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**Sugar**  
Consumption at  
a crossroads

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## Introduction

The global obesity epidemic and related nutritional issues are arguably this century's primary social health concern. With breakthroughs in the field of medicine, huge leaps in cancer research and diseases such as smallpox and polio largely eradicated, people around the globe are, on average, living much longer and healthier than they were decades ago. The focus on well-being has shifted from disease to diet. The whole concept of healthy living is a key pillar of our Credit Suisse Megatrends framework – themes we consider crucial in the evolution of the investment world. In this report, we specifically explore the impact of “sugar and sweeteners” on our diets.

Although medical research is yet to prove conclusively that sugar is in fact the leading cause of obesity, diabetes type II or metabolic syndrome, we compare and contrast various studies on its metabolic effects and nutritional impact. Alongside this, we question some of the accepted wisdom as to what is perceived as “good” and “bad” when it comes to sugar consumption, namely as to whether a calorie consumed is the same regardless of where it is derived from – sugar, fats, or protein – and whether solid foods are “nutritionally different” to liquids.

Naturally, recent focus here – medical, media and regulatory – has intensified on certain products, with soft drinks being the common denominator for all three. Within the population, we are already seeing a gradual reduction in the consumption of sugar and a switch to an alternative “diet” or “low-fat” products, particularly among the most highly educated. Demands for regulation, or taxation to limit consumption, are growing. Yet governments and health officials have so far taken a mixed stance on the matter.

The potential for a surge in negative public opinion and the looming threat of regulation and taxation are issues that the food and beverage industry clearly must address, though the extent to which they can do so without hurting their current business models is up for question. A diversification into new healthier products is gathering momentum. Change will bring new investment opportunities with clear winners and losers.

What can we expect in the future? What should investors focus on? Although a major consumer shift away from sugar and high-fructose corn syrup may be some years away, and outright taxation and regulation a delicate process, there is now a trend developing. From the expansion of “high-intensity” natural sweeteners to an increase in social responsibility messages from the beverage manufacturers, we see green shoots for dietary changes and social health advancement. Ultimately, we expect consumers, doctors, manufacturers and legislators to all play a crucial role in changing the status quo for sugar.

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# Composition, consumption and consequences

There can be no doubt that the global obesity epidemic has been at the center of a major debate involving medical research, healthcare professionals, insurance companies and society at large. More recently, research has shown that a significant number of chronic diseases, including coronary heart diseases, metabolic syndrome, and diabetes type II strongly correlate with weight gain. The future costs of dealing with all these diseases are putting further pressure on the private and public sectors' finances alike.

While these diseases might result from the combined effect of several factors, recent focus – medical, media and regulatory – has converged on the role played by sugar consumption, with soft drinks being the common denominator for all three. Opinions on the effects of sugar range from those who maintain that it is toxic to those who say that it is a natural product and perfectly healthy at current levels of consumption. While the parties on both sides of the debate continue to disagree on a number of important issues, there are several areas where there are few doubts.

**1.** The consumption of added sugar (sugar not contained in natural products like fruit or milk) or high-fructose corn syrup (HFCS) has increased dramatically over the last few decades. Added sugar is now ubiquitous in processed foods, both as a flavor enhancer and preservative. The world daily average consumption of sugar and HFCS per person is now 70 grams (or 17 teaspoons) per day, up 46% since 30 years ago (when it was 48 grams per day). This is the equivalent of 280 calories per day (four calories for

each gram of sugar). Yet, consumption varies considerably from country to country. At the top, we find the USA, Brazil, Argentina, Australia and Mexico, all at more than double the world average; ranging from 40 teaspoons for the USA to 35 for Mexico. At the other end, we find China with 7 teaspoons. If you exclude children less than four years old, you can add another 5%–10% to the numbers above.

**2.** While medical research is yet to prove conclusively that sugar is the leading cause of obesity, diabetes type II and metabolic syndrome, the balance of recent medical research studies are coalescing around this conclusion. Advances in understanding the negative effects of refined carbohydrates on blood sugar regulation and cholesterol, and the metabolic impacts of fructose, are undermining the traditional view that all calories are the same.

