No Through Road:
The Limitations of Food Miles

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Abstract

Some consumers and environmentalists espouse purchasing food that is produced locally or nationally. An appealing expression of this is the “food miles” concept, which reflects the aim of minimizing the distance food has traveled before reaching the consumer. The concept of food miles is flawed because it ignores the costs of production, the mode and scale of transport, and the importance of other inputs such as capital and labor. Nonetheless, the notion has become popular recently with the rise in the costs of both food and transport. Indeed, some organizations that set standards for organic certification are considering incorporating, or have already incorporated, food miles into their standards, including a ban on air freighted goods. As a result, exporters, including those in some developing countries, may lose their markets in developed countries, especially in Europe. This approach may make consumers and foreign producers worse off, and may lead to increases in global energy use and emissions, contrary to the stated objectives.

JEL Classification: F13, Q17

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All currencies are in US$ unless otherwise stated.

I. INTRODUCTION

Consumers and environmentalists in developed countries have understood the concept of "food miles" for years, but its popularity has recently begun to increase. This has implications for developing country exporters. The focus on distance traveled is an attempt to highlight the hidden costs of energy use. This is based on the notion that most energy is derived from non-renewable sources, and is under-priced. The food miles concept's recent rise in popularity reflects the globalization of the food sector and increasing demand for out-of-season and exotic foods, rising fuel and food prices, greater awareness of the link between transport and carbon emissions and the desire to limit greenhouse gas (carbon) emissions, and other environmental concerns. Producers in importing countries have an incentive to encourage the food miles movement as a means of protecting themselves from foreign competition. The focus of this paper is on food miles issues associated with the import of products from developing countries. As the concept of food miles has been an issue in organic agriculture since before the early 1990s, many of the examples quoted in this paper are from that sector.

The Soil Association, which sets organic standards in the United Kingdom (UK), has encouraged consumption of locally produced food for some time. More recently, however, the association has decided to change its standards, refusing to certify air freighted produce as organic, unless "it also meets the Soil Association's own Ethical Trade or the Fairtrade Foundation's standard" (Soil Association 2008). This is effectively a ban on air freighted imported organic products. It is likely that such a ban will decrease energy use and emissions, but at a cost to local consumers (higher prices) and foreign producers (loss of market). The major beneficiaries will be local producers. For goods imported by sea, rail, or road, it is likely that a switch from imported to locally produced goods will increase global energy use and pollution, in contrast to stated aims (Vanzetti and Wynen 2002). This is because the energy used in international transport is generally relatively small compared with the additional use of energy and other resources in local production.

While the food miles idea has some merit, we argue in this paper that the concept is fundamentally flawed and that its advocates are not only misguided, but may be doing more harm than good. There are three reasons for this: first, although locally produced goods may generate less pollution in transport than imported goods, this benefit may be more than offset by increased pollution during the production phase, for example through the use of gas in greenhouses; second, the mode and scale of transport are important, with sea and rail transport being more efficient than road or air; third, the concept of food miles emphasizes one factor (energy) but ignores others, such as pesticides, labor, and capital.

Section 2 of this paper will explain the concept of food miles. Section 3 addresses the concept's recent popularity while Section 4 deals with the potential impacts. The pitfalls of the concept are then discussed in Section 5. The concept's potential effects on specific countries are illustrated with some examples in Section 6; the focus will be on imports of produce into Europe, mainly organic, and exports from Africa. New Zealand, perhaps the most distant country of all, has produced some studies of relevance to the issue of food miles, and they also provide some examples. Finally, after exploring some preferred approaches, we present the implications and conclusions of this work.

II. THE CONCEPT OF FOOD MILES

In its simplest form, "food miles" refers to the distance food travels from the farm to the consumer.

The concept of food miles has existed for some time, at least within the organic movement, where environmental issues have always been a priority.[1] However, in conventional agriculture, food miles seem to have become popular only recently, at least under that name. In 2005, the UK Department for Environment, Food and Rural Affairs (DEFRA) published a major study, *The Validity of Food Miles as an Indicator of Sustainable Development*, in which it quoted only one earlier report on the topic using the name "food miles" (SAFE Alliance 1994). DEFRA (2005: i) defines food miles as "the distance food travels from the farm to consumer." More sophisticated versions of the concept relate to energy use, carbon emissions, or other measures of environmental damage.

