Linking agricultural policies with obesity and noncommunicable diseases: A new perspective for a globalising world

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A B S T R A C T

In light of the shift in policy paradigm in agriculture from state intervention to market liberalisation and globalisation, this paper develops a series of hypotheses on the relationship between agricultural policies and consumer diets. The first hypothesis is that the paradigm shift has led to greater specialisation of production, so changing the ability and incentive for producers to supply certain foods relative to others. Second, the shift has affected farmgate prices (both up and down), so creating opportunities for the industries which purchase farm commodities (the food consuming industries – FCIs) to substitute lower priced ingredients, thereby influencing the nutritional quality and content of foods available in the marketplace. Third, it has increased the ability of the FCIs to “add value” through product innovation and marketing, creating a market characterised by highly differentiated products targeted to individualised preferences, thus increasing the acceptability of a wider variety and quantity of food products. The changing agricultural policy paradigm has therefore altered the environment in which consumers make their food choices, in the form of food availability, affordability and acceptability. Nevertheless, the paper finds no clear pattern when it comes to health; the changes have affected both “unhealthy” and “healthy” foods and ingredients. The key process of importance for health, then, is not whether the “ingredients” produced by agriculture are healthy or not, but how they are substituted, transformed, distributed and marketed through the supply chain (e.g. vegetable oils into transfats).

This leads to an important implication: that policies to intervene directly in agricultural production to promote healthy eating are unlikely to be effective or efficient if they do not take into account how foods are processed, distributed and marketed through the supply chain. In practice, this means that the potential for policy interventions in agriculture to improve diets is limited – but nevertheless potentially important where it exists given the upstream nature of the change. Incentives could be created for the FCIs to substitute “healthier” ingredients in their products, and/or to sell more of them, in instances where these changes can be passed all the way to the consumer. Greater investment could also be made in fruit and vegetable production for local markets. Third, it has increased the ability of the FCIs to “add value” through product innovation and marketing, creating a market characterised by highly differentiated products targeted to individualised preferences, thus increasing the acceptability of a wider variety and quantity of food products.

Along with testing the hypotheses established in this paper, the research priority should to identify the incentives that influence the products produced by the FCIs, with the objective of finding those most amenable to leveraging the supply chain towards healthier eating.

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Introduction

It is now established that the burden of diet-related ill-health is a serious global public health problem. Analysis by the World Health Organization (WHO) suggests that five diet-related risk factors – high blood pressure, high blood glucose, overweight/obesity, high cholesterol, low fruit/vegetable intake – are, combined with lack of exercise, responsible for 19% of all global deaths and 57% of deaths due to heart disease, the world’s leading cause of death. The majority of deaths attributable to these risk factors are found in low- and middle-income countries (WHO, 2009). Diets high in fats, especially saturated fats and trans-fatty acids, free sugars and salt, and low in fruits, vegetables, pulses, whole grains, and nuts have been identified as a significant risks for these “non-communicable” diseases (NCDs) (WHO/FAO, 2003). Such diets are becoming more prevalent across the globe, as are overweight and obesity.

Many theories have been proposed on the factors responsible for dietary change, from globalisation to lack of personal responsibility. One hypothesis is that agricultural policies (Box 1) have...
encouraged the adoption of these diets (Lock, 2004; Nugent, 2004; Hawkes, 2007; Wallinga, 2010). In the United States, it has been argued that agricultural subsidies have led to greater supply and use of corn and oilseed derivatives in energy-dense processed foods and soft drinks, and in Europe that the Common Agricultural Policy (CAP) has boosted intake of saturated fats and reduced fruit and vegetable consumption (Fields, 2004; Pollan, 2003; Tiltotson, 2004; Schoonover and Muller, 2006; Lloyd-Williams et al., 2008; Schafer Elinder et al., 2003). Not all agree, though: other studies suggest that the effect of these agricultural policies is negligible owing to the weak relationship between farmgate prices and retail prices (Alston et al., 2008; Miller and Coble, 2007; Schmidhuber and Shetty, 2010; Veerman et al., 2006; LaFrance, 1999; Rickard et al., 2011).

Box 1. Definition of agricultural policy and food policy for the purposes of this paper. Source: Definition of food policy, derived from Lang et al. (2009); definition of agricultural policies, the authors.

Agricultural policies refer to the political economic processes put into place to achieve agricultural goals, such as food production, income generation and rural development. They include trade and investment policies that affect food.

Food policies refer to the policies that shape who eats what, when and how. The remit of food policy is broad, and include agricultural policies as well as those that affect the whole food supply chain.

These studies to date have been largely concerned with policies of state intervention in agriculture. Yet the global growth of obesity, and of NCDs in the developing world, has taken place during a paradigm shift in agricultural policies – away from state intervention towards market liberalisation and “globalisation”.

In light of the emergence of this paradigm change, this paper takes a new look at the relationship between agricultural policies and diet. The objective is to develop a hypothesis about the relationship between agricultural policies and consumer diets, and the implications for food policies to address obesity and diet. The remit of food policy is broad, and include agricultural policies as well as those that affect the whole food supply chain.

