Trade, Food, Diet and Health

Perspectives and Policy Options

Edited by

Corinna Hawkes, Chantal Blouin, Spencer Henson, Nick Drager and Laurette Dubé

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5 International Trade, Food and Diet Costs, and the Global Obesity Epidemic

Adam Drewnowski, Andrew S. Hanks and Trenton G. Smith

5.1 Introduction

In the United States, obesity rates have risen as the American diet has become increasingly energy-rich but nutrient-poor (Drewnowski & Specter 2004). Energy-dense diets, rich in added sugars and fats, are far more affordable (per unit of energy) than diets composed of whole grains, lean meats, fish, low-fat dairy products, and fresh vegetables and fruit (Drewnowski & Darmon 2005a). Energy-dense diets also taste good and are readily available and convenient. Inexpensive starches, fats and sweets may represent the only viable food option for low-income consumers. As a result, more people consume energy-dense diets, especially in lower income groups (Drewnowski & Darmon 2005b). The low energy cost of the diet ($/1,000 kcal) rather than the consumption of fast foods, sweets or desserts per se, may thus be the most powerful predictor of weight gain (Drewnowski 2007).

Population groups with low education and income, some racial and ethnic minorities, and high-poverty areas suffer from higher rates of obesity and its metabolic complications (Drewnowski & Specter 2004). Overlapping maps of poverty and obesity by geographic location clearly demonstrate that obesity in America is, for the most part, an economic issue (Drewnowski 2007). Historically, obesity in developing countries has also followed a socioeconomic gradient, but with greater obesity among wealthier groups (Nguyen *et al.* 2007; Sobal & Stunkard 1989). It was initially described as a 'disease of affluence', with the highest prevalence observed among the better-educated urban dwellers (Monteiro *et al.* 2004). In recent years, as gross national product (GNP) has increased, the distribution of obesity in developing countries has shifted towards lower socioeconomic groups, particularly in those characterised by large agglomerates of urban poor (Drewnowski & Popkin 1997). The shift towards obesity in lower income women has typically occurred at earlier stages of economic development than it did for men. In a number of developing countries, obesity is rapidly becoming the problem of women and the urban poor (Aguirre 2000; Monteiro *et al.* 1995, 2004).

These rising obesity rates in the developing world have been linked to the 'nutrition transition', the replacement of traditional plant-based diets with more sugars and vegetable and animal fats (see Chapters 1 and 3) (Drewnowski & Popkin 1997; Popkin 1994). It seems likely that this wave of cheap fats and sugars has propelled the growth of obesity in developing countries by lowering the cost of energy-dense

diets (Monteiro *et al.* 2004). International trade has likely contributed to this process by lowering the economic costs of food and diets. As a result, a diet high in energy and low in nutrition becomes more affordable and/or attractive relative to a diet that is more nutritious.

This chapter sets out a series of propositions that link economic theory with current public health findings regarding increasing obesity rates. The first proposition is that international trade lowers food and diet costs; second, that energy-dense foods and diets cost less relative to nutrient-rich foods and diets; third, that consumption of energy-dense foods and diets increases as income declines and, therefore, low-cost, energy-dense diets may contribute to overeating by the poor; and finally, that the recent significant increases in global food prices may increase the likelihood that poor consumers will purchase energy-dense diets, thus further contributing to the growth of obesity in the developing world.

5.2 Proposition 1: World trade has reduced the relative cost of dietary energy

World trade has influenced the cost of energy dense foods. While trade is rightly credited with allowing the more efficient production of goods and services, it has also affected changes in economic organisation that have reliably driven consumers towards the purchase of energy-dense processed foods. This phenomenon is perhaps best viewed from the perspective of the economist's conception of consumer choice. When a consumer chooses foods, he or she is constrained by the scarcity of money (needed to purchase food), of time (to obtain, prepare and eat meals), and of information (about cooking, availability of food products and the various effects of particular foods on health outcomes such as obesity) (Box 5.1). These

Box 5.1 Constraints on dietary choice.

Material

- Food prices (energy-dense versus nutrient-rich)
- Availability
- Household income

Time

- Paid labour
- Shopping
- Food preparation

Information

- Cultural knowledge of foods and food preparation
- Nutrition education
- Local price and availability

constraints are inextricably linked in a market economy, since time spent on cooking or obtaining knowledge is necessarily time that cannot be devoted to earning a wage (hence the economist's phrase 'opportunity cost of time') or other necessary or desirable activities. Any change in the relative cost (or price) of one of these items might, therefore, be expected to induce changes in (i.e. substitution either towards or away from) consumption of the others.