**3.** Genetic variations in insulin response are an important factor and allow some people to tolerate more sugar than others. Even so, a scientific statement issued by the American Heart Association in 2009<sup>1</sup> recommends that women take no more than six teaspoons of added sugar a day and men no more than nine. To put this in context, a regular can of soda has eight teaspoons of sugar, as does a one cup serving of low-fat granola. Based on the figures above, current intake of added sugars is well above these “recommended” levels in several developed and developing countries.

**4.** Liquid and solid “sugar calories” are handled differently by the body. The energy that is obtained through beverages

is interpreted and processed differently by our body from energy that is obtained through solid foods, even if the overall quantity of calories consumed is the same. Sugar by itself is a poor source of calories as it provides little nutritional value. Not surprisingly, the public debate has centered on soft drinks and the role they have played in this issue.

**5.** The medical profession has many times pointed to the link between sugar and the diseases we mentioned above, but definitive causality has been difficult to prove, as experiments involve a large number of individuals under direction to follow a controlled diet for several months or years. Yet, our proprietary survey of general practitioners in the USA, Europe and Asia shows that close to 90% of participants support these conclusions. In addition, there is not a single study showing that added sugar is good for you, which would be expected if the impact of sugar or HFCS was truly neutral.

**6.** Consumers are increasingly aware of this debate. Within the population, we are already seeing signs of reduction in the consumption of sugar, particularly among the most highly educated. Public opinion asking for some regulation or taxation to limit consumption is growing.

Sugar-sweetened beverages, which are concentrated sources of sugar, are becoming a main focus of consumers. In the USA, 31% of sugar supply is absorbed by the beverage industry. As the sugar is in a solution, it is easily and completely ingested, giving a large injection of calories without the consequential satiation of appetite. The

correlation between obesity and soda consumption across many populations is convincing and is a particular risk factor for childhood obesity. Mexico, for example, ranks second in the world in adult obesity, first in diabetes type II – which is the leading cause of death in the country – and fourth in infantile obesity.<sup>2</sup>

It also ranks second globally in added sugar consumption per person and second in the amount of soft drinks consumed per person, with 95% of soft drinks consumed (excluding water) being full-calorie.

**7.** Regulators, governments and public officials have done little so far to counteract concerns, with very few notable exceptions. Yet, we estimate that the annual costs to the healthcare system due to the global obesity epidemic are in excess of USD 600 billion. But obesity, as bad as it is, is not the most worrisome issue.

Diabetes type II is now affecting close to 370 million people worldwide, with one in ten US adults affected by it. The costs to the global healthcare system are a staggering USD 470 billion according to the most recent estimates from the International Diabetes Federation, and represent over 10% of all healthcare costs. In the USA alone, the healthcare costs tied to diabetes type II are estimated at USD 140 billion, compared to USD 90 billion for tobacco-related healthcare costs. Even

more worrisome is that these numbers are growing at a rate of 4% a year, much faster than for obesity (1%–2%). By 2020, the annual cost to the healthcare system globally will reach USD 700 billion and the people affected will be close to 500 million. Recent events would indicate that local and national authorities around the globe are beginning to take action, with varying degrees of success. Interventions include anti-soda advertising campaigns, tax levies, removal of vending machines in schools and regulation of portion size. However, as Mayor Bloomberg discovered in New York, when his attempt to limit cup sizes was defeated in court, the combined lobby of the sugar industry – which is a huge employer and therefore has significant voting power and that of the food and beverage manufacturers – makes things much more difficult. After balancing arguments in favor and against, we believe that taxation would be the best approach and will provide the best outcome: reducing consumption while helping the public sector deal with the growing social and medical costs.