If food supply chains are similar in other respects (e.g., production and storage costs), it makes sense for the consumer to purchase the product that uses the smallest amount of energy in transportation. However, this does not necessarily favor the item that has traveled the fewest miles, as different modes of transport require differing amounts of energy per unit of produce. In addition, other factors are rarely equal, as production methods and costs in different countries vary a great deal. In the absence of market failure, or with sound policies to address any failures, differences in energy use are reflected in the consumer price, and so influence consumer behavior.

There are various environmental and perhaps social costs that may not be incorporated in the product price, however. Transport involves several externalities, such as emissions, accidents, and noise, which may not be taken into account. The relation between these externalities and distance traveled is a complex one. Indeed, consumers may be inadvertently encouraged by environmentalists to buy goods that may contribute to greater environmental pollution. As this paper will show, buying locally produced goods is an oversimplified way of addressing the issue of unpriced externalities.

III. THE RISE OF FOOD MILES

The recent popularity of the food miles concept can be attributed to several factors:

1. Increased trade in food; this has come about because of:
    a. Declining transport costs, new technologies, and lower tariff barriers; and
    b. Growing demand for out-of-season, processed (pre-packaged), and perishable products;
2. Environmental concerns, such as climate change;
3. A rise in protectionist sentiment in developed countries and a growing concern among farmers' organizations about the impact of increased imports on local producers; and
4. Food security concerns caused by rising food prices

There is no doubt that international food trade has increased in recent years, along with trade in most other goods and services. Global trade in food products increased from $450 billion in 1995 to $739 billion in 2006 (United Nations Conference on Trade and Development [UNCTAD] 2008). However, transport costs have fallen over the long term, in

[1] An earlier version of Vanzetti and Wynen's 2002 paper, the topic of which was the effect of food transport on the environment, was presented at the 8th Conference of the International Federation of Organic Agriculture Movements in Budapest, 27–30 August 1990.

spite of recent fluctuations of fuel prices.[2] Ocean freight rates for grain are around $20–35 per metric ton (t) for large shipments, perhaps 10% of the import price.[3] A major factor in calculating transport costs is switching from one mode of transport to another, for example, from ship to rail or rail to road. Improved ports and large distribution centers have facilitated cost reductions; larger vehicles have also helped to lower the average transport costs by spreading fixed costs over a larger number of units.

Lower tariffs have further decreased the cost of delivering goods to the consumer. Average agricultural tariffs in the European Union (EU) and the United States (US) are now around 15% and 5%, respectively (World Trade Organization, International Trade Centre, and UNCTAD 2007). There has been a switch, in recent times, away from border measures (tariffs and export subsidies) to domestic support; this has been driven, in part, by international agreements such as the Uruguay Round, but also by numerous regional and bilateral trade agreements.

Consumers demand, or are prepared to pay for, out-of-season products such as tomatoes and oranges. International trade means that seasonal products can be made available for much longer periods, in some cases all year round. In general, expenditure on food as a proportion of income has fallen to around 10% in OECD countries (The Economist 2008), making food relatively cheap (although recent price increases represent a reversal of this trend—see later in this section). As a result, consumers perceive imported foods as less exotic and are, therefore, accustomed to buying food that has traveled large distances.

In the past couple of years, concerns about climate change have risen, and the focus of food miles has shifted from general environmental impact to carbon emissions more specifically.

Support for open markets (trade liberalization) has declined recently in OECD countries. This reflects concerns about stagnant wages, job losses, job instability, growing income inequality, and environmental degradation (Warwick Commission 2007). Some consumers feel that the purchase of locally produced products may address these issues.

The price of food has risen substantially in the past year, driven by increasing prices of primary (unprocessed) commodities. The international price of rice, admittedly a thin market, doubled in the 12 months to May 2008 to reach $963 per ton before falling back to $764 per ton in September (Food and Agriculture Organization of the United Nations 2008a). Commodity prices were driven up by increased demand from the People's Republic of China (PRC) and India, decreased supply due to a shift away from food crops in favor of bio-fuels, droughts in some producing countries, and increased cost of inputs such as fuel, fertilizer, and pesticide. Primary commodity prices are only a fraction of what the consumer spends on processed foods such as bread, but nonetheless, higher prices encourage consumers to think about where their food is coming from. Indeed, some governments have voiced concerns about food security and the need to increase self-sufficiency. Taxes, and even bans, on rice and wheat exports encouraged this line of thought.

IV. IMPACTS

For exporters, the food miles movement can seem a transparent attempt by producers in some European countries (UK, France, and Germany) and the US to protect their local markets from foreign suppliers. Producers in importing countries certainly have an incentive to favor policies that support local consumption.