Trade-driven factors have reduced the relative cost of dietary energy in the developing world. Four particularly critical factors have been: (i) the dramatic expansion of trade in the inputs to processed energy-dense foods (refined grains, sugar cane and corn sweeteners, and vegetable oils), (ii) urbanisation, (iii) foreign direct investment and (iv) rising household incomes (factors that are also discussed in Chapters 3, 4, 6, 9 and 11).

The most direct effect of international trade on food and diet is probably via the stimulation of technological innovation and production of vegetable oils and sugars. Major economic and political initiatives led to the development of oil crops not only in Europe and the United States, but also in Southeast Asia (palm oils) and in Brazil and Argentina (soya bean oils) (as also discussed in Chapter 3). The production and export of inexpensive vegetable oils were promoted through direct subsidies, credit guarantees, food aid and market development programmes. As shown in Figure 5.1, global availability of corn, palm, palm kernel, rapeseed, soya bean and sunflower oil surpassed 100 million tons by 2005, more than twice the amount produced in 1991 and more than 13 times world production in 1961.

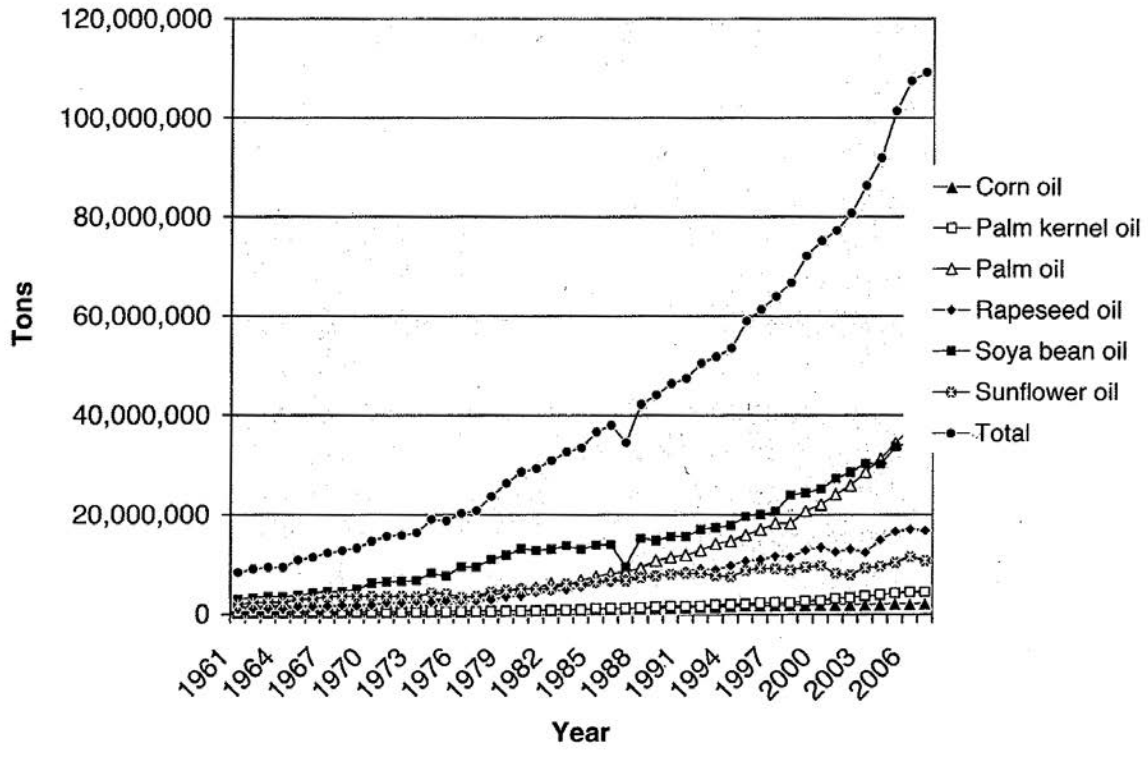

Figure 5.1 World production of vegetable oils, 1971–2007. *Source*: Data from FAOSTATS (Retrieved 10 March 2009 from http://faostat.fao.org/site/636/DesktopDefault.aspx?PageID=636#ancor).

While much of the growth before 1990 was attributable to soya bean oil, in recent years, palm oil production – driven in part by the health-motivated move away from hydrogenated oils – has risen dramatically and now exceeds that of soya bean (Figure 5.1).

Technological advances in oilcrop yields and refining practices have greatly reduced the price of vegetable oils relative to meat or fresh produce. Technological breakthroughs in the development of high-yield oilseeds and in the refinement of high-quality vegetable oils have further helped reduce the cost of baking and frying fats, margarine, spreads, and salad and cooking oils. As a result, vegetable oils have altered the global food supply, becoming widely available to countries in the early stages of economic development (Drewnowski & Popkin 1997).

