February 2008

Andersons Policy Bulletin

The US Ethanol Sector: An Infant Industry?

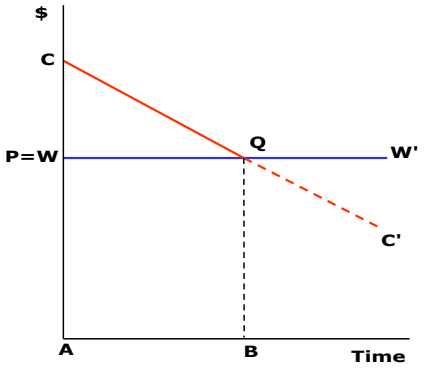
In an article published last year, Robbin Johnson and Ford Runge noted, "…Since 1974, when the first federal legislation to promote corn-based ethanol as a fuel was approved, ethanol has been considered an infant industry and provided with increasingly generous government subsidies and mandates…" (Johnson and Runge, 2007) Earlier this year, Don Warlick stated, "…The beginnings of the ethanol industry started with the Energy Bill of 2005 that supported an infant industry but provided for a ramped-up construction program to build ethanol plants across the Midwest…" (Warlick, 2008) In this bulletin the arguments for infant industry protection and whether they can be applied to the US ethanol sector are outlined and assessed.

Economics of Infant-Industry Protection

Infant-industry protection has long been considered the only legitimate exception to free trade since the arguments of John Stuart Mill in the 19th century. There are two key issues Mill alluded to in his discussion of such protection: first, an industry should exhibit dynamic learning economies that are *external* to firms; and second, any protection afforded an industry should be *temporary*, and the industry must eventually become viable without protection.

While the temporary nature of such protection should be obvious, what is meant by dynamic external economies? There are two important ideas at play here: first, over time firms "learn-by-doing", resulting in lower unit costs of production; and, second, these economies are external to firms in the sense that any knowledge gained by learning over time spills over to other firms. The key to understanding the argument for infant-industry protection lies with the idea of knowledge spillovers – if the future benefits of current production cannot be entirely appropriated by a firm or firms, because other firms in an industry can freely benefit from such spillovers, then firms will under-invest in current production. To use the language of economists, there is a market failure.

The basic logic of infant-industry protection can be illustrated in this simple figure:



Suppose the competing industry abroad is mature, all learning economies having been realized, its minimum unit costs of production being constant over time at WW', which is also equivalent to the world price P. CQ represents the potential for some domestic firms to learn-by-doing over the time period A to B, their minimum unit costs being falling with greater experience of production. After B, domestic

firms' minimum unit costs fall with additional learning along QC'.

Due to the fact that firms can learn freely from the experience of other firms, there is no barrier to firms entering the market at B, with the same cost level as firms that have already been in the market since A. In the absence of any intervention by the government, no firm will be willing to enter the industry prior to B, as they will make a loss, their minimum unit costs of production exceeding the world price. Consequently, for the domestic industry to be able to compete with that abroad, it will be necessary to provide temporary protection over the period A to B.

This can be done through a tariff on imports. At A, the initial rate is set equal to CW, which drives up the price of imports to the minimum unit costs of domestic firms C. The tariff is then lowered progressively over time to zero at B when the domestic firms' minimum unit costs are equal to those of firms abroad, and they are able to compete at the world price P. Of course after B, the domestic industry has a competitive advantage over its foreign rival, minimum unit costs falling along QC' as new firms enter the industry.

This analysis reinforces the two basic ideas Mill was getting at: first, protection is necessary because no firm will be willing to enter the industry if the future benefits of learning-by-doing are freely available to other firms. Second, the tariff should decline over time and eventually fall to zero. Of course, if these learning economies are *internal* to firms that initially enter the market, then there is no reason at all for the government to provide protection. This follows from the fact that firms can borrow to cover their losses over the period A to B, in the expectation that they will make additional profits after B, new firms not having had the benefit of learning-by-doing up to that point.

Infant-industry protection can also be achieved with a subsidy. At A, instead of imposing a tariff of CW on imports, a subsidy of CW could be given to firms in the domestic industry, so that they are able to compete at the world price P. Like the tariff, this subsidy should decline over time until B where the domestic industry's minimum unit costs have fallen to those of its foreign rival. The difference between the policy instruments is that under a subsidy, domestic consumers continue to pay the world price P, whereas under a tariff, they pay a price higher than the world price until B. While the tariff corrects for under-production by the domestic industry, it also distorts domestic consumption, whereas the subsidy only corrects for under-production. Economists would argue in favor of using the least distorting policy instrument to correct a market failure, i.e., a subsidy, not a tariff.