**8.** Against growing negative public opinion and the threat of regulation or taxation, the food and beverage industry is beginning to take steps toward “self-regulation” and pro-active media campaigns. The beverage industry has also for some time recognized the need to diversify into healthier products, including fruit juices, sports drinks, bottled water and diet soda. However, many of these products are also coming under scrutiny; either as sugar in a healthier guise (fruit juices) or for the inferred disadvantages of

artificial sweeteners – particularly Aspartame, whose application was rejected six times by the Food and Drug Administration (FDA).

**9.** In the process of self-regulating and educating the public to take advantage of healthier choices, the beverage manufacturing industry has one advantage: in most cases, it already provides a healthier alternative of the fully caloric version (which is not the case for the tobacco and alcohol industry. We believe the next step in “self-regulation” will be to launch food and beverages that use natural sweeteners with zero or minimal caloric content. The experiment of Coca-Cola Life in Argentina (sweetened with half Stevia and half sugar leading to a 50% reduction in calories) is an example of what we expect to see over the next few years.

**10.** Bringing all this together, we believe that the “noise” on sugar and its effects on our health will increase rather than decrease. Even well regarded and independent bodies like the World Health Organization (WHO) have to catch up. In all its reports on diabetes, the WHO barely mentions sugar as either a cause or as part of the treatment (i.e. reducing sugar intake). So the most likely outcome over the next 5–10 years will be a significant reduction in sugar consumption and a marked increase in the role played by high-intensity natural sweeteners in food and beverages. Soft drink consumption might suffer somewhat in the short term, as it will take some time for companies to successfully establish a new line of “healthier” alternatives.

<sup>1</sup> Circulation, Journal of the American Heart Association (August 2009) – <http://circ.ahajournals.org/content/120/11/1011.full.pdf>

<sup>2</sup> Data are based on measurements rather than self-reported height and weight. OECD Health Data 2011 – <http://www.oecd.org/els/health-systems/49105858.pdf>

# Medical research

Medical research has made significant progress, particularly in understanding the way we process calories. Causality linking excess sugar consumption to obesity, diabetes type II and metabolic syndrome is difficult to prove; but for the doctors we surveyed the link is very strong.

There are also a number of factors where the debate on medical research in this area is ongoing. Let us start with the basics and focus on three important facts that allow us to better understand some of the consequences of “excess” sugar and HFCS intake: obesity, diabetes type II and metabolic syndrome:

## 1. Fructose and glucose are essentially same

Fructose, also called fruit sugar, is one of three monosaccharides (along with glucose and galactose) that are absorbed during digestion. Fructose is mainly ingested in one of two forms, either sucrose (table sugar) or high-fructose corn syrup (also called high-fructose maize syrup, glucose fructose syrup or glucose/fructose). Sucrose consists of equal parts fructose and glucose. High-fructose corn syrup (HFCS), on the other hand, usually has 55% fruc-

tose and 42% glucose (in HFCS 55) or 42% fructose and 53% glucose (in HFCS 42). HFCS does have some important commercial advantages over table sugar, and is considerably cheaper, meaning it is now regularly used as the main sweetener in beverages. The temporal relationship between an increase in HFCS consumption (especially in sweetened beverages) and the increase in obesity has also elevated the focus on the potentially unique role that fructose may play in weight gain.

There have been a number of studies looking for differences in how the body metabolizes fructose compared to glucose. Unfortunately, many have been very short-term or carried out at levels much higher than the concentrations at which either nutrient is typically ingested. In addition, it is rare for either substance to be consumed in isolation in the typical human diet.

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Our review of the latest literature and our conversations with experts in the field lead us to believe that, in general, the biological impact of fructose is essentially identical to that of glucose at the concentrations at which these nutrients are generally consumed. The American Medical Association has weighed in on the debate and concluded that it does not believe there to be any difference between HFCS and sucrose when it comes to causing or aggravating conditions such as obesity or diabetes type II.

## 2. Liquids and solids are handled differently by the body

Much of the recent focus in the debate around added sugars has focused on the sugars that come from sweetened beverages. This is partially

Figure 1

### Major sources of added sugar in the American diet

Source: Johnson et al, Circulation, 2009: 120:1011-1020. Food groups that contribute more than 5% of the added sugars to the American diet are listed in decreasing order.