[2] Energy intensity on road freight transport in the United States halved between 1960 and 1990, and has continued to decline slowly (Bureau of Transportation Statistics 2008). However, recent increases in oil prices are likely to have a dampening effect on trade, particularly of low value goods (Rubin and Tal 2008).

[3] With the rise in oil prices, freight prices have increased. The October 2007 rate for shipments from the Gulf of Mexico to the European Union was $75 per ton (Food and Agriculture Organization of the United Nations 2008b).

Assuming consumers are primarily concerned about distance, rather than favoring local products over imports, the exporters most adversely affected by the food miles movement would be those who are furthest from Europe and the US and who supply a large share of their food exports to those countries. Many developing countries with agricultural industries focused on the export market would fall in this category, including those in Africa, South America, and Asia and the Pacific.[4]

Purchasing local goods also changes the location of pollution associated with production. Some pollutants, such as methane gas (produced by cattle and sheep), respect no boundaries, making the location of emissions irrelevant from a global perspective. However, others, such as nitrogen from manure that leaches into the soil on livestock farms, directly affect the place of production. Since countries vary in the absorptive capacities of their local environments, minimizing food miles by moving the place of production will not necessarily lessen the overall environmental impact, and could in fact be more damaging, especially for the formerly importing country. Purchasing locally produced goods is effectively importing the associated pollution along with the beneficial effects. Whether these effects are trivial or significant depends on the nature of the industry. A problem arises because those bearing the costs of additional local pollution are not those who are purchasing the final goods. In the absence of sound environmental policies, purchasing locally produced goods may actually increase both local and global pollution.[5]

V. FLAWS IN THE FOOD MILES CONCEPT

There are several flaws in the arguments that imports should be decreased on the grounds of food miles.

First, increased energy use in the local production and storage of goods may more than offset the energy saved in transport if, for example, greenhouses are used to grow warm weather crops in cool climates. A lifecycle analysis is required to compare these costs. Such an analysis should also address the impact of other pollutants ignored by the food miles concept, that need to be factored into decision-making. These include those generated in the production of agricultural inputs such as chemical fertilizers, and in the production process itself, such as methane.

Second, the mode and scale of transport are important determinants of the quantity of energy used. Sea transport has a relatively low environmental impact, followed by rail, road, and air transport. Scale problems in measuring distance traveled relate to the size of the vehicle. For example, 10t of grain traveling 1,000km in a 10t truck uses less energy than 10t of grain traveling the same distance in 20 half-ton trucks. This example illustrates that a better measure would be energy use per ton of product, rather than distance traveled per item.

Third, food miles emphasizes the use of one input (distance in its simplest form, and energy use or carbon emissions in the more sophisticated version), but ignores others, such as labor and capital. It also ignores negative externalities related to those inputs, such as the chemicals used in the production process.

Total lifecycle analysis: transport and other pollutants

Using distance traveled as the sole indicator of resource consumption (reflected in the price of goods) disregards use of resources (and costs) of production outside the transport sector. An obvious example of this is the use of (subsidized) gas in some northern European

[4] See Section 6 below for a detailed review of New Zealand as a case study for remotely located countries affected by the food miles concept.

[5] See Vanzetti and Wynen (2002) for further discussion on the issue of reallocated pollution effects caused by the food miles concept.

countries to heat greenhouses for producing tomatoes that could be grown in natural sunshine in Spain or Morocco. A UK study undertaken for DEFRA (2005) compares the energy use and emissions in growing tomatoes in the UK versus importing them from Spain. The trade-off in this case is between the additional gas used in the UK for heating, and the fuel used in road transport.[6] The conclusion was that food miles alone is not an adequate indicator of energy use or carbon emissions, or even of more general environmental impact.

The global warming potential of methane (CH_4) and nitrous oxide (N_2O), are over 20 and 300 times higher, respectively, than that of carbon dioxide (CO_2). These environmentally damaging substances are generated during the production of certain agricultural inputs (N_2O in fertilizer production) and the farm production process (CH_4 in cattle-raising). Pollution levels may vary in different countries due to natural variations such as soil type or climate. A lifecycle analysis can quantify these variations and take the various environmentally damaging substances into account.

Mode and scale of transport

The food miles concept, at least in its simplest form of calculating distance, does not address the financial and environmental costs of different transport modes. Carbon emissions for sea transport are 15% of those for transport by road. Grams of carbon emitted per ton per kilometer (g/t/km) are 15 for sea and 98 for road transport, respectively. Air transport, however, emits 570g/t/km according to DEFRA estimates, which is a figure undoubtedly subject to some uncertainty depending on the size of the vehicle, container, or ship (DEFRA 2005). Road transport also has associated costs, including congestion, infrastructure, accidents, and noise. These are real, if difficult to calculate, costs that should be taken into account. Nonetheless, the argument here is that it is primarily the mode of transport, not the distance, that matters.