The paradigm shift in agricultural policy: 1930s/1970s to 1980s/2010s

A paradigm based on state intervention which explicitly adopts regulatory and fiscal measures to achieve agricultural goals (including food supply, income generation, environmental protection and rural development) has been described in many countries during the last century. The stimuli were the depression-induced farm crisis in the United States, food shortages in war-torn Europe, and an under-performing agricultural sector in the decolonising “third” world (Lang and Heasman, 2004). In the United States, what were to become huge “commodity” programs were initiated by the 1933 Agricultural Adjustment Act; in Europe, the CAP was established in 1957 to protect and promote food production and rural development. In the eastern bloc, food production, distribution, price and trade were generally organised in a nationalised system of state and collective farms and state monopolies (Osborne and Trueblood, 2002). In most developing and industrialising countries, the state intervened in agriculture using different policy tools: low food price policies, income and land taxes on agricultural producers; and systems to control the supply and marketing of key commodities (e.g. through state marketing boards) (Krueger et al., 1991; Anderson, 2006; Khan, 2001; World Bank, 2007; Chang, 2009; van der Laan and van Haaren, 1990; Delgado, 1995; Rashid et al., 2008). In both developed and developing countries, public investments were made in agricultural research and technology, such as the Green Revolution beginning in Mexico in the early 1940s, and intensive meat production in the United States (Adelman and Taylor, 1990; Roberts, 2009).

Though these policies varied considerably between and within regions, the paradigm in common was that countries/regions should increase their output, to either feed themselves completely (“self-sufficiency”), or raise production dramatically and avoid the collapsed markets of the 1930s. This would then provide “cheap” food for the urban workforce to enable wages to remain low, thus fuelling urban-industrial growth (Mazoyer and Roudart, 2006).

On its own terms, state intervention was successful in many places. Production soared in the United States and Europe, and the cities were well-fed. Surpluses were created, enabling these regions to become (supported by policies like export subsidies) huge exporters. In Latin America and Asia, agricultural growth rates exceeded population growth. In the then Soviet Union, there was a huge increase in the production of animal source foods (Osborne and Trueblood, 2002). However, per capita food output in Africa declined (Aziz, 1990) and overall production growth in developing nations was not as fast as developed nations. By the late 1970s, despite having 75% of the world’s population, developing countries contributed less than half of the total world cereal production, and export growth was far exceeded by developed countries (Paulino, 1988). Importantly, too, malnutrition remained rampant, with some devastating famines in developing nations in the early 1970s. In 1976, the Food and Agriculture Organization of the United Nations (FAO)-hosted World Food Conference reemphasised the importance of agricultural production in order that “no child should go to bed hungry within a decade” (Associated Press, 1974).

In this context, the international financial institutions raised concerns that state intervention in agriculture was reducing incentives for productivity growth and creating economic inefficiencies (Krueger et al., 1991). More broadly, they were concerned that nationally-oriented state intervention in general was imposing spatial limits on the potential for economic growth, and was inefficient, overbureaucratic and/or corrupt (McMichael, 2004). The international financial institutions subsequently embraced a set of economic development policies known as “the Washington consensus” (Williamson, 2004), in which the free flow of market forces were seen as key to national and global economic development. Advocated by several key national governments, the new model implied a shift from inward-oriented to outward-oriented national economies in which – for agriculture – food could freely flow through the market, with each country specialising where it had “comparative advantage.” The idea was that reducing or eliminating state control over agriculture would promote private-sector activity and foster competitive markets, in turn leading to increased agricultural yields and a more flexible, globally efficient food system with lower production costs.

Two main policy processes put the new model into action on an international scale. The first were the World Bank and International Monetary Fund (IMF) “structural adjustment programs” of the 1980s, in which developing countries received loans to ease
balance of payments problems on condition of policy reform. Such policies were also implemented unilaterally. Reform of agri-food markets was very much part of the process. Countries throughout Africa, Asia and Latin America took steps to open up their food markets by dismantling state food marketing monopolies, reducing subsidies on agricultural inputs, lowering barriers to trade and investment, reducing consumer food subsidies, and aligning domestic producer prices with their equivalent world prices (Kherrallah et al., 2000; Byerlee and Sain, 1991; Valdes, 2006).

The second key policy process was trade agreements. Until the 1990s, food was typically excluded from negotiations at the General Agreement on Tariffs and Trade (GATT) (Hawkes and Murphy, 2010). The Uruguay Round of the GATT in 1994 and the creation of the World Trade Organization (WTO) marked a new era, pledging countries to open their agri-food markets by reducing tariffs, non-tariff barriers, export subsidies and domestic agricultural support. GATT and WTO rules promoted the integration of national food markets (e.g. through harmonisation of food safety and quality regulations) and provided a more favourable operating environment for the private sector (e.g. through protecting intellectual property). Trade and investment agreements were also made at the regional and bilateral level (UNCTAD, 2006).

The process of market liberalisation did not mean the removal of all state intervention. In the European Union (EU) and United States, domestic support programs and assistance for exports remain significant,1 although there has been some shift away from production support to support decoupled from production. In developing nations, too, various forms of state intervention remain.2 Indeed, there is a controversial debate about state intervention in agriculture, with strong voices both for and against; the Doha Round of GATT trade talks stalled largely on the basis of political tensions about the policy prescription for agriculture.