Global production of caloric sweeteners and their export (primarily by Brazil) has also increased over the past several decades. Sugars, derived from cane, corn and sugar beet, account for a progressively higher percentage of energy in the global diet. Until recently, the world price of raw and refined sugar had shown a steady decline and, according to some analyses of food balance data, sweetener consumption by lower income nations has increased the most (Popkin 1994). As a result of these changes, even the lowest income countries now have access to additional caloric sweeteners and vegetable fats.

Trade in vegetable oils and sugar has also increased dramatically in recent years, mainly due to the increase in imports of palm oil (for more detail, see Chapter 3). Figure 5.2 shows world trade in oilseeds; and while reliable trade data for caloric sweeteners is not readily available, Brazil's recent experience is informative: between 1990 and 2005, exports of refined sugar increased tenfold (FAOSTAT 2009). Increased trade in the agricultural commodities that serve as feedstocks for energy-dense processed foods does not necessarily speak to the key issues of price and availability, but it does underscore the magnitude of the profound changes taking place in food systems around the world.

A second trade-related factor that reduces the cost of energy-dense diets is urbanisation. At the most fundamental level, trade between countries is advantageous because it allows for specialisation in productive activity. In practice, this typically means the employment of unskilled labour increasingly moves from agriculture to manufacturing – which in turn implies migration of workers from rural to urban areas. Urban growth now dominates most low-income countries, leading to vast urban conglomerates. These cities of 5–27 million are growing much faster in the less developed than more developed regions of the world. The most explosive growth of mega-cities has been in Asia.

Physical access to healthy foods is limited in poor urban areas. The relation between urbanisation and dietary quality should not be surprising. New immigrants to urban areas are not only physically removed from their rural culture and food traditions (exposed, instead, to advertisements for brand-name foods), but they are also likely to be faced with dramatically different relative food prices. Compared to prepackaged processed foods, delivering fresh produce to urban populations will always be at a significant cost disadvantage on at least three counts: production is necessarily more dispersed, which implies higher transportation costs; it is subject