No account of non-transport costs

The idea that a single variable can be used as a basis for decision-making is obviously flawed. It is reminiscent of Ricardo's labor theory of value, in which the price of a commodity reflects the hours of labor gone into its production. According to this theory, if it takes one hour to catch a rabbit and two hours to catch a deer, the deer should be valued at twice the price of a rabbit in the market. The problem here is that no consideration is given to: (i) other inputs such as the capital needed to catch the animals; and (ii) demand for the product, that is, the value of a deer or rabbit to consumers. For an appreciation of the total resource use from production to consumption, calculating carbon emissions (in terms of fuel cost and environmental damage) is not enough; other factors, such as the cost of capital, land, and labor, also need to be taken into consideration (Gillespie 2008). The labor theory of value went out of fashion in the 19th century, when it was recognized that prices are determined by demand-side as well as supply-side considerations. The carbon theory of value suffers similar limitations.

The share of transport costs in the total of resources used in the production, processing, and transport process is important in determining whether to purchase locally produced goods. Although transport is relatively energy intensive, the contribution of energy costs to total costs is low if the share of transport to total costs is low. Other costs related to non-carbon inputs (such as those associated with the use of pesticides in agricultural production) should also be considered.

[6] The DEFRA-funded study concluded that carbon emissions were 2,394kg/ton for locally produced tomatoes, and 630kg/ton for imported ones (DEFRA 2005).

VI. ILLUSTRATIVE CASE STUDIES

Are consumers minimizing energy use by purchasing products according to distance travelled? This is essentially an empirical issue. In addition to the production method, distance traveled, and mode of transport, the retail system (e.g., supermarket or farmers' market), transport method to home (e.g., walk, bike, or car; distance; also, was the outing a specific trip for food or was it combined food shopping and other activities), and food preparation methods (e.g., raw or roasted) are also important in an analysis of energy use.

Interestingly, some product lifecycle studies found that the greatest energy use occurred when moving the produce from the retailer to the consumer. This was because consumers often drive an empty car to the shop, then drive home with five or ten kilograms of groceries in a one-ton vehicle. The energy use per kilogram on the trip between the retailer and the consumer's home was found to be greater than the cumulative production and distribution costs to that point.

Saunders and Hayes (2007) summarized some recent studies looking at energy use and greenhouse gas emissions. In some of the studies cited, energy use and emissions were discussed in the transport phase only, but a few also included other phases of the supply chain, such as farm production, the packing and packaging system, storage, distribution to wholesalers and retailers, transport to home, and household use. Few included all these stages.

Most of the studies focused on local energy use and emissions for production within developed countries, with some comparisons done between local goods and production and transport of items imported from abroad. For example, Van Hauwermeiren et al. (2005), as reported in Saunders and Hayes (2007) compared emission levels from farm to retailer of tomatoes grown in Belgium for local consumption (both organic and conventional, grown outdoors; and conventional grown in greenhouses), imported from Spain by truck (conventional), and imported from Kenya by air (conventional and organic) (Table 1).

Table 1: Comparison of CO_2 emissions in tomato production and transport within the supply chain (grams CO_2/kg)

Location	Type	Farm	Distribution to wholesale or retail	Retailer	Total
Belgium	Conventional	18.60	78.53	4.73	101.86
Belgium	Organic	11.49	78.53	4.73	94.75
Belgium	Conventional Greenhouse	1459.41	78.53	4.73	1542.67
Spain	Conventional	18.60	283.53	4.73	306.86
Kenya	Conventional	18.60	8509.68	4.73	8533.01
Kenya	Organic	11.49	8509.68	4.73	8525.90

Source: Adapted from Van Hauwermeiren et al. (2005), as reported in Saunders and Hayes (2007).

Two features of Table 1 are the high emissions for produce grown in a greenhouse (third entry for Belgium, column 3) and for airfreight (both entries for Kenya, column 4). Emissions for tomatoes grown in a greenhouse (1459g CO_2/kg) are far greater than the emissions for tomatoes produced by the open-air method (18.6g CO_2/kg for conventionally grown tomatoes). Organically grown tomatoes (11.5g CO_2/kg) produce fewer emissions during the growing process, and importing from Spain (307g CO_2/kg) pollutes less than buying locally grown greenhouse tomatoes (1543g CO_2/kg). However, airlifting tomatoes from Kenya (8510g CO_2/kg) creates considerably more pollution than growing them locally in greenhouses. The only way to justify buying greenhouse or airfreight tomatoes is if energy comprises a small share of total resource use (expressed in retail price). For example, a carbon tax of €20 per ton would raise the cost of air freighted Kenyan tomatoes by €0.17 per kg on tomatoes with a retail value of €3–4 per kg.

