sum of these baselines represents the desired environmental outcome. When a firm's emissions are lower than this baseline, the emitting firm earns 'credits'. These credits can be sold to participants whose

emissions exceed their baseline and who must therefore buy credits sufficient to match their actual emissions. Giving market value to credits in this way creates an incentive for firms to reduce emission levels below their baseline level.

While the two main types of emissions trading schemes are broadly equivalent in theory, they vary significantly in practice in terms of ease of implementation and effectiveness. In particular, baseline and credit schemes can involve lengthy negotiations to set the baselines, and achieving the desired environmental outcome is less certain than with a cap and trade scheme.

Setting strong foundations via composite markets

Dennis Collentine of the Swedish University of Agricultural Sciences suggests two reasons why trading programs may fail: transaction costs[1] and undefined property rights[2], particularly with diffuse sources. The complexity of funding arrangements, the development of the transactional mechanisms and technical tools for trades and the implementation of credit-generating activities on the ground calls for careful and timely establishment of these markets. Collentine proposes introducing a composite market having three interrelated markets each serving a particular function to alleviate these complexities. This will allow the real payoff with credit generation on a large scale from diffuse source load reductions, which government agencies may need to finesse and administer.

Under nutrient trading, for example, a *nutrient sellers market* and a *nutrient buyers market* could be assembled in the first instance. The sellers market is where emitters such as sewage treatment plants, dairy farms, market gardens, fish farms and urban runoff, reduce the nutrient loads exported to waters and have them quantified and validated. This could be undertaken by an authority such as the EPA or a scheme manager established to carry out this function. The EPA or scheme manager then assigns the relevant number of nutrient credits.

The establishment of such a nutrient market has now created an asset for trade. Ranking the lowest to highest abatement costs produces a marginal cost abatement curve for the catchment. The more cost effective solutions for diffuse sources occur at the bottom end of the marginal cost abatement curve. For example, the cost of reducing one kilogram of nitrogen can cost a technologically challenged sewage treatment plant between $5,000 and $20,000 through the adoption of new technologies. Comparatively, diffuse source emissions can be reduced for as low as $5-$10 per kilogram through simple solutions such as water runoff controls at agricultural sites; or wetlands filtering storm water runoff can cost around $100 per kilogram.

Figure 1 shows how these actions can be carried out and brought to market. A scheme manager, or done directly by parties themselves, implements an abatement action that is modelled and assessed for its emissions reduction. The marginal cost of those actions equates to the price of the credits brought to the market for potential buyers to assess against their own abatement activities. The grouping of these actions and their marginal costs of abatement forms the supply curve for the catchment.

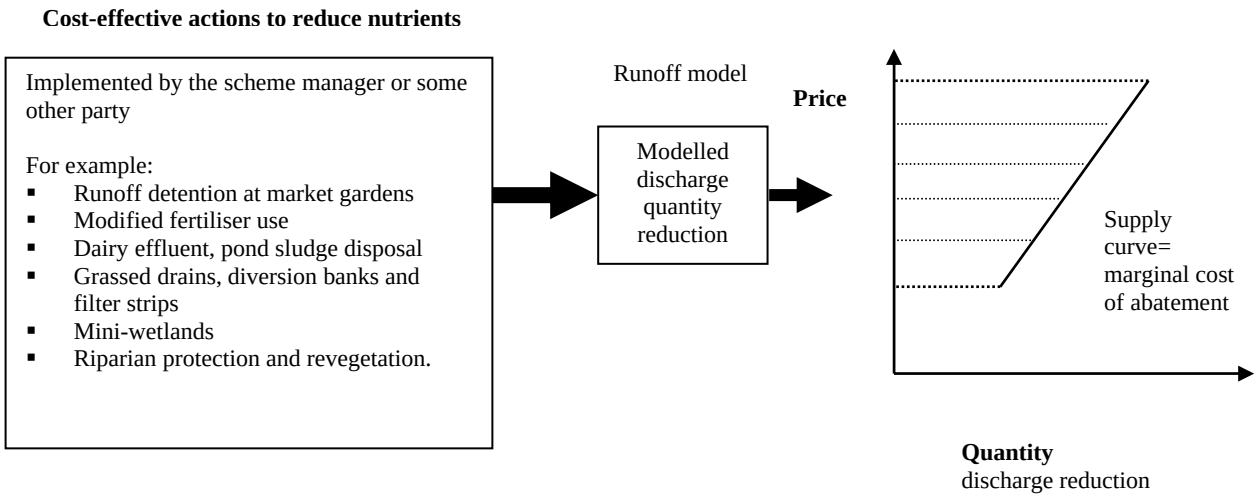
The credits from these nutrient reductions are purchased by the scheme manager and pooled to take for sale in the *buyers market* where the sale price equals the marginal cost of abatement found in the