The relationship between agricultural policies and diet: some hypotheses

Hypothesis 1: Agricultural policies influence food availability for “consumers”

How may this paradigm shift in agricultural policy, where implemented in practice, have influenced consumer diets? First, it may have influenced food availability, a key factor in the consumer food environment associated with diet (Swinburn et al., 1999; Story et al., 2008). Real life examples suggest that different agricultural policies have influenced availability of specific food products. Take the case of oilseeds. During the 1960s, global production of oilcrops was spread relatively evenly between soybean, palm, rapeseed oil, sunflower oil, groundnut, cottonseed and coconut oil (Fig. 1). The production of soybean, sunflower, rapeseed and palm oil rose steadily into the 1980s, in part attributable to state support (e.g., for rapeseed and sunflower in the EU) (Bruinsma, 2003). Much more radical change came in the early 1990s when key countries implemented policies to globalise the market for soybean and palm oil. Building on historical and natural advantages, Argentina and Brazil introduced policies to: increase soybean productivity (e.g. public investment in research; lower import restrictions on agricultural inputs); enable more open sourcing (e.g. lower export taxes on oilseed products); and promote private sector activity in the supply chain (e.g. privatise marketing and transportation infrastructure; reduce restrictions on foreign direct investment in processing and manufacturing) (Schnepf et al., 2001).3 Malaysia and Indonesia took related measures for palm oil, such as reducing limits on land area available for production (Ahmad and Tawang, 1999; Hawkes, 2010). Importing countries, meanwhile, implemented policies to permit more open sourcing, particularly of palm and soybean oil, such as the elimination of state marketing boards and import monopolies in China and India (Tuan et al., 2004; Dohlman et al., 2003).

The results were as intended. Production increased, as did trade. The share of oilseed exports from Argentina and Brazil rose as the share from the United States fell (from around 80% in the early 1980s to 45% in 2000/05) (Ash et al., 2006). Between 1990 and 2005, exports of palm oil from Indonesia and Malaysia rose nine-fold and twofold respectively (FAOSTAT trade data). On the import side, China and India, with their substantial populations became the world’s leading importers, along with other countries like Mexico and Pakistan (Bruinsma, 2003).

The supply chain also changed. Horizontal integration increased – by the end of the 1990s, the five largest soybean processors in Brazil owned 60% of crushing capacity (Schnepf et al., 2001) – as did vertical integration.5 Taking one leading example, Cargill undertook numerous mergers and acquisitions in equivalent steps in the supply chain, so increasing the degree of horizontal integration. It also became a vertically integrated company, evolving since the 2000s “from trading soybeans, to processing them into meal and oil, to producing high-value natural vitamin E from a soybean byproduct” (Cargill, 2010). With a presence in 68 countries, it now processes, exports and imports soybean oil, soybean meal and palm oil. Importantly, too, to make use of plentiful supply, Cargill and other oilcrop companies began to process oils to create longer shelf-life hydrogenated (“trans”) fats; Cargills first factory to manufacture hydrogenated fats in Brazil opened in 1993.

1 For example, the United States government provided subsidies worth $56.2 billion for corn, $22.1 billion for wheat and $14.2 billion for soybeans between 1995 and 2006 (EWG, 2007).
2 For example, when India eliminated its state monopoly on vegetable oils, it still retained high tariffs on oilcrops to protect domestic producers (Persaud and Landes, 2006).
3 The incentive to increase soybean production came not just to produce oil, but animal feed. Animal feed is in fact the dominant use. It has been estimated in the United States that, depending on the prices of soybean meal versus soybean oil, soybean meal can range from 50% to 75% of the processing value, whereas soybean oil constitutes just 18–19% of the value (Ash et al., 2006).
4 Horizontal integration occurs when firms take control of competing firms in the same level of the production chain, resulting in companies becoming larger and often more concentrated.
5 Vertical integration occurs when a company brings the upstream and downstream parts of the food supply chain together under its control by buying and contracting companies, services and growers.
The net consequences were soaring availability of palm and soybean oil relative to other oils, and greater availability of vegetable oils overall (Fig. 1; Table 1). Between 1982/84 and 2000/02, vegetable oils contributed more than any other food group to the increase of calorie availability worldwide (by 70 kcal/capita/day) (FAOSTAT, cited in Hawkes, 2006b).

Another example comes from meat. According to the FAO, meat consumption doubled in developing countries between 1980 and 2002 (Steinfeld et al., 2006). In developed countries, consumption rose much more slowly but remained well over double that of developing countries. Uniting both developed and developing countries was the shift away from beef towards chicken consumption (Fig. 2) – a trend particularly notable in places with historically high consumption of beef, such as the United States and South America (Hawkes, 2006a).

That chicken now exceeds beef consumption in the United States today reflects changes in productivity and supply chain organisation going back decades. Vertical integration of the supply chain began in earnest in the 1950s, when chicken consumption began its upward turn (Martinez, 2002; Buzby and Farah, 2006). The adoption of a more integrated production system not only dramatically lowered production costs, but enabled larger chicken slaughtering and processing facilities – so increasing productivity. The low cost of chicken feed (corn, soybeans, etc.) and quick turn around due to genetic breeding also increased the incentive to produce.

Market liberalisation in the 1990s then added the stimulus of more open sourcing into the equation, facilitating export of the supply chain model, and chicken itself. The North American Free Trade Agreement (NAFTA), for example, signed between the United States, Canada and Mexico in 1994, reduced limits on foreign company ownership in Mexico and lowered tariff and non-tariff barriers to trade in animal feed and select meat cuts ( Zahnisser and Crago, 2009). United States-based chicken processors then had greater flexibility to pursue a two-pronged international growth strategy: establish new production facilities in key regions; and export American production overseas (Tyson, 2011). Chicken was the ideal model to export because of the relative ease of adaptation of modern poultry production technologies, the relatively short production cycle of chicken (so increasing the rapidity of the return on investment), and lower feed concentrate prices and higher feed efficiency ratios than other meats (Steinfeld et al., 2006).