In another study reviewed by Saunders and Hayes (2007), Jones (2006) described a similar situation for green beans grown in Kenya and airlifted to the UK. In his study, energy requirements for beans were similar at the two locations (0.82–1.38 megajoules per kg [MJ/kg] for production in the UK, and 0.69–1.72 MJ/kg in Kenya). With the same energy requirements for packaging at each location (3.92 MJ/kg), Jones calculated a total of 4.74–5.30 MJ/kg for beans produced and sold in the UK, and 62.51–63.54 MJ/kg for Kenya-grown beans exported to the UK. These figures, however, do not include storage costs. Examples of energy use (emissions) required to ship goods between two developed countries (including by sea), are given in Saunders, Barber, and Taylor (2006). They compared energy use (emission levels) in the production and transport of dairy products, apples, onions, and lamb from New Zealand to the UK (Table 2).

Table 2: Comparisons of energy use and emission levels in various industries

	Energy use		**Ratio**	**Carbon emissions**		**Ratio**
	MJ/t			**Kg CO_2/t**		
	UK	New Zealand	UK/New Zealand	UK	New Zealand	UK/New Zealand
Dairy	48,368	24,942	1.9	2,920.7	1,422.5	2.1
Apples	5,030	2,980	1.7	271.8	185.0	1.5
Onion	3,760	2,889	1.3	170.0	184.6	0.9
Lamb	45,859	10,618	4.3	2,849.1	688.0	4.1

Note: New Zealand figures include transport from New Zealand to nearest UK port.

Source: Adapted from Saunders, Barber, and Taylor 2006 (Tables 7.1, 7.3, 7.4, 7.5).

It is clear from the data in Table 2 that, when considering the total lifecycle of a product (in this case production and transport from New Zealand to the UK, assuming similar costs for domestic transport and distribution within the UK), local consumption does not necessarily result in lower energy use or lower carbon emissions.

The ratios in Table 2 show that energy use (measured in MJ/t) and emission levels (measured in kg CO_2/t) for the production and transport of the four products can be considerably higher when production takes place in the UK than when it takes place in New Zealand. This is especially the case for lamb (with energy and CO_2 levels four times higher in the UK), although less so for onions. On the face of it, emission levels are higher for onions grown in New Zealand, but if energy used in storage during the months that onions are not produced in the UK were to be included, the UK energy use would be 30% higher than that in New Zealand. British consumers who wish to minimize energy use should be buying dairy products, apples, onions, and especially lamb from New Zealand, rather than from local producers. Other externalities, such as accidents and noise,, should also be taken into account.

Some organic organizations have considered banning international trade in organic agriculture (by refusing the use of the logo of the dominant certifier to the potential exporter), If this occurs, it is useful to examine how importer and exporter are affected.

Gibbon and Bolwig (2007) gave examples of the costs involved in exporting organic products to the UK from two African countries (Kenya and Ghana), if airfreight were to be banned by the Soil Association in the UK.

A number of scenarios were examined. Outcomes depend on many factors, such as reactions to the ban from supermarkets in the UK; whether exporters and importers were wholly or partially dependent on organic produce; whether airlifted produce was for year-round supply, supplementing out of season produce, or to temporarily alleviate acute shortages in certain produce; and whether the enterprises examined in Kenya could revert to marketing of conventional produce after the ban, or whether they would need to close down.

If UK supermarkets accepted other certification schemes than the Soil Association's, the outcome was expected to be close to "business as usual," both in the UK and in Kenya.

However, if supermarkets were to continue mainly or exclusively carrying products certified by the Soil Association, drastic changes could be expected in both countries. In the UK, changes would include the disappearance of virtually all air-freighted organic produce from supermarket shelves, losses in direct annual retail sales of £42 million, flow-on effects of another £4.9 million, and long-term effects of a similar scale.

For exporters in Kenya, the effects would also be drastic. A Soil Association ban on airfreight would affect two large fresh produce exporters, and at least three other operations certified as organic, although only the two large exporters are discussed here. For these two, organic produce comprises only a small part of their total operation: approximately 100 hectares (ha) certified organic, in addition to 25 ha under conversion, and 42 ha certified organic but without infrastructure. Exports are mainly bulk baby leaf salads and fine green beans.