Food categories	Contribution to added sugar intake (% of total added sugar consumed)
Regular soft drinks	33.0
Sugars and candy	16.1
Cakes, cookies, pies	12.9
Fruit drinks (fruitades and fruit punch)	9.7
Dairy desserts and milk products (ice cream sweetened yogurt, and sweetened milk)	8.6
Other grains (cinnamon toast and honey-nut waffles)	5.8



because soft drinks and other sugar-sweetened beverages are now the primary source of added sugar in the typical American diet (Figure 1).

In addition, there is now compelling evidence that supports the notion that energy obtained through beverages is interpreted and processed differently from energy obtained through solid foods, even if the overall quantity of energy consumed is the same. This was first shown by Flood-Obbagy and Rolls<sup>1</sup>, who showed that there was no impact on the amount of solid food that was consumed during a meal if the subject was given nothing, water or a soft drink in advance of the meal.

Similarly, Mattes et al<sup>2</sup> demonstrated that ingesting a beverage did not impact the amount of calories that were ingested during a subsequent meal or in the 24-hour period after the beverage was consumed. When a solid food was given, however, the number of calories that were ingested in the follow-

ing meal and in the following 24-hour period was reduced, suggesting the solid calories that had been ingested were processed in a different way, either in the intestine or in the central nervous system, so that the body appropriately adjusted its subsequent calorie intake. With calories from liquids, however, the body does not seem to compensate and the calories are “added on” to what the person would have ingested anyway. This is not surprising as high-caloric drinks became available only in the late 1830s with the introduction of carbonated lemonade in the United Kingdom.

The amount of added sugars that come from sugar-sweetened drinks, along with the evidence that these calories are processed in a different way to calories from solid foods, has contributed to the scrutiny that sugar-sweetened beverages are now under for potentially contributing to the increase in overweight and obese individuals. These sugars

from sweetened beverages are also easier to identify and isolate, and potentially regulate, restrict or tax as opposed to sugars that are almost ubiquitous in all solid foods.

### 3. The response to sugar intake is individual

A final factor of no debate is that there is clearly a genetic component to the development of obesity. At a population level, one widely cited hypothesis is that of the “thrifty genotype”, as coined by geneticist James Neel<sup>3</sup>. This essentially argues that the human genes selected over time were those that helped humans survive challenging times where there were frequent famines. The environment that many of us now live in has plentiful amounts of food available year round, but the genes may still be focused on conserving energy whenever possible and, in that way, can lead to

excess energy reserves and, over time, weight gain and obesity.

Richard Johnson and others<sup>4</sup> sustain that homo sapiens experienced two important genetic mutations that increased our ability to store fat in seasons where food was plentiful: the lack of the uricase enzyme and lack of the ability to make vitamin C. These mutations enhanced our ability to increase fat in response to our original major food source, fruit, and increased our chance to survive in periods of famine.

Many studies have also been completed that look for individual genetic variations between subjects who are and are not obese to try and identify possible genetic variations that could play a role in how a person consumes and processes energy. More than 40 different genetic variants have been identified to date that have been linked in some way to an added risk of weight gain and obesity. In total, genetics are believed to contribute between 30% and 70% of the risk to developing obesity, with environmental factors driving the rest of the risk.

Interestingly, a recent publication by Qi et al in the New England Journal of Medicine<sup>5</sup> again shows that sugar-sweetened beverages may play a particular role in the development of obesity. In this study Qi examined 32 genetic loci that have been found to be associated with body mass index (BMI) in the past and the impact these genes had on weight gain. Upon examining the intake of sugar-sweetened beverages, it was found that there was a stronger association between the presence of these genes and changes in BMI in people who had a higher intake of sugar-sweetened beverages as opposed to those who had a lower intake of these drinks. While more research is needed in this area, Qi’s work suggests that any impact that genetics may have on weight gain may be more pronounced in people who consume more sugar-sweetened beverages. Another possibility may be that people who have a stronger genetic predisposition to obesity may be more sensitive to any potential weight gain caused by these drinks.