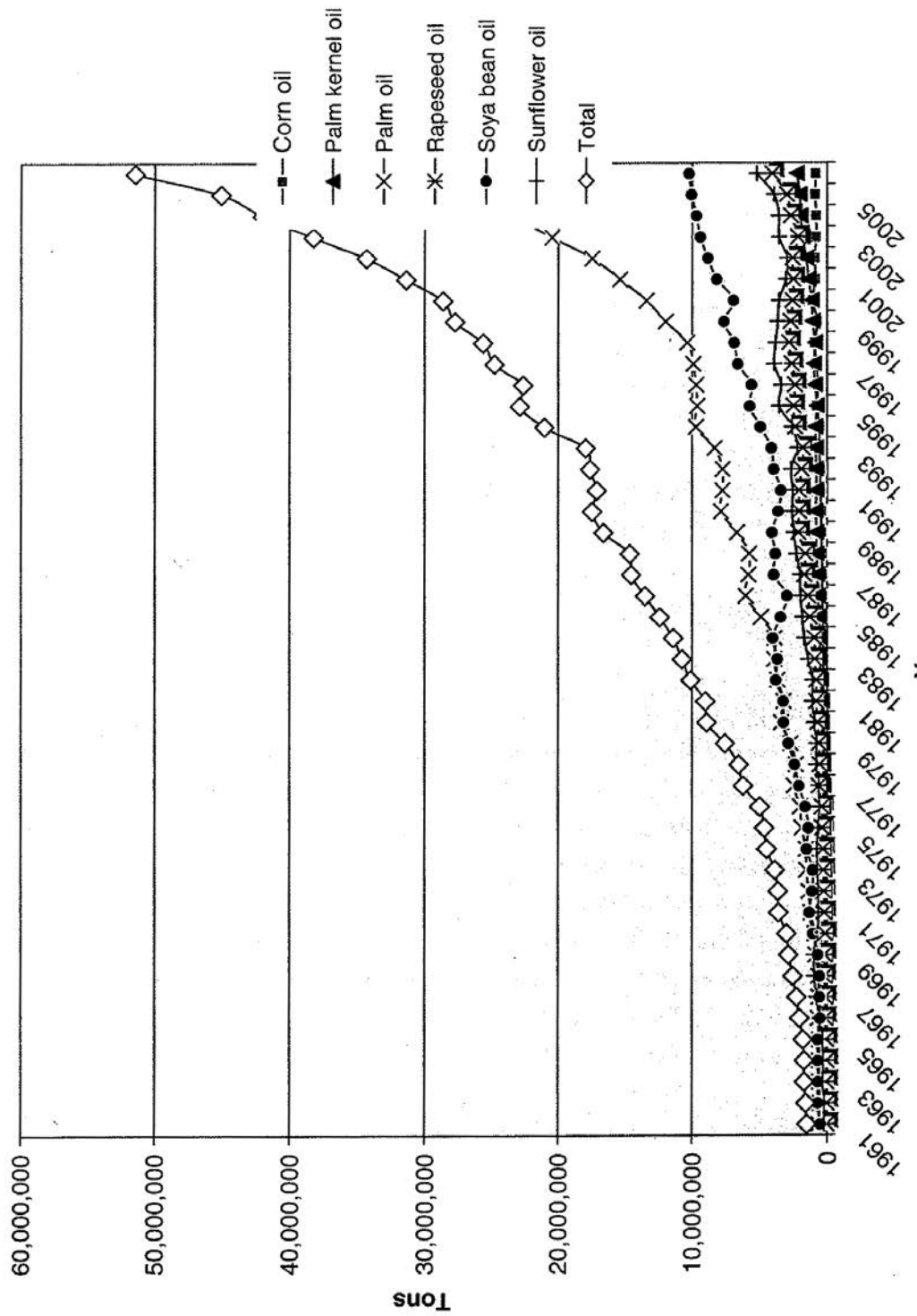

Figure 5.2 World trade in vegetable oils, 1961–2006 (imports). *Source*: Data from FAOSTATS (Retrieved 10 March 2009 from http://faostat.fao.org/site/535/DesktopDefault.aspx?PageID=535#ancor).

to spoilage (and may require refrigeration en route); and it weighs as much as ten times more per calorie.

Urbanisation has a profound effect on diet composition. Analyses of Food and Agriculture Organization (FAO) food balance sheets and World Bank economic indicators data for 1990 simulated the impact of urbanisation on the proportion of sugars energy in the diet (Drewnowski & Popkin 1997). The simulation predicted a significant increase in sugars consumption, especially in low-income countries. Since then, other studies have explored the consumption of caloric sweeteners by the urban poor, with particularly persuasive data obtained from Brazil (Monteiro *et al.* 1995). As predicted in 1997 by Drewnowski and Popkin, increased urbanisation of lower income nations is accelerating the shift towards increased consumption of sweeteners and fats.

A third key trade-related factor is foreign direct investment (FDI) inflows. It has been suggested that FDI into food processing increases the availability and lowers the cost of highly processed foods (Hawkes, 2005; also discussed in Chapter 3). A simple data analysis of FDI and a processed food index suggests that FDI promotes processed food consumption. Using consumption data from the UN's FAO, the index is composed of the ratio of consumption of the three primary feedstocks of processed foods: corn, soya beans and sugar crops (fraction of total calories in the diet) to consumption of fruits and vegetables (again, as a fraction of calories in the diet) for 1990–2005. The index can thus be conceptualised as:

$$\text{PFI} = \frac{\%\ \text{corn} + \%\ \text{soybeans} + \%\ \text{sugar crops}}{\%\ \text{fruits and vegetables}}$$

A simple bivariate linear regression indicates a positive association between changes in this processed food index (PFI) and changes in FDI inflows (Figure 5.3). Although the FDI data are not specific to the food processing or food production industries, the association is consistent with trade-induced changes in local food production systems.

Fourth, trade liberalisation has stimulated economic growth in developing countries, leading to rising incomes. It is an unfortunate irony that success in this regard has been accompanied by the displacement of traditional food cultures in favour

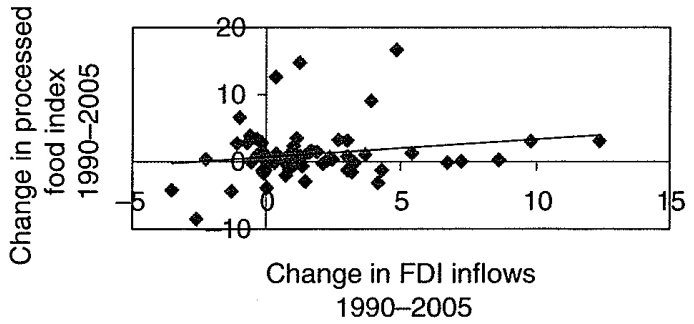

Figure 5.3 Relationship between foreign direct investment into low-, middle-income countries (1990–2005) and index of processed food consumption. Source: Data from FAOSTATS (Retrieved 13 September 2007 from http://faostat.fao.org/site/609/default.aspx#ancor) and from World Bank (2007).