If supermarkets ban the sale of air-freighted organic produce, both exporters said they would abandon organic production and go back to selling only conventional produce. This would result in a decrease in prices for their exports (loss of organic premiums). In the case of fine beans, these lower prices would be partly offset by an increase in productivity and a decrease in the number of workers needed for conventional management. In the case of baby leaf salads, the decrease in prices would not be offset by those same factors (reasons not provided). Both exporters mentioned that, as their ability to supply both conventional and organic produce gave them increased bargaining power; that would be another area in which they would be affected.

A large part (60%) of the investment in infrastructure for organic farming (conversion period, certification, consultancies, and training) would be lost. Lack of cross-pollination of ideas from organic to conventional farming practices (i.e., adoption of some of the methods used in organic farming) was also seen as a potential loss. Losses suffered by contracted farmers would be even higher, as they would experience problems with rotations that would need to include different crops acceptable to local consumers.

Other effects of a ban on air-freighted exports would include those on farm employees (approximately 700), as half the workers at the two establishments would likely lose their jobs. This would particularly affect casual workers who, in Kenya, are often older women. Apart from loss of income, the workers would also lose benefits such as free lunches, medical care, and child care. An estimated six to eight people are dependent on a single worker's wages in Kenya, and that, on average, for each worker employed, another half a person was further employed in support of the original worker's job. Knowledge about sustainable practices in organic agriculture could also be lost, such as knowledge about what to include in the rotations for soil and pest management, and about use of compost. In the words of one of the exporter-growers: "[It] would affect us technologically. It would be like going backwards. Organics is a business that has made us think outside the box. If conventional customers want us to move toward a residue-free product then the technical knowledge will have to come from organics" (Gibbon and Bolwig 2007: 22).

Less direct, down-stream effects were calculated, such as loss of sales within the community of local resources (e.g., straw and animal manure). These losses would have a significant impact on the local informal sector.

Of course, the loss of this sector in Kenya would create opportunities for countries closer to the market, such as northern Africa. However, this example serves to show that a ban based on distance or mode of transport may have unintended consequences.

Product-based studies do not capture the interactions between sectors and countries. A New Zealand paper by Ballingall and Winchester (2008) looks at the impact on importing and exporting countries of a shift in preferences in the UK, France, and Germany towards purchasing produce that has traveled shorter distances. The authors used a general

equilibrium model, where imports are differentiated by country of origin, making New Zealand lamb a unique product, not only in relation to domestic (e.g., UK) lamb, but also in relation to lamb from competing countries, such as Australia. Ballingall and Winchester's paper is innovative in its approach, in that it incorporates a measure of distance traveled into consumer preferences. This enabled the authors to show the likely impact of changing preferences on trade flows.

In importing countries where preferences have shifted in response to the concept of food miles, domestic producers would benefit from higher domestic prices, but the economy would be worse off overall because consumers would be limited in their source of supply. Exporting countries, in this case, New Zealand, would be worse off as a result of lower export prices, while importing countries, such as Japan, that do not have a preference for locally produced goods, would benefit from the lower prices and increased supply of New Zealand lamb. Empirical estimates indicate that the major negative impacts of a preference shift would be on poor, agriculture-dependent exporting countries, such as Malawi, which exports a high percentage of their production to Europe.[7] Countries located further away, such as South Africa, might not be as adversely affected as countries like Malawi, as fewer of South Africa's exports go to Europe. New Zealand could experience losses amounting to $135 million, or 0.3% of GDP, if 80% of European consumers switched to homegrown products. This loss would diminish by two-thirds if European consumers demanded homegrown goods, but were not overly particular about the distance that imported food had traveled. A region that would benefit from a preference shift in Europe is South East Asia. This region as a whole would gain because exports that had gone to Europe in the past would be diverted elsewhere, such as to Japan and Korea, lowering import prices in the region. However, it is possible, indeed likely, that individual countries and specific sectors within South East Asia would be worse off following an effective European food miles campaign. The general equilibrium framework highlights the gains and losses that flow from a shift in preferences.

VII. A BETTER APPROACH

It is reasonable to expect producers, or organizations that serve producers, to encourage the consumption of locally produced goods, even under the pretext of improving the environment or achieving social objectives. On the demand side, the food miles idea is a concept driven by private groups, such as environmental organizations and consumers, rather than by governments. Consumers should be aware, however, that buying locally produced goods may have a detrimental effect on local and global environments (The Observer 2008).