With greater freedom to invest in processing facilities, American companies transferred their production model to Mexico (Tyson de Mexico is now the largest producer of value-added chicken in Mexico, and Pilgrim’s Pride is the second largest chicken company) (Rick and Yang, 2011). This in turn was facilitated by greater availability of cheap feed: imports of corn (mainly targeted for animal feed) quadrupled into Mexico from the United States during the NAFTA period, and tripled for soybeans – a rate of increase mirrored by the increase in poultry production (Zahniser, Crago, 2009).

Rival oilcrop producers suggest that the increased availability of soybean oil relative to other oils is the result of agricultural policies that are “discriminatory.” For example, the Canola Council of Canada has alleged that the ability to supply canola oil to the global market is reduced as a result of higher tariffs relative to soybean and palm oil and technical barriers to trade, and “hidden subsidies” in Latin America and the US (Canola Council, 2006).

Table 1

<table>
<thead>
<tr>
<th>Examples of agricultural policies</th>
<th>Effects on the food supply chain</th>
<th>Hypothetical outcome</th>
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<tbody>
<tr>
<td>Investment in research and adoption of crop technologies</td>
<td>Greater production and productivity of targeted food and greater concentration in specific geographical locations</td>
<td>More open sourcing of foods and ingredients e.g. imports and exports between key countries</td>
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<tr>
<td>Lower tariffs and higher quotas on agricultural inputs</td>
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<td>Greater availability of the targeted food and/or processed derivatives for the food consuming industries</td>
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<td>Reducing limits on land area for production</td>
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<tr>
<td>Lower tariffs and higher quotas for foods and food ingredients</td>
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<tr>
<td>Reduction/elimination of export taxes, introduction of tax-free export quotas</td>
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<td>Elimination of state marketing boards and import monopolies</td>
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<td>Price deregulation</td>
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<td>Investment in post-harvest handling, including meeting foreign phytosanitary standards</td>
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<td>Reducing limits on foreign direct investment</td>
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<tr>
<td>Incentives provided to private actors</td>
<td>More “efficient” food supply chain e.g. greater horizontal and vertical integration = power shift to the “food consuming industries”</td>
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<tr>
<td>Privatisation of state marketing boards (plus policies affecting more open sourcing)</td>
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* Based on examples in the text.

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6 Rival oilcrop producers suggest that the increased availability of soybean oil relative to other oils is the result of agricultural policies that are “discriminatory.” For example, the Canola Council of Canada has alleged that the ability to supply canola oil to the global market is reduced as a result of higher tariffs relative to soybean and palm oil and technical barriers to trade, and “hidden subsidies” in Latin America and the US (Canola Council, 2006).
2005; Clark et al., 2012). As put by Zahniser (2005, p. 9): “U.S. feed-
stuffs enable Mexican livestock producers to expand output, lower production costs, and compete more effectively with meat imports from the United States, Canada, and other countries. They also have made possible a marked increase in Mexican meat consumption. Between 1993 and 2003, Mexico's per capita consumption of broi-
ler meat rose 54 percent.”

NAFTA also resulted in more chicken exports to Mexico – albeit with an interesting pattern. NAFTA retained a restrictive tariff-rate quota for chicken leg quarters in order to protect the domestic Mexican market, so the most important exports were of products with little competition in the Mexican market: turkey meat and mechanically deboned meat. As a result “strong linkages have emerged between US poultry industry and Mexican sausage and cold-cut producers” (Zahniser, 2005, p. 6).

These changes are not restricted to Mexico. Though there re-
main significant trade barriers, opening in key markets permitted an increase in chicken exports from the United States, particularly of brown meat. As put by Haley (2001, p. 46) “The popularity of skinless, boneless chicken breast meat in the United States gave rise to enormous quantities of poultry parts less desirable to US consumers – dark meat, primarily leg-quarters. Large supplies of low-cost, dark US chicken meat coincided however, with the relax-
ation of selected policy constraints to international meat trade, and, to growing incomes in a part of the world where consumers prefer dark poultry meat: Asia and Russia.”

Another example of a link between policy and food availability comes from fruit in China. Production of many types of fruit in-
creased in China throughout the 1990s/2000s in response to a range of policy measures, including the elimination of an agricultural tax on fruit production (originally implemented to encourage the production of staples) in the early 2000s (Deng, 2006). Apples experienced a particularly rapid increase, the result of a specific policy to target apples as part of plans to expand agriculture in western parts of China in the 2000s (Gale et al., 2010). Apples were targeted because of their potential price competitiveness in the world market: several western provinces had similar growing con-
tions to leading producers in Europe and North America, but with a fraction of the labour costs (Rae et al., 2006). In addition to pol-
icies to promote production, investments were made in developing a post-harvest supply chain (e.g. waxing) and ensuring coherence with phytosanitary standards to permit export.

The results were, again, as intended: the Chinese share of global apple production increased from 7% in 1980 to 50% in 2009 (FAO-
STAT Food Supply database). Though globally, rates of apple pro-
duction did not increase faster on average than any other fruit, Chinese exports (especially to south east Asia) meant that per ca-
pita apple supply more than doubled in developing countries be-
tween 1990 and 2005 (FAOSTAT supply data) (Fig. 3).

In addition, in light of a newly abundant supply of apples that were too small, misshapen, or off-colour to sell on the fresh mar-
ket, China implemented policies to develop a supply chain for apple juice concentrate (AJC). Policies included investment in equipment and infrastructure, providing preferential treatment to juice processing companies which purchased apples (usually though contracts) from small farmers,7 and encouraging domestic and foreign investment encourages in juice processing (Gale et al., 2010). China consequently became the world’s leading exporter of AJC, with exports growing from zero in the early 1990s, to under $50 million in 1998/99, peaking at $1.4 billion in 2007/08 (Gale et al., 2010). During this period, the availability of AJC in the largest importing country, the United States, increased, despite declining production at home (Fig. 4). China now supplies about one-third of AJC in the United States (Gale et al., 2010).