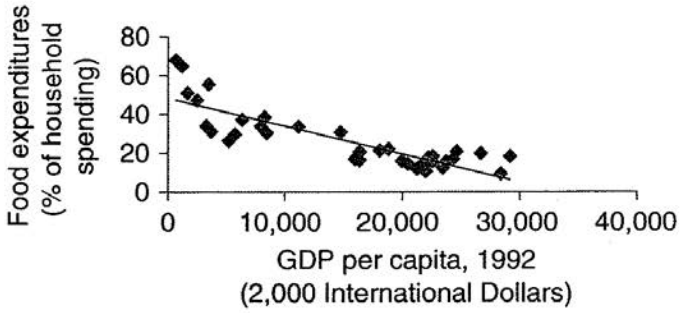

Figure 5.4 Relation between per capita GDP and percent income spent on food, 1992–2005. *Source*: Meade and Rosen (1996) and Euromonitor International (1992–2005).

of energy-dense processed foods. Indeed, one of the most reliable trends over the past several decades has been the sustained realisation of what is known as 'Engel's law', the principle that the share of income spent on food decreases as incomes rise. Figure 5.4 shows that as per capita real GDP increases among various countries (36 countries in 1992 and 60 in 2005, to be exact) between 1992 and 2005, the percentage of disposable income spent on food declines. Again, as incomes have risen, the relative cost of food has fallen – although it is important to note that, in 2005, many households in the poorest countries still spent more than 40% of income on food.

5.3 Proposition 2: Energy-dense foods and diets cost less; nutrient-dense foods and diets cost more

Studies on the relative cost of dietary energy have a long and distinguished history (Atwater 1894; Boyd Orr 1937). Studies conducted by W.O. Atwater, the founder of nutrition research at the United States Department of Agriculture (USDA), examined the relative cost of protein from different food sources. A contemporary re-analysis (Drewnowski 2004) showed that wheat flour, dried beans, white bread and cheese were more energy-dense and cost less per megajoule (MJ) of dietary energy than did either seafood (oysters) or fresh fruit (oranges). Even based on 1887 food prices, there was a negative relation between energy density (energy per unit weight) and energy cost (retail cost per unit energy).

The relation between energy density (MJ/kg) and energy cost ($/MJ) is by now well established. Figure 5.5 shows the relation between foods' energy density and energy cost ($/MJ) based on 2006 prices in Seattle supermarkets (Monsivais & Drewnowski 2007). Fats and oils, sugar, refined grains, potatoes and beans provided lowest-cost dietary energy. Energy cost of vegetable oils and sugars was less than $1/MJ, whereas the cost of fresh produce was ten times as much. The energy cost of sweetened beverages was much lower that the cost of fruit juices or fresh fruit. The differential in energy costs between lard and lettuce was several thousand per cent. The same results have been obtained using 2000 food prices in France (Drewnowski & Darmon 2005a, 2005b). Again, refined grains, added sugars and

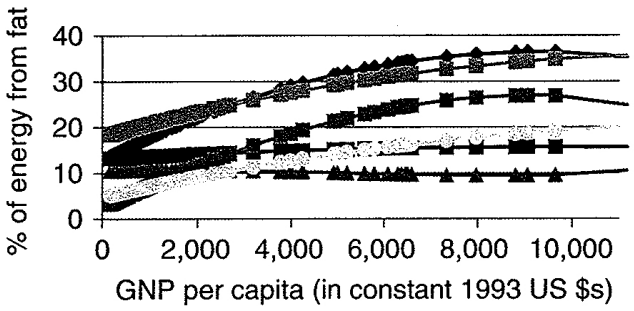

Figure 5.5 Relationship between energy density (kcal/100 g) and energy costs. *Source*: Based on data from the city of Seattle, Washington, United States (Monsivais & Drewnowski 2007).

fats were the lowest cost sources of dietary energy, whereas the more nutrient dense foods were associated with higher energy costs per MJ.

If healthier foods cost more per unit energy, then so must healthier diets. Observational studies relating dietary energy density to energy costs have come to two principal conclusions. First, lower energy density is associated with higher energy costs. This was first shown in a study of French adults, with diet costs estimated using mean national food prices for 57 index foods provided by the French National Institute of Statistics (INSEE) (Darmon *et al.* 2004). Dietary energy density (MJ/kg) was obtained by dividing energy intakes by the estimated edible weight of all foods and caloric beverages consumed. Participants were split by quintiles of energy intake (MJ/day) and the relationship between dietary energy density and diet costs was assessed separately for each quintile. Figure 5.6 shows that, at each quintile of energy intake, energy-dense diets cost less (€/day) than low energy density diets. Selecting an energy-dense diet was, in other words, an effective strategy to save money.