What can governments do? One possibility is for them to provide objective information to consumers and producers about the direct and indirect effects of encouraging the consumption of locally produced food. Rather than merely looking at energy use or emissions resulting from the transport of products to its borders, more comprehensive information should include other inputs such as labor and capital used in the production process (that is, a lifecycle approach), and alternative uses to which these inputs could be put. These factors should also be reflected in the price of goods, with increased scarcity indicated by higher prices. Importing of goods would then occur when exporting countries could deliver goods for a lower price due to a comparative advantage (Vanzetti and Wynen 2002).

To the extent that some inputs (e.g., fuel) are underpriced, or that some emissions are not taken into account (the lack of which therefore distorts the true cost of the product), the

[7] The preference shift is modeled as an 80% loss in New Zealand exports, and lesser losses for other countries depending on distance from market. This is the so-called "iceberg" specification, where the good "melts" with distance (see Hertel, McDougall, and Itakura 2001 for a description of this specification). In the model, any increase in satisfaction consumers may enjoy from knowing they are contributing to improving the environment is not taken into account.

appropriate policy would be to price these factors accordingly. This implies increasing taxes on energy to combat waste, or taxing road-use if congestion, noise, or accidents are an issue. One pertinent example is the tax treatment of aviation fuel. Currently, there is no tax on aviation fuel in Europe or in numerous other countries, as agreed in the 1944 Chicago Convention governing the international airline industry, resulting in aviation not being on equal footing with other transport services (European Commission 2008). Although imposing a fuel tax in the airline industry would contravene existing international agreements and have adverse competitive effects, such inconsistencies do not represent sound policy.

Imposing a fuel tax to compensate for negative externalities, or developing a market for carbon credits, would increase the prices of goods produced with relatively high carbon emissions. Although fuel taxes, carbon credits, food miles, and lifecycle analysis all send the same message to the consumer, that is, that carbon emissions are undesirable, the last two (food miles and lifecycle analysis) rely on the voluntary actions of consumers. With taxes or a carbon market, all consumers are involved as the message is conveyed via the market in which everybody is involved.

VIII. IMPLICATIONS AND CONCLUSIONS

The generally-accepted concept of food miles, while simple to grasp, is flawed because it focuses primarily or exclusively on distance traveled. Even the more sophisticated version, which takes into account energy use and harmful emissions produced during transport, is misleading because reductions in these two factors may be offset by increased energy use and emissions in local production. A lifecycle analysis may address this problem, but still does not incorporate primary inputs such as labor, capital, and other intermediate inputs such as fuel and fertilizer with their polluting effects. Rather than restricting travel, a better approach would be to price all environmentally damaging inputs appropriately.

Where airfreight is concerned, the evidence suggests that air freighted goods may indeed use more energy in production and distribution, although this was not found to be the case with luxury items such as cut flowers (William 2007). However, in other forms of transport (such as shipping), energy use for imports is not necessarily higher than for locally produced goods.

In addition, there is no sound rationale for banning the movement of goods on the basis of energy costs alone—including for environmental damage. Consumers are willing to pay the costs of imported goods because the transport costs are a relatively small share of the total costs. By banning imports (e.g., by denying organic certification to all air-freighted produce) or by espousing consumption of local goods, not only are importing countries reducing the options available to domestic consumers and hurting foreign producers to benefit local producers, but this practice may actually increase pollution. Furthermore, they may effectively be importing pollution that could be better assimilated in less populated regions.

REFERENCES

Ballingall, J. and N. Winchester. 2008. Miles and more: A quantitative assessment of the "food miles" movement. Paper presented at the 11th Annual Conference on Global Economic Analysis: Helsinki, April. Accessed 22 October 2008: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2765.

Bureau of Transportation Statistics. 2008. *Energy Intensity of Class I Railroad Freight Service*. Table 4-25. Accessed 22 October 2008: http://www.bts.gov/publications/national_transportation_statistics/2007/html/table_04_25.html.

Department for Environment, Food and Rural Affairs (DEFRA). 2005. *The Validity of Food Miles as an Indicator of Sustainable Development: Final report*. London: DEFRA. Accessed 22 October 2008: http://statistics.defra.gov.uk/esg/reports/foodmiles/final.pdf.

Economist, The. 2008. Tightening belts. 18 April. Accessed 22 October 2008: http://www.economist.com/business/displaystory.cfm?story_id=11021146.

European Commission. 2008. *Taxation of aircraft fuel*. Accessed 22 October 2008: http://ec.europa.eu/taxation_customs/taxation/excise_duties/energy_products/aircraft_fuel/index_en.htm.