<sup>1</sup> Flood-Obbagy and Rolls. “The effect of fruit in different forms on energy intake and satiety at a meal” - *Am Diet Assoc.* 2009;109: 430-437. (2009)

<sup>2</sup> Richard D. Mattes, PhD, MPH, RD; Wayne W. Campbell. “Effects of Food Form and Timing of Ingestion on Appetite” - *Am Diet Assoc.* 2009;109:430-437 (2009)

<sup>3</sup> Neel, James. “Diabetes Mellitus: “A ‘Thrifty’ Genotype Rendered Detrimental by ‘Progress’?” - *Am J Hum Genet.* (December 1962)

<sup>4</sup> Johnson, Rachel., et al. “Dietary Sugars Intake and Cardiovascular Health” - *Circulation* 2009, 120:1011-1020 (August 2009)

<sup>5</sup> Qi, Q., et Al. “Sugar-Sweetened Beverages and Genetic Risk of Obesity” - *New England Journal of Medicine* 367: 15: 1387-1396 (September 2012)

The individualized response to sugar consumption contributes significantly to the debate about how much government or health authorities should tax or restrict access to foods or drinks with added sugars. One of the reasons that supporters cite the need for these measures is the significant economic impact that obesity and other medical conditions have on society as a whole. It could be argued that a person at lower risk for developing any complications from ingesting sugar should be able to avoid any restrictions and avoid paying any taxes since it is less likely that they will develop the associated medical condi-

tions. On the other hand, perhaps those who possess a genetic predisposition to developing these conditions (or someone who is already overweight or obese) should be further restricted from consuming sugary foods or have to pay greater prices for these foods. Obviously, individualized regulations or taxes such as these would be difficult to implement, adding uncertainty about how regulations and taxes should be used against sugary foods in general.

#### 4. The obesity link

Globally, 35% of adults are considered overweight and 12% of all adults are obese<sup>6</sup>. The rates of obesity increased from 5% for men and 8% for women in 1980 to 10% of men and 14% of women in 2008. It is now estimated that<sup>7</sup> 205 million men and 297 million women over the age of 20 are obese, or more than half a billion adults worldwide.

There are a number of major health implications from the rise in the number of people who are overweight and/or obese in both the developed world and emerging markets. The landmark Global Burden of Disease report published at the end 2012 highlighted obesity as a more significant health crisis globally than hunger and/or malnourishment and as the leading global cause of disabilities. The five primary conditions that are linked to increases in body mass index are high blood pressure, high cholesterol, coronary heart disease, stroke and diabetes type II. Beyond these major conditions, being overweight and/or obese also increases the risk of numerous other disorders including osteoarthritis, gout, nonalcoholic fatty liver disease, gallstones and cancer.

Along with the health implications of the increase in the number of people who are overweight and/or obese, there are also significant economic impacts. The direct cost of managing obesity-related conditions has been estimated to be around USD 190 billion in the USA alone. There are also indirect costs related to issues such as increased absenteeism, increased disability and increased premature mortality that have been estimated to add as much as USD 66 billion in additional costs in the USA.

In parallel with the increase in obesity, there has also been a dramatic rise in the total amount of calories being consumed each day. The number of calories needed for the average male according to the UK NHS (National Health Service) is 2500, though the US authorities recommend 2700. What is generally agreed is that sugar should account for no more than 10% of caloric intake.