Higher nutrient density (an index of diet quality) is also associated with higher energy costs. Among UK women, diet quality, as measured by an index of fruit and vegetable intakes, has been associated with higher diet costs (Cade *et al.* 1999). A study of French adults showed that higher fruit and vegetables intakes were associated with higher diet costs, after adjusting for energy (Drewnowski *et al.* 2004). Another study of French adults showed that energy density and nutrient

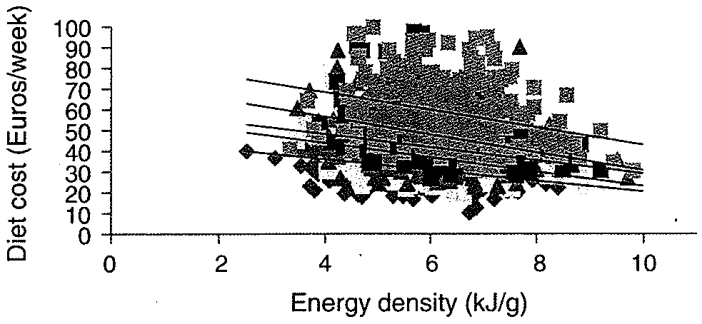

Figure 5.6 At each intake quintile, higher energy density–lower cost (€/week). *Source*: INCA Data (Darmon & Drewnowski 2008).

density each had independent effects of diet cost. The nutrient content of the diet (i.e. dietary quality) contributed substantially to diet costs. As a result, the lowest cost diets were energy dense but nutrient poor. They were also associated with the highest energy intakes overall.

5.4 Proposition 3: Consumption of energy-dense foods and energy-dense diets increases as incomes decline

As shown in Figure 5.4, the share of income spent on food decreases as incomes rise. The drop in food spending is disproportionately greater than the drop in spending on other goods. In the United States, the average American spends approximately 7% of disposable income on food consumed at home and another 4% on foods consumed away from home, the lowest such percentage in the world (Drewnowski 2004). Mean per capita expenditure on foods and beverages (including alcohol) has been estimated at under $8/day, with some families spending no more than $4/day. However, the proportion of disposable income devoted to food can reach 25–30% for lowest income families (Drewnowski 2004).

In United States, evidence is accumulating that lower income families preferentially select lower cost but more energy-dense diets. Added sugars and fats now account for close to 40% of daily energy intakes (Drewnowski & Darmon 2005b). Time trend analyses suggest that average diet composition has moved – presumably driven by changes in production technology, income distribution and relative prices – towards more lower cost foods. Data show that there has been a 300-kcal increase in daily energy intakes between 1985 and 2000 in the United States (Drewnowski 2004). This increase was largely due to refined grains, added sugars and added fats. Second, the consumption of fruits and vegetables has not kept pace, with trends pointing to the lower cost options. In 2000, half of total fruit servings in the United States were accounted for by low-cost orange juice, bananas, apple juice, fresh apples, fresh grapes and watermelon. Low-cost potatoes (fresh, frozen and potato chips), canned tomatoes and iceberg lettuce accounted for 48% of total vegetable servings. The consumption of more nutrient-rich (and more costly) leafy green vegetables was of only 0.2 servings per day, with deep yellow vegetables adding another 0.2 servings (Drewnowski 2004).

Lower income families economise by buying low-cost vegetables and fruit, cheaper cuts of meat and more cereals, added sugars and added fats. They also buy more meals at fast-food restaurants. Meals away from home tend to have a higher content of added fats, sugars and sodium than meals at home. The American diet has thus become more energy-dense and there are growing concerns that it is also becoming nutrient-poor. A recent review of the literature linked diet quality with incomes and social class (Darmon & Drewnowski 2008). Based on data largely collected outside the United States, the review concluded that certain foods acted as social class indicators. Thus, the consumption of whole grains, lean meats, fish, and fresh vegetables and fruit was associated with income.

The present theory suggests that low-income families struggling to buy food in the face of severe budgetary constraints would be driven towards more energy-dense foods. This suggests that energy-dense foods meet the economist's definition of *inferior* goods. A consumption good is inferior when its use decreases with increasing income. As discussed below, this observation could exacerbate the public health problems stemming from consumption of energy-dense diets.