From these examples emerges a hypothesis: that agricultural policies introduced as part of the market liberalisation process cre-
ated incentives for greater specialisation in specific crops, and/or by specific countries, so making some foods more readily available to “consumers” relative to other foods (Table 1). Policy changes fed through the food supply chain through the processes of greater production and productivity, more open sourcing, and the reorga-
nisation of the food supply chain. In this latter process, an impor-
tant change was the rise in power of what, as consumers of agricultural products, can be termed the “food consuming indus-
tries” (FCIs) – the traders and distributors (e.g. animal feed shippers), primary processors (e.g. oilseed crushers), manufacturers (e.g. of processed products with apple juice concentrate), wholesalers, retailers and food service outlets (e.g. fast food outlets), who purchase food before it reaches the final consumer (World Bank, 2007; ETC Group, 2008; Hendrickson and Heffernan, 2002; Murphy, 2006; Vorley, 2003). As such, the hypothesis proposes that changes in availability are not just relevant for the final food consumers, but for the FCIs, with the latter becoming more important as the primary consumers of agricultural products.

Yet making some foods more readily available than others cannot alone explain rising consumption: for consumption to increase by the final food consumers and/or the FCI's, the foods must also be also affordable and acceptable (see Benson, 1994).

Fig. 3. Availability for consumption of apples and all fruit, SE Asia. Source: FAOSTAT food supply database.

Fig. 4. US supply, imports & production of apple juice concentrate. Source: USDA FAS, PSD database.

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7 Vertical integration often involves contract farming between producers and corporate buyers. That is, when an agricultural producer provides an agreed amount of a crop directly to a corporate buyer at an agreed time, with a price often, but not always, being agreed in advance. The producer supplies the land and labour, with the corporate buyer supplying the material inputs and technical advice. In the contract, producers typically must meet safety and quality standards set by the corporate buyer.
The second part of the hypothesis concerns food prices and affordability. Vegetable oils again provide a good illustration. Since policy reforms, soybean and palm oil have become the lowest cost vegetable oils in the global market, especially palm oil (Fig. 5). In the United States, the “composite” price for chicken declined from $2.22 in 1980 to $1.74 per pound in 2004 making beef relatively more expensive (Henry and Roths- well, 1995). In the United States, the “composite” price for chicken declined from $2.22 in 1980 to $1.74 per pound in 2004 making beef relatively more expensive (Buzby and Farah, 2008; Mintert et al., 1996). Apple and AJC prices from China have also led to the availability of much cheaper products – the price paid to apple growers in China in the 1990–2000s was around half the United States grower price (Gale et al., 2010).

Following the economic theory that a lower price leads to a tendency for consumers of the good to shift away from the more expensive product and towards less expensive substitutes (the “substitution effect”), these relative price differentials are likely to have played a role in purchasing choices. In India, for example, soybean and palm oil now make up a significant proportion of total vegetable oils consumed, having substituted for the more expensive domestically produced rapeseed, groundnut and cotton seed oils (Dohlman et al., 2003). Soybean and palm oil are also blended with what are considered to be the higher quality domestic oils in order to boost sales through lower prices (and/or raise margins). In an “income effect”, lower prices also mean that consumers can afford to buy more oils overall.

It is important to distinguish between the FCIs and the final food consumers here since oils are “consumed” by both at different stages in the supply chain. The FCIs are the most immediately affected by the price change. In India, for example, FCIs, from the smallest street vendor to the largest food manufacturer, have a clear incentive to substitute cheaper for more expensive vegetable oils.8 That FCIs switch between close substitutes as a result of price differences is evidenced by the case of sugar and high-fructose corn syrup (HFCS). When HFCS became cheaper than sugar in the 1980s in the United States (as a direct result of farm policies), the Coca-Cola Company substituted HFCS for sugar (Beghin and Jensen, 2008). In 1984, the Company raised the ratio of percentage HFCS in drinks from 50% to 75%, saving them an estimated $25 million a year (Nazzario, 1984). This in turn is credited with the “upsetting” trend in which the enlargement of bottle and can sizes was accompanied by relatively smaller increases in price. In Mexico, fluctuations in the prices of HFCS and sugar also stimulated the substitution (and re-substitution) between HFCS and sugar. The example indicates, too, that there are cases when agricultural policies make the targeted product relatively more expensive for the FCIs – in this case, the U.S. sugar program making sugar relatively more expensive. Sugar policies are also estimated to make sugar more expensive in the EU (Schmidhuber and Shetty, 2010).

The impact of specific policies on farmgate/market prices thus cannot be generalised as being up or down. Nevertheless, in whatever direction, changes in relative prices – over time, space and between products – arguably have the potential to encourage the FCIs to substitute for lower priced products, thus increasing the incentive to consume more of that product, and more overall.

The situation for final food consumers is far less clear. This is because farmgate prices are not necessarily passed through to the final retail price, meaning that consumer affordability may or may not be affected by changes in farmgate price (Alston et al., 2008; Miller and Coble, 2007).8 In some cases, price changes are passed onto consumers. In China, for example, vegetable oil prices fell from 4.4 to 2.5 yuan/L between 1993 and 2000 following policy reforms. Ng et al. (2008) associate this trend with lower intake of animal fats, and higher vegetable oil intake in China, especially of the lower cost oils among lower income consumers. Consumption and cooking patterns associated with use of vegetable oils – snacking and frying – also increased (Wang et al., 2008).