[1] Transactions costs: the extra costs (beyond the price of the purchase) of conducting a transaction, whether those costs are money, time, or inconvenience

[2] Property Rights: The conditions of ownership of an asset, the rights to own, use and sell. The right to use or consume something, or trade the right away in return for something else.

sellers market. The buyers market is comprised of licensed sources who decide to buy credits to meet compliance targets rather than invest in more expensive actions onsite. It is also possible for other discharge sources such as development sites administered by other government agencies to be a part of the buyers end of the market requiring them not to exceed certain net loads discharging from development activities.

Figure 1. How emissions reductions are brought to market



In time, a *direct market* could be established allowing direct trading between parties or to continue to make purchases from the buyers market (through the scheme manager). The scheme manager oversees the functioning of the markets, facilitates trades and assist where inefficiencies or weaknesses emerge, particularly in the early stages of the market. The EPA regulates the market to achieve environmental benefits and mandated targets. The high transaction costs from having multiple buyers and sellers performing complex monitoring, auditing, and assessment tasks is reduced by pooling together and managing key functions. In this way, the market develops capability and confidence based on clearly establishing the necessary institutions and infrastructure as well as experience and knowledge.

Queensland Waters

The information available on water quality indicates that excessive nutrients are causing problems in SEQ, and other catchments in Queensland. Diffuse sources are likely to be playing a significant role. Information on alternative management actions shows there are likely to be cost-effective measures available to reduce stormwater and other diffuse sources in the catchments. While good data on the relative cost-effectiveness of different measures is limited this is a common problem in developing any policy instrument. The current instruments are however influencing money to be spent on the more expensive actions. The local data that is available and the studies undertaken in the US, the Netherlands, Sweden, New South Wales and Western Australia suggest that market-based instruments that direct funds towards diffuse sources of water pollution have the potential to dramatically reduce the costs associated with water quality improvements.

These jurisdictions lead the study of water quality trading and have found it is a regulatory, incentive based tool that can assist with the dilemmas outlined in the above sections on the invisible hand. In particular, they have revealed the following advantages of water quality trading:

- they can incorporate non-regulated sources without the need for new regulation
- they can move the catchment closer to its goals within existing resources
- industries are provided with an incentive to do better than the required regulatory limits or minimum performance
- new industries can develop and existing industries can expand without increasing total emission levels, at lowest possible overall cost
- financial resources of larger industries can be used to leverage improvements in smaller capital deficient sectors, relieving demands on state funding.

CONCLUSION

Adam Smith's explanation of economic growth has had a profound influence on Western society laying down the foundations of modern economic theory. His picture of parts of the economy simultaneously interacting with each other via an invisible hand are the centrepiece of these foundations. But the hand has become rather shaky when dealing with externalities such as the impacts of pollution. Smith did warn us of the perils of accumulating possessions and his perspectives on ethics have been lost in the pursuit of the wealth a capitalist economy can bring. This wealth may be in jeopardy however especially for future generations as the costs of externalities increase over time.

Surface and groundwater systems around the world are degraded because of the inability of this vast economic system to account for water use and pollution impacts and to value ecosystems. Water quality trading is emerging as a key regulatory tool to dramatically cut the costs of achieving water quality targets. These schemes are attempting to turn pollution into a marketable commodity and move away from the ill-defined product it is at present: free for polluters and costly for those who are forced to bear it. Many catchments in Queensland exhibit characteristics that could benefit from such a market-based instrument.

Note. These views represent the views of the author and are not government policy.

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