5.5 Proposition 4: Low-cost, energy-dense diets contribute to obesity among the poor

The observed links between eating habits and rising obesity rates appear to be mediated by low-cost energy-dense diets and the economics of food choice. Economic studies have linked rising obesity rates in the United States to the lower cost of all foods and the increasing cost of physical activity relative to other goods (Chou *et al.* 2004; Cutler & Shapiro 2003). These analyses, however, have not examined the related problem of disparities by socioeconomic strata. Obesity rates are not equally distributed across all segments of American society; not all foods have dropped in price by the same amount; and diet quality and diet cost may show sharp variations by social class (Darmon & Drewnowski 2008).

In reality, the burden of obesity falls disproportionately on population subgroups with the most limited economic means. Paradoxically, following Engel's law, groups at most risk for obesity spend the *largest* proportion of disposable income on food. Whereas the affluent lean may spend no more than 7% of income on food, the obese poor spend in excess of 25%, this according to data from the Bureau of Labour Statistics. For the poor, the only way to meet daily caloric needs might be through the purchase of nutrient-poor, energy-dense processed foods (Darmon *et al.* 2002).

The preferential consumption of energy-dense foods and energy-dense diets may have metabolic consequences. Experimental and clinical studies have shown that energy density of foods, coupled with larger portion sizes, can cause overeating. The energy-dense diets were high in fats and sweets, whereas the low-energy density diets contained more low-fat dairy products, vegetables and fruit. In other words, there may be physiological and economic reasons why low-cost, energy-dense diets are associated with overeating and weight gain.

Numerous studies have linked the rising rates of obesity in the United States to growing consumption of fast foods, snacks, caloric beverages, sweets and desserts. These observations are consistent with a single parsimonious explanation: obesity is caused by the consumption of low-cost energy-dense processed foods (Drewnowski 2007). Paradoxically, reducing food expenditures may raise energy intakes (perhaps via differential effects on satiety) as consumers spend less and eat more (Drewnowski & Specter 2004). In today's America, the poor are obese and the rich are thin (Aguirre 2000) and there is good reason to believe that as the developing world becomes more and more linked (by trade) to the world economy and traditional food systems are displaced by manufactured energy-dense foods, that the rest of the world will soon suffer the same fate.

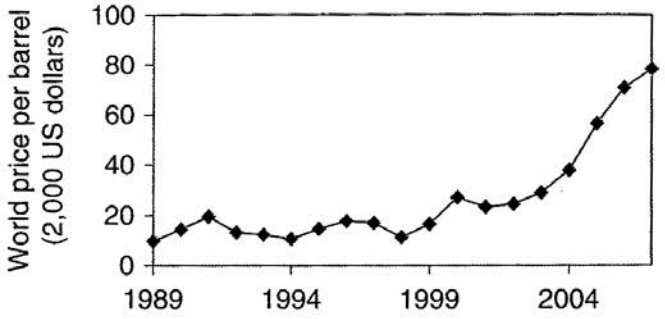

Figure 5.7 The rising price of crude oil, 1989–2007. *Source*: Data from U.S. Energy Information Administration (2007).

5.6 Proposition 5: Rising global food prices could paradoxically lead to increasing global obesity rates

Refined grains, vegetable oils and sugars (both cane and corn) have experienced unprecedented price volatility over the past few years. The rising price of crude oil depicted in Figure 5.7 has had a profound impact on food prices. The real prices for most agricultural commodities have risen dramatically since 2006, as shown in Figure 5.8 for vegetable oils in the United States.

One view (Severson 2008) is that such price increases represent good news for public health since global obesity rates are likely to decline. That view is not only profoundly elitist (implying that semi-starvation is somehow better than obesity) but is also likely to be incorrect. Rather, economic theory suggests that faced with scarcity and rising costs, people might well consume *more* energy-dense foods and diets. The reason for this is as follows.

First, commodities such as soya bean oil and refined sugar are primary feedstocks for the production of processed foods and energy (especially liquid petroleum-based fuel) is an important input to the production and shipment of processed foods. As such, it could be assumed that the prices of processed foods would *rise* as a result of the recent developments. Yet, when the price of a particular good rises, economic theory holds that two distinct effects follow. First, consumers of the good will tend to shift away from the more expensive product and towards less expensive substitutes (the *substitution* effect). Such a consumer also finds himself or herself (from the perspective of his or her pre-price-increase consumption bundle) with

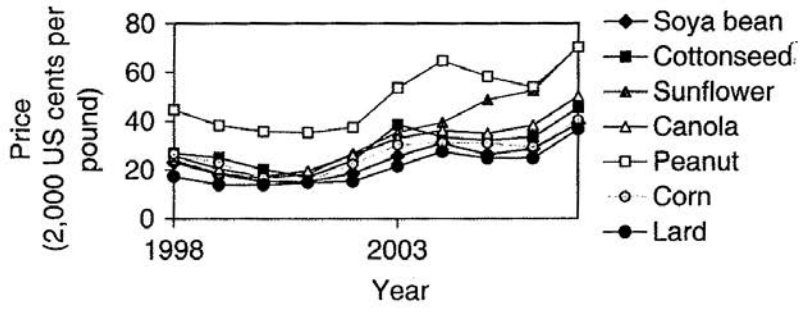

Figure 5.8 US prices of vegetable oils, 1998–2007. *Source*: U.S. Department of Agriculture (2007).