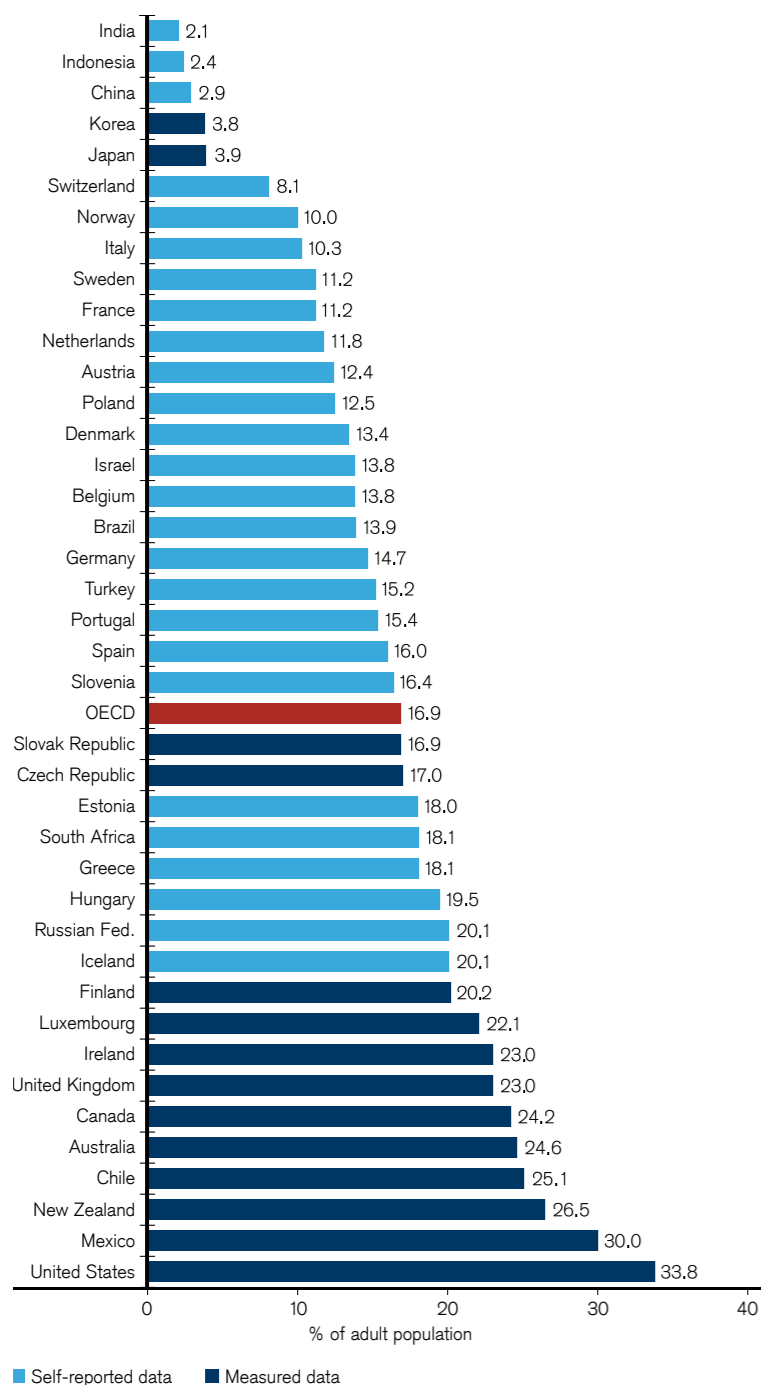
Actual consumption is now significantly ahead of this in virtually every market, peaking at 3700 per head per day in the USA. The emerging markets have generally low per capita consumptions and the developed world generally higher.

So is it just sugar that has led to an obesity epidemic? No, but sugar has been a major contributor, beyond the simple amount of calories it added to our diet.

Figure 2

#### Prevalence of obesity among adults, 2009

Source: OECD Health Data 2011; national sources for non-OECD countries.



#### 5. Is there a "fat switch?"

The general view is still that obesity is due to people ingesting more calories than they burn. More provocative research led by Richard Johnson from the University of Colorado<sup>8</sup> now suggests that it may not be as simple as that. Johnson suggests that weight gain may be driven by activation of a "fat switch" that increases the rate of fat storage and that can drive weight gain. The trigger of this switch could be the ingestion of sugar (and in particular fructose), although carbohydrates may trigger this switch as well.