Finally, it should be noted that arguments in favor of infant–industry protection are based upon the political-economic assumption that disinterested governments only implement policies that maximize the net economic benefits to society. This ignores the obvious possibility that policies are put in place by self-interested vote-seeking politicians, subject to lobbying by firms, i.e., protection is "for sale". In particular, once infant-industry protection is in place, firms will typically continue to make political contributions to maintain it. Timothy Besley recently notes, "…there is now a widespread acceptance that the political forces unleashed by such selective protection need to be weighed against the economic benefits it can generate…" (Besley, 2007, p. 571)

The US Ethanol Industry

In the US, there are currently 134 ethanol plants in operation, located mostly in the Mid-West, with another 77 either planned or under construction (Warlick, 2008). This compares to 81 plants in operation at the start of 2005. Total US production of ethanol reached almost 6 billion gallons in 2007, a substantial increase from the 1.6 billion gallons produced in 2000. By contrast, it took over 20 years for the industry to reach the production levels of 2000 (Shapouri, Salassi, and Fairbanks, 2006).

Approximately 97 percent of US ethanol production uses corn as a feedstock. Corn is processed in order to separate fermentable sugars, with about 75 percent processed by "dry"-milling, and 25 percent by "wet"-milling.[1] The sugars are then fermented, the resulting product being distilled and purified to

[1]Dry-milling uses a grinding process, the key by-product being distillers dried grains. Wet-milling uses a chemical extraction process, the key by-products being corn oil, corn gluten meal and feed.

generate anhydrous ethanol. Shapouri *et al*. (2006) estimate that over the period 2003-05, total ethanol production costs for wet-mill (dry-mill) plants averaged $1.03 ($1.05) per gallon, net feedstock costs being $0.40 ($0.53) per gallon.[2] This compares to Brazilian ethanol production costs of $0.81 per gallon, with sugar cane feedstock costs of $0.30 per gallon.[3]

In the late-1970s, agribusiness-firms typically constructed large wet mills with production capacities of 100 to 350 million gallons per year (Gallagher, Shapouri, and Brubaker, 2007). At the same time, smaller dry-mills with production capacities of 10 million gallons per year were built by farmer cooperatives. During the more recent expansion of the industry, dry mills have been constructed with capacities ranging from 40 to 100 million gallons per year (Gallagher, Brubaker and Shapouri, 2005).

Over a period of 30 years, production of corn-based ethanol in the US has become a widely adopted technology. There have been some reductions in plant operating costs due to energy-savings and reduced enzyme costs (Gallagher, 2006). In addition, there is some evidence for economies of scale in dry-mills due to capital costs increasing less than proportionately with increases in plant scale (Gallagher *et al*., 2005). There is no available published evidence to indicate that the US corn-based ethanol industry has been characterized by substantial external learning economies – a necessary condition for infant-industry protection.[4] However, if there have been such learning economies in this industry, they ought to have been realized by now. The implication being that any protection it receives should be ended or phased out.

Policy and the US Ethanol Industry

How has the US ethanol industry actually been affected by policy? The federal tax credit provided to firms blending gasoline with ethanol probably comes closest to an infant-industry policy instrument. Originally set at 40 cents per gallon of ethanol blended in the 1978 Energy Tax Act, the tax credit currently stands at 51 cents per gallon, with an estimated treasury cost of over $2 billion in 2007 (Hahn and Cecot, 2007).

In principle this is the appropriate policy instrument, as it is passed back to ethanol producers, and could be seen, therefore, to be similar to an infant-industry subsidy.[5] However, due to the fact that the tax credit is available to refiners irrespective of whether they use US-produced or imported ethanol, a tariff was also imposed on ethanol imports under the 1980 Omnibus Reconciliation Tax Act. Currently, the duty on imported ethanol stands at 54 cents per gallon.[6] This policy necessarily distorts the consumption side of the US ethanol market, the US price of ethanol being higher than it otherwise would be with free trade, reducing the level of ethanol imports, particularly from Brazil.[7]

The tax credit and ethanol import tariff also have to be seen in the context of the federal mandates for use of alternative fuels. The Energy Policy Act of 2005 contained a renewable fuel standard provision requiring the use of at least 7.5 billion gallons of biofuels in US fuel supplies by 2012. Under the Energy Independence and Security Act of 2007, the renewable fuel standard provision was increased to use of 36 billion gallons of biofuels by 2022. This mandate will substantially increase the treasury cost of the tax credit as well as the losses due to the tariff.