less money to spend. He or she therefore must re-allocate all expenditures, just as he or she would if his or her income had fallen. This re-allocation (known as the *income* effect) might include either an increase or a decrease in consumption of the good whose price had risen. If the latter holds (i.e. consumption rises with rising income), then the income and substitution effects work in the same direction, and a price increase unambiguously results in decreased consumption. If consumption falls with rising income (in which case the good in question is known as an *inferior* good), it is possible that an increase in price could (as long as the income effect dominates) result in *increased* consumption (assuming, of course, that only the price of the good in question changes). Goods for which demand rises in response to increases in price are known in economic theory as 'Giffen goods'.

Instances of such 'upward-sloping demand' (i.e. Giffen goods) are exceedingly rare in the modern world, because the conditions necessary to meet them are extreme: a low-quality (inferior) good, for which high-quality substitutes are also consumed and which must constitute a large fraction of household expenditures. There is one real-world situation, however, in which Giffen behaviour seems likely: the purchase of energy-dense foods by poor families in the developing world. As put in the original text explaining the economic theory: 'As Mr. Giffen has pointed out, a rise in the price of bread makes so large a drain on the resources of the poorer labouring families and raises so much the marginal utility of money to them, that they are forced to curtail their consumption of meat and the more expensive farinaceous foods: and, bread being still the cheapest food which they can get and will take, they consume more, and not less of it' (Marshall 1895: 208).

As noted above, there is ample evidence that energy-dense foods are inferior goods for the low-income household. For poor families, such foods constitute large proportions of household income. Deaton and Subramanian (1996), for instance, find that the poorest households in Maharashtra, India, spend an average of 20% of their income on (and get 53% of daily calories from) sorghum; Jensen and Miller (2007) find similar patterns in China for rice in the Hunan province and for wheat in the Gansu province, and even present experimental evidence of Giffen behaviour for these goods.

If this conjecture about the dominance of income effects is correct, the rising world prices of grains, sugars and fats may paradoxically serve to *aggravate* the global obesity epidemic, as well as contributing to political instability and social unrest.

5.7 Conclusions

International trade lowers the relative costs of energy-dense foods and diets. Consuming these diets leads to obesity and groups of lower socioeconomic status are more likely to consume them. Thus, the rising prevalence of obesity among lower income people in developing countries can be partly explained by the decreasing costs of energy-dense diets. This evidence-based proposition adds to the argument that international trade has a profound influence on diet quality and, therefore, global health.

Dietary shifts that occur as a function of economic growth and development have been characterised previously as the nutrition transition (Popkin 1994). Developing nations undergoing the nutrition transition replace their traditional plant-based diets with more animal protein, sugar and animal fat. The optimistic view was that the next stage of the nutrition transition would lead to diets with more whole grains, lean meats, vegetables and fruit, and to more leisure time and increased physical activity (Popkin 1994).

However, the world economic situation is less ideal than previously hoped, and those projections of future global health and happiness may have been overly optimistic. Instead, globalisation and world trade have made societies dependent on low-cost, energy-dense foods – and none more so than the urban poor. Added sugars and vegetable fats reduce energy cost ($/MJ) of the global diet, while increasing its energy density (MJ/kg). Whereas the nutrition transition used to be based on the dietary shift from plant to animal foods, the new 'post-industrial' version of the nutrition transition is based around low cost refined grains, added sugars and fats. Foreign direct investment and world trade may have also opened the door to diets of low cost processed foods, largely based on commodity crops: soya bean, corn and sugar crops.

The increase in fuel and food prices means that these nations will be in a difficult situation. One view (Severson 2008) is that obesity rates will decline. The conclusion arrived at here is far more pessimistic. Energy-dense foods seem to meet all the criteria for Giffen goods for low-income households. In the face of global scarcity of foods, low-income household consumption of energy-dense foods will likely increase even as prices rise. By that time, as their prices rise, meat, fruits and vegetables will be out of reach.

The question of the effects of recent market developments on dietary quality should be considered an urgent research question. The current geopolitical and economic trends are already disturbing the world food supply. One undesirable potential consequence has been a rise in staple food prices attended by political and economic unrest. Another may well be even more obesity in the developing world.

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