But for other, often more processed, products, changes in the farmgate prices of ingredients are not necessarily passed onto consumers. In the case of HFCS, corn prices have never been correlated with soft drink prices, and HFCS and soft drink prices have not been correlated since the early 1990s (Beghin and Jensen, 2008). This reflects in part the low proportion of the retail price made up by agricultural costs – the cost of HFCS is just 3.5% of the total cost of soft drinks. Another example comes from bread: in the United States, changes in bread prices over past decades have not closely reflected changes in wheat and flour prices (Roeger et al., 2011). Flour prices as share of the cost of a loaf of bread have also declined, with costs at the level of agricultural production now making up just 10% of the retail price for bread (compared with 48% for beef). In the EU, too, the price of bread for consumers is about 20 times more than the cost of wheat flour (Schmidhuber and Shetty, 2010). The significance of these post-farm costs appears to have increased: in the United States costs of labour, packaging, marketing and corporate profits rose 45% relative to 13% for on-farm costs between 1980 and 1999, with the largest increase coming from pre-tax corporate profits (rising 98%) (Elitzak, 2000).

Thus emerges the hypothesis: that agricultural policies implemented as part of market liberalisation have influenced farmgate prices (both up and down), so creating an incentive for the FCIs to substitute for the lower priced product, with implications for the nutritional quality and content of foods available in the consumer marketplace (see Golan and Unnevehr, 2008), but with no consistent implications for food retail prices.

Hypothesis 3: Agricultural policies influence food acceptability

One of the hallmarks of the modern food economy is the wide array of highly-differentiated products on offer based on one or a small number of core-ingredients. Box 2 shows some examples for vegetable oils. Chicken is another good example, with companies like Tyson and Pilgrims Pride now producing products from fresh chicken breast to nuggets to ready meals. Differentiated chicken products are also widely available in the food service sector; in the United States, it is estimated that 42% of chicken in 2006 was sold through foodservice outlets, 60% of that from fast-food chains (Buzby and Farah, 2006). Fruit and vegetables are also

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8 This substitution affect occurs not just between oils in the food supply chain, but between food and non-food uses, such as soybean oil used as biodiesel.
increasingly differentiated to appeal to different markets. Even a product as basic as carrots can be differentiated: loose carrots (in different classes), carrots ready-packed in a plastic bag, ready-washed and peeled carrots; carrot sticks for children, and grated carrots in pre-bagged salads. An analysis by Humphrey and Oetero (2000) shows this can have a striking impact on adding value to the product. “Loose carrots sold for 18p per pound,” they found, while “merely packaging the same carrots in plastic bags more than doubled the price per kilo, while further processing raised the price much more. Peeling and slicing carrots increased the price to £2.83 per kilo, while minicarrot batons and “mini-crunch” carrots could be sold at a price of up to £6.00 per kilo, or 15 times the price of loose, full-sized carrots. Clearly, not all of the increased price of the processed carrots could be accounted for by the extra work involved in making the product.” Higher degrees of processing also facilitate product differentiation further down the food supply chain. A JC, for example, is used as a basis of soft drinks, but also as a substitute for sugar to sweeten baked goods, dried fruit, sauces, etc., which is then sold as a “healthier” alternative to sugar-sweetened products.

Box 2. Mechanisms of “adding value” to vegetable oils by the food consuming industries. Source: The authors.

Product innovation
- Vegetable oils with improved fatty acid profiles (e.g. canola from rapeseed)
- Vegetable oils with improved chemical structures (e.g. no hydrogenation needed to become hard in processed foods)
- Vegetable oil products for use by food manufacturers (e.g. hydrogenated fats)
- Vegetable oils with different functions for final consumers (e.g. “frying” oils vs “salad” oils)
- Vegetable oils with added health functionality for final consumers (e.g., enriching with vitamins A and D in soybean oil, or increasing ratio of omega 6 to omega 3s).
- Products made with vegetable oils for final consumers (e.g. salad dressings, margarine, oil-based spreads)

Marketing
- Vegetable oils in different sized packages (e.g. in large sized drums for the catering industry; small sized bottled for higher-priced oils)
- Vegetable oils with labels that communicate the “naturalness” of the product (e.g. pictures of the plant and/or fields; claims such as “naturally high in vitamin E” or “made from non-transgenic soybeans”)
- Vegetable oils with labels that claim health benefits (e.g. “cholesterol free”)
- Processed products that claim health benefits of the oils they contain (or do not contain) (e.g. “trans fat free”)
- Processed products that claim environmental benefits of the oils they contain (e.g. “sustainable palm oil” in processed foods)
- Advertising & promotion (e.g. of value-added oils and oil-products)

This ability to differentiate has come from the higher degree of explicit chain coordination in modern food supply chains, the incentive from the aim of maximising returns (Gereffi et al., 2009; Hatanaka et al., 2006; Wilkinson, 2002). With greater power in the supply chain, the FCIs can now “buy undifferentiated commodities from their suppliers and sell differentiated commodities to their customers. This allows them to buy low and sell high(er), while capturing most of the value added” (Hatanaka et al., 2006, p. 48). In other words, the FCIs are “adding value” to basic commodities through the processes exemplified in Box 2 – thus explaining the increasing contribution of post-farm relative to on farm costs as the price of the final product (Arce and Marsden, 1993). In so doing, the FCIs have shifted to product innovation and marketing as their core growth strategy (Goldman Sachs, 2007; Langlois et al., 2006; Wilkinson, 2002).