If the tariff were removed, the mandate would be met to a greater or lesser extent by increased imports from Brazil. Does this mean corn-based ethanol production still needs protection? If as seems likely, that, such economies have been exhausted, and the

[2]Net feedstock costs are defined as the difference between the gross feedstock and the sale of by-products.

[3]In 2006, Brazil produced 4.5 million gallons of ethanol compared to US production of 4.9 million gallons (Shapouri *et al*., 2006).

[4]Rask (1994) has also shown that there is no empirical validity to the infant-industry argument for past subsidization of the Brazilian ethanol industry.

[5]There are also some direct subsidies to ethanol production such as the Small Ethanol Producer Tax Credit originally put in place under the Clean Air Act Amendments of 1990. This allows for a 10 cent per gallon tax credit to small producers up to 15 million gallons per year per producer.

[6] A tariff rate quota in place under the Caribbean Basin Initiative, also affects US ethanol imports.

[7]Elobeid and Tokgoz (2006) have forecast that US imports of ethanol would increase by nearly 200 percent with removal of the tariff.

sector is still unable to compete with imports, there is no longer an argument for infant-industry protection. However, given the 2007 legislation requires that just over 50 percent of the mandate be met by second-generation biofuels by 2022, a production subsidy could be targeted directly at this sector. This presumes of course that there will actually be external learning economies in say cellulosic ethanol production, and that a production subsidy will eventually be phased out.[8]

Of course, many would argue that there are other reasons for increasing US ethanol production, such as reducing dependence on imported oil, cutting carbon emissions and improving the environment. While these are perfectly legitimate objectives for US energy policy, they are not a robust argument for infant-industry protection of the US ethanol sector. Rather, they require use of multiple policy instruments such as gasoline, carbon and congestion taxes to change the relative prices of all energy sources, and not just the US price of ethanol.

Bibliography

Robbin S. Johnson and C. Ford Runge. "Ethanol: train wreck ahead? Government policy is stoking unsustainable growth of the corn-based fuel. A more sober, diversified approach is needed." Issues in Science and Technology, Fall 2007. http://www.issues.org/24.1/p_johnson.html

Don Warlick. "Energy bill provides kick-start to biofuels." *Oil & Gas Financial Journal*, 5(January 2008). http://www.ogfj.com/display_article/318053/82/ARCHI/none/none/1/ALTERNATIVE-ENERGY,-PART-1/

Timothy Besley. "The New Political Economy." *The Economic Journal*, 117(2007): 570-587.

Hosein Shapouri, Michael Salassi, and J. Nelson Fairbanks. *The Economic Feasibility of Ethanol Production from Sugar in the United States*, USDA: Washington DC, 2006. http://www.usda.gov/oce/EthanolSugarFeasibilityReport3.pdf

Paul Gallagher, Hosein Shapouri, and Heather Brubaker. "Scale, Organization, and Profitability of Ethanol Processing." *Canadian Journal of Agricultural Economics*, 55(2007): 63-81.

Paul Gallagher, Heather Brubaker, and Hosein Shapouri. "Plant size: Capital Cost relationships in the dry mill ethanol industry." *Biomass & Bioenergy*, 28(2005): 565-571.

Paul Gallagher. "Energy Production with Biomass: What are the Prospects?" Choices, 21(2006): 21-25. http://www.choicesmagazine.org/2006-1/biofuels/2006-1-04.htm

Kevin Rask. "Evidence of the empirical relevance of the infant industry argument for the protection of Brazilian ethanol production." Agricultural Economics, 10(1994): 245-256.

Robert Hahn and Caroline Cecot. "The Benefits and Costs of Ethanol." Working Paper 07-17, AEI-Brookings Joint Center for Regulatory Studies, Washington DC, November 2007. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1027692#PaperDownload

Amani Elobeid and Simla Tokgoz. "Removal of US Ethanol Domestic and Trade Distortions: Impacto n US and Brazilian Ethanol Markets." Working Paper 06-WP 427, CARD, Iowa State University, October 2006. http://www.card.iastate.edu/publications/synopsis.aspx?id=1018

[8]Currently, ethanol production from cellulosic feedstocks is considerably more costly than that from corn.

Andersons Policy Bulletins are discussions of key trade and policy issues. The author of this bulletin, Ian M. Sheldon, is Andersons Professor of International Trade in the Department of Agricultural, Environmental, and Development Economics within the College of Food, Agricultural, and Environmental Sciences at The Ohio State University.

Questions or comments?
e-mail: sheldon.1@osu.edu

Columbus, OH USA 43210-1067
2/2008

http://aede.osu.edu/programs/Anderson/trade