Food and Agriculture Organization of the United Nations (FAO). 2008a. October. The FAO Rice Price Update - October 2008. Accessed 22 October 2008: http://www.fao.org/es/esc/en/15/70/highlight_533.html.

———. 2008b. May. *Food Outlook*. Accessed 22 October 2008: http://www.fao.org/docrep/010/ai466e/ai466e14.htm#328

Gibbon, P. and S. Bolwig. 2007. The economic impact of a ban on imports of air freighted organic products. Paper presented to the UK. International Trade Centre: Geneva. October.

Gillespie, R. 2008. Economics of global warming. Paper presented at the 52nd AARES Annual Conference: Canberra, 6–8 February 2007.

Hertel, T., R. McDougall, and K. Itakura. 2001. GTAP Model Version 6.0. Accessed 22 October 2008: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=576

Jones, A. 2006. A lifecycle analysis of of UK supermarket imported green beans from Kenya. *Fresh Insights No.4. International Institute for Environment and Development:* London, UK. Cited in: Saunders, C., and P. Hayes. 2007. *Air freight transport of fresh fruit and vegetables. Paper* commissioned and published by International Trade Centre: Geneva. 25 October.

Observer, The. 2008. How the myth of food miles hurts the planet. 23 March. Accessed 20 October 2008: http://www.guardian.co.uk/environment/2008/mar/23/food.ethicalliving.

Rubin, J. and B. Tal. 2008. Will Soaring Transport Costs Reverse Globalization? *StrategEcon*. 27 May. Accessed 22 October 2008: http://yaleglobal.yale.edu/about/pdfs/oil.pdf

SAFE Alliance. 1994. *The Food Miles Report: The dangers of long distance food transport*. Available from Sustain. Accessed 20 October 2008: http://www.sustainweb.org/page.php?id=549.

Saunders, C., A. Barber, and G. Taylor. 2006. Food Miles – Comparative Energy/Emissions Performance of New Zealand's Agriculture Industry. *AERU Research Report* 286.

Saunders, C. and P. Hayes. 2007. Air freight transport of fresh fruit and vegetables. Paper commissioned and published by: International Trade Centre: Geneva. October.

Soil Association. 2008. Ensuring limited organic air freight is fair and ethical. Press release. 6 March. Accessed 21 October 2008: http://www.soilassociation.org/web/sa/saweb.nsf/89d058cc4dbeb16d80256a73005a2866/4cd8fffaf33bced18025740400535855!OpenDocument.

United Nations Conference on Trade and Development (UNCTAD). 2008. *UNCTAD Handbook of Statistics 2008*. New York and Geneva: United Nations. Accessed 22 October 2008: http://www.unctad.org/en/docs/tdstat33_en.pdf.

Van Hauwermeiren, A., G. Coene, C. Claes, and E. Mathijs. 2005. Energy lifecycle inputs in food systems: a comparison of local versus mainstream cases. *Journal of Environmental Policy and Planning* 9(1): 31–51. Reported in C. Saunders and P. Hayes. 2007. *Air freight transport of fresh fruit and vegetables.* Paper commissioned and published by International Trade Centre: Geneva. October. p49.

Vanzetti, D. and E. Wynen. 2002. Does it make sense to by locally produced organic produce? In *Economics of Pesticides, Sustainable Food Production and Organic Food Markets*. Edited by D. Hall: Elsevier, Amsterdam. Accessed 21 October 2008: http://www.elspl.com.au/OrgAg/Pubs/Pub-B-MktgTrade/OA-Mktg-B9-Hall-2002.htm.

William, A. 2007. *Comparative Study of Cut Roses for the British Market Produced in Kenya and the Netherlands*. Cranfield University, Bedford. Accessed 22 October 2008*:* http://www.fairflowers.de/fileadmin/flp.de/Redaktion/Dokumente/Studien/Comparative_Study_of_Cut_Roses_Feb_2007.pdf.

Warwick Commission. 2007. *The Multilateral Trade Regime: Which Way Forward?* Coventry: The University of Warwick. Accessed 22 October 2008*:* http://www2.warwick.ac.uk/research/warwickcommission/report/uw_warcomm_tradereport_07.pdf.

World Trade Organization, International Trade Centre, and UNCTAD. 2007. *World Tariff Profiles 2006*. Geneva: WTO. Accessed 22 October 2008*:* http://www.wto.org/english/tratop_e/tariffs_e/tariff_profiles_2006_e/tariff_profiles_2006_e.pdf.