For consumers, the result is a heady combination of price and quality competition in the marketplace, with the apparent “value-added” encouraging a willingness to pay more for the product. Some consumers, for example, may “value” convenience and thus be willing to pay for a higher priced product (e.g. pre-sliced carrots); others may “value” a heavily promoted product and likewise be willing to pay more for it relative to another (e.g. advertised KFC chicken pieces relative to non-branded fried chicken sold from a street vendor). Other consumers may not perceive any benefits to products to which “value” has apparently been “added” (e.g. a “cholesterol free” claim on sunflower oil), whereupon price becomes a more important arbiter of choice, and consumers, as predicted by economic theory, become more sensitive to price differences between closely related products (Timmer et al., 1983; Traill and Henson, 1986). In both cases, what is important is the perceived benefit of the product relative to its price (“value”).

What emerges, then, is a marketplace characterised by an array of products competing both on quality and price which aims to stimulate and “constantly reactivate” consumer demand and mobilise the preferences of consumers (Wilkinson, 2002, p. 332). Thus emerges the hypothesis: that changes in agricultural policies have created an enabling environment for FCIs to add “value” through product innovation and marketing, creating a market characterised by highly differentiated products which are targeted to individualised preferences, thus creating apparent “value” for consumers and increasing the acceptability of a wider variety and quantity of food.

Conclusions and policy implications

This paper has argued that the paradigm and policy shift to more liberalised agricultural markets has: increased specialisation of production, so changing the ability and incentive of producers to supply some foods relative to others; affected farmgate prices (both up and down), so changing the incentives for the FCIs to use some ingredients relative to others, thereby affecting the nutritional quality and content of foods available in the consumer marketplace; and influenced the ability of the FCIs to “add value” through product innovation and marketing, creating a market characterised by highly differentiated products which are targeted to individualised preferences, thus increasing the acceptability of a wider variety and quantity of food.

However, the examples here also indicate no clear pattern when it comes to health; the changes have affected both “unhealthy” and “healthy” foods and ingredients. Palm oil has an unhealthy fatty acid profile, but chicken and soybean oil have healthier fatty acid profiles than beef and animals fats respectively. Vegetable oil exports have grown, but so have fruit exports. The key implication for health, then, is not just whether the “ingredients” produced by agriculture are healthy or not, but on how they are substituted, transformed, and marketed relative to each other through the supply chain. “Healthy” soybean oil can become transfa; “low fat“
chicken can be combined with vegetable oils and cheap carbohydrates to make energy-dense fast food; fruit can be used as an ingredient in processed foods with a far higher calorie content.

From this arise several implications for food policies to address unhealthy diets and associated diseases (Box 3). The first implication is for intervention in agricultural policy itself. Policies that intervene directly in agricultural production to promote healthy eating are not likely to be effective or efficient if they do not take into account how foods are processed, distributed and marketed through the system. In other words, intervening in production policies will do little if the supply chain dynamics are also not taken into account. The ability to substitute (and re-substitute) means that changing the production of one product (e.g. corn) could lead to the substitution by another (e.g. sugar, potato starch), or changing production of a product in one locality (e.g. meat in Europe) could lead to the substitution by imports (e.g. meat from Brazil). In addition, the processes of transforming foods means that encouraging the production of a specific product (e.g. apples), does not necessarily mean there will be more of that product in the marketplace, but a processed food containing that ingredient (e.g. foods sweetened with apple juice).

In practice, this means that the potential for policy interventions in agriculture to improve diets is limited – but nevertheless potentially important where they exist. There are particular instances where intervention could beneficial. The first involves creating incentives for the FCIs to substitute “healthier” ingredients in their products, and/or to sell more of them, in instances where these changes can be passed all the way to the consumer (as opposed to where further transformations invalidate the positive change). Incentives could be introduced, for example, where a substitution is possible between a less healthy and healthier ingredient yet FCIs have been reluctant to make the change for reasons of input costs. Policies could be used to make the more expensive ingredient less expensive (e.g. investment in research and development), so lowering prices and increasing the incentive for the FCIs to consume it. Potential example include substituting vegetable oils with healthier fatty acid profiles relative to saturated fats or trans fats for snack manufacturers, grass-fed beef for corn-fed beef (healthier fatty acid profile) or orange-fleshed sweet potato in place of white (greater vitamin A). Engagement by policy makers with the FCIs is therefore needed to identify where different policies could create incentives for FCIs to use/sell more of these ingredients and foods (in full awareness of the potential for transformation) as part of policies to encourage product reformulation and development (Box 3).

The other potential area of intervention is investment in local production of fruit and vegetables for local markets. With short, more manageable chains, the increase in production could be directly targeted towards increased consumption by local people through direct farm-consumer supply chains. The analysis here suggests that this would be a wise investment. First, smaller farmers have the incentive to engage in these initiatives because they provide a means to recapture value from the supply chain from the FCIs – an approach consistent with current agricultural development initiatives to support smaller farmers. Second, local markets could mean more affordable fruits and vegetables because value is not being captured by additional supply chain actors. The proliferation of direct marketing via farmers markets, schools and restaurants in the United States is an example of the response (USDA, 2010). There has also been a surge of interest in international development in creating more value for small farmers in developing countries through direct marketing initiatives (Hawkes and Ruel, 2011). Brazil, for example, passed a law in 2009 requiring that 30% of the budget for the school meal program is used to purchased food from family farmers. The World Food Program is also focusing some of its programs on local procurement for local markets. It should be noted, however, that even these cases, experience suggests that investment in supply chain logistics (including in input supplies) is just as important as agricultural production.