This theory is based in part on some of the genetic factors behind obesity that were discussed earlier and the fact that certain genes may have been naturally selected over time as genes that were favorable to helping people survive periods of famine. These genes act as a switch that is activated when the body ingests sugar or carbohydrates and leads to the more rapid production of fat.

Johnson and colleagues argue that the body is especially sensitive to fructose (as opposed to other sugars and carbohydrates) and that the ingestion of fructose may have a more pronounced impact on the "fat switch" and the production of fat. Our review of the literature leaves us intrigued by the fat switch theory although we admit that as of now the science and data are inconclusive.

#### 6. The diabetes link

The suspicion that increased consumption of sugar leads to diabetes has been highlighted by several doctors since the 1800s. Sir Frederick Banting, who received the Nobel Prize in 1922 for his discovery of insulin, linked the sharp increase of diabetes in the USA, to the sharp increase in sugar consumption. Haven Emerson, the Commissioner of Health for New York City in 1924 wrote a paper entitled "The Sweet Death" and he too linked the consumption of sugar to the sharp increase in diabetes among the wealthier New Yorkers. While causality on a scientific basis requires more than suspicions, the amount of data linking the sugar consumption and diabetes has grown exponentially.

The debate flared up again earlier this year following the publication of a study by Basu et al<sup>9</sup> that examined the potential impact of sugar on causing diabetes, independent of other factors, including overweight and obesity. This group found that for every 150 kcal/person/day increase in sugar availability there was a 1.1% increased prevalence of

<sup>6</sup> OECD Health Data 2011

<sup>7</sup> World Health Organization, Obesity Health Observatory ([http://www.who.int/gho/ncd/risk\\_factors/obesity\\_text/en/](http://www.who.int/gho/ncd/risk_factors/obesity_text/en/))

<sup>8</sup> Johnson, Rachel, et al. "Dietary Sugars Intake and Cardiovascular Health" - *Circulation* 2009, 120:1011-1020 (August 2009)

<sup>9</sup> Basu S, Yoffe P, Hills N, Lustig RH (2013): "The Relationship of Sugar to Population-Level Diabetes Prevalence: An Econometric Analysis of Repeated Cross-Sectional Data"; *PLoS ONE* 8(2): e57873. doi:10.1371/journal.pone.0057873

Figure 3

#### US calorie consumption growth over the 20th century

Source: USDA, Credit Suisse Research

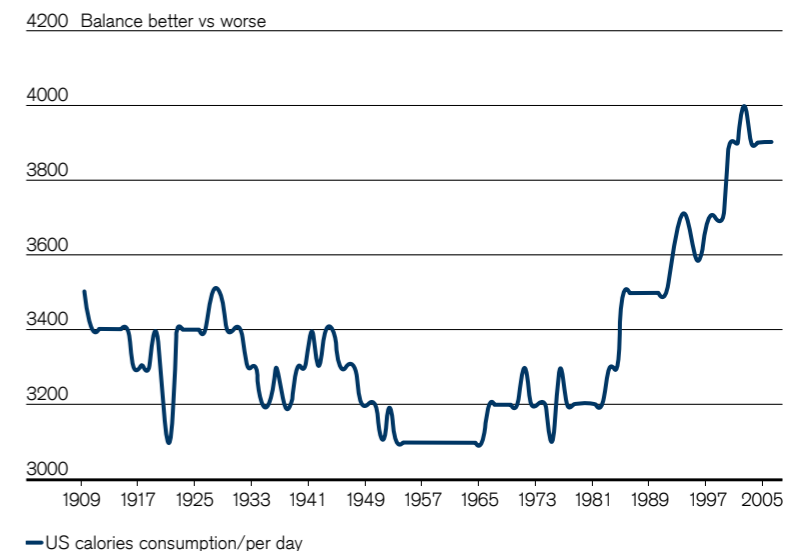
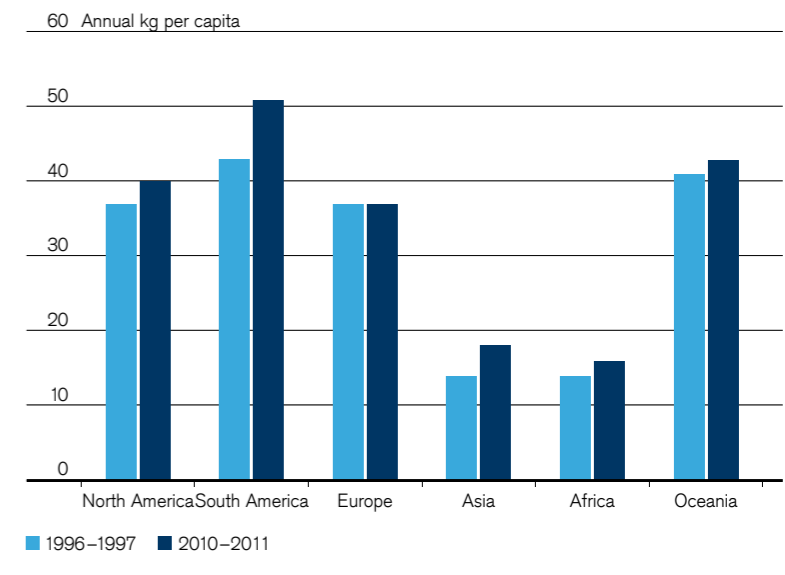