The second policy implication concerns the emergence of the FCIs. FCIs now have more power in the food supply chain and can, though contract farming, influence what farmers produce. By providing a stable market, the FCIs can provide an incentive for farmers to produce ingredients to improve the nutritional profile of processed products. With the FCIs making pledges to contribute to better diets, it is incumbent on them to do so. However, even with greater control over farmers, FCIs still face the supply-side incentives to consume and sell more of some foods relative to others outlined in this paper. In addition, the FCIs have the incentive to meet, mobilise and create consumer demand. For change to happen, then, additional incentives are needed in the form of a coherent framework of consumer-end standards and regulations to discourage the production and sale of energy-dense, nutrient poor foods (see also Nugent, 2011). The greater flexibility in the supply chain created by policies that permit private markets to flourish should make it easier for the FCIs to respond to regulations and standards relative to the greater state intervention of the earlier paradigm: the FCIs have more flexibility to respond, and can benefit by innovation.

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**Box 3. Implications for food policies to address unhealthy eating, obesity and associated diseases.**

- **Policy makers should:**
  - Engage with the FCIs to identify what incentives in agriculture and supply chains are needed to encourage substitutions for healthier ingredients
  - Invest in local production of fruits and vegetables for local markets
  - Identify points in the supply chain that could be levered to create healthier food environments
  - Set a coherent framework of standards and regulations for the FCIs to disincentivise the production, sale and marketing of foods associated with obesity and diet-related chronic diseases, including clear standards for promotional marketing
  - Consider pricing strategies to encourage healthier eating for carefully targeted products, while conducting health promotion campaigns and educational initiatives to encourage consumers to value healthier foods and healthier eating

- **The FCIs should**
  - Through their influence on farmers, encourage production of healthier substitutes and then adopt them and transmit the benefits all the way through the supply chain to the consumer

- **Researchers should**
  - Test the hypotheses established in this paper using methods from, among other disciplines, economics, nutrition, public health, agricultural science, food science, and industrial analysis, especially value chain analysis
  - Conduct research to identify the degree of importance of the different incentives faced by the FCIs to produce the products they do, and the sources of those incentives, with the objective of finding those most amenable to leveraging the supply chain towards healthier eating.
A third and related policy implication likewise concerns the central role of product innovation and marketing as the lifeblood of the modern food system. Very clear, standard global rules on what can, and cannot, be marketed from a health perspective would provide a much more coherent framework in which the FCIs could operate and send signals back into the supply chain. These rules could be developed based on the framework already provided by the WHO (2010). With regard to innovation, instead of the plethora of new products coming to market, shaped by interests of the FCIs, which are then ‘tested’ (i.e. sell or fail to sell in the marketplace), a contrary flow of demands from public health back down to the FCIs is needed. Policy-makers and suppliers need to ask and be asked: what would a food supply system and agriculture look like if they were responding to public health concerns? Major food businesses and think-tanks are already suggesting such approaches through voluntary measures (PepsiCo, 2011; WEF, 2010), particularly concerning labour and environmental considerations, like sustainability, climate change and water stress. Overall, there are increasing demands from affluent consumers, consumer groups and a significant number of socially responsible investment groups (e.g. FTSE4Good) for value chain transparency. Policymakers need to build on these growing pressures to shift product innovation towards healthier product portfolios within and between industry sectors.

The fourth policy implication comes from complex relationship between value and prices for consumers in modern retail channels. Value has become a more important arbiter of consumer choice, with price as part of that. Intervening in pricing is thus far more complex today than ever before. However, for products that are close substitutes and which are perceived to possess relatively equal benefits – or more benefits for the healthier one – pricing interventions could be highly effective. At the same time, investment is thus needed by health promotion agencies and programs to continue their efforts to create perception of value for these healthier products (and vice versa), as well as healthy eating habits overall.

The final policy implication concerns the food supply chain as the unit of analysis and intervention rather than agricultural production or the farm-holding. Although the potential for intervention in agriculture is rather limited, there are many opportunities to intervene at points along the supply chain to reduce disincentives and create incentives for improved food availability, affordability and acceptability – such as reducing incentives for vending machine operators to sell a high volume of soft drinks in schools, or reducing barriers to entry by innovative fruit and vegetable retailers (Hawkes, 2009). Policymakers should adopt this more food systems oriented approach in order to improve the consumer food environment and create an environment supportive of more food systems oriented approaches to improve the consumer end of the value chain towards healthier eating. The research community should also test the hypotheses established in this paper using methods from, among other disciplines, economics, nutrition, public health, agricultural science, food science, and industrial analysis, especially value chain analysis (Box 3).

This paper has developed some hypotheses concerning the influence of agricultural policies on what we eat. It finds that by altering incentives for producers, the FCIs, and consumers, agricultural policies have had, and do have, important implications for food availability, affordability and acceptability. But in so doing, it finds that the potential for intervening in agricultural policies to encourage healthy eating is limited, and would only be effective if the substitutions and transformations in the supply chain were taken into account. Thus the “upstream” unit of interest for policy-makers and analysts must move to include the supply chain. As this paper has demonstrated, engaging with the dynamics of the supply chain is far from just a theoretical exercise. Rather, it can help identify potentially effective policies and approaches to prevent unhealthy eating, obesity, and associated noncommunicable diseases.

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