Figure 4

#### Per capita sugar consumption 1996-97 and 2010-11

Source: Sucden



diabetes, independent of a variety of dietary, social and economic factors (Figure 6). As with any population-based analysis such as this one, there are limitations in the strength of the conclusions that can be made from the study. It does add one more piece of possible evidence on the side of the argument that there is something specific to sugar that drives the development of conditions such as diabetes, beyond just the calories sugar contains and the weight gain and obesity that the added calories may cause.

The Basu study did a commendable job of attempting to control for other factors that may contribute to weight gain and obesity. It is essentially impossible for a study to completely isolate sugar for a long enough period of time to allow for

Figure 5

**Estimated prevalence and healthcare costs of adults with diabetes**Source: UnitedHealth Group Modeling, 2010 ([http://www.unitedhealthgroup.com/hrm/unh\\_workingpaper5.pdf](http://www.unitedhealthgroup.com/hrm/unh_workingpaper5.pdf))

	Prevalence in adult population			Health costs attributable to diabetes (in USD bn)		
	2007	2010 (estimate)	2020 (estimate)	2007	2010 (estimate)	2011–20 (projection)
People with prediabetes	26.3 %	28.4 %	36.8 %	27	34	585
People with undiagnosed diabetes	2.9 %	3.1 %	4.1 %	12	15	253
People with type I diabetes	0.2 %	0.2 %	0.2 %	4	5	73
People with type II diabetes	7.6 %	8.2 %	10.8 %	110	140	2,439
Total	37.0 %	39.9 %	51.9 %	153	194	3,351

fully convincing results to be generated either in support of or against sugar. One point that we find interesting, however, is that there are no studies that have been published (to our knowledge) that suggest sugar has a protective benefit, while there are a number of studies (including the Basu study) that at least partially implicate sugar. If sugar truly has no specific impact on the body when considered in isolation from other factors, one would assume that random chance would lead to some studies showing sugar to be beneficial, while others show harmful effects and others show no effects.

**7. The metabolic syndrome link**

While it does appear that fructose and glucose are handled in an essentially equivalent manner in the body, there may be some conditions in the body where fructose may have a greater detrimental impact than glucose. Two specific conditions that have been highlighted in the literature where fruc-

tose may play a particular role are metabolic syndrome and nonalcoholic fatty liver disease (NAFLD). Some of the opinions connecting fructose in particular to metabolic syndrome and nonalcoholic fatty liver disease are driven by the temporal association between the rise in fructose consumption (as part of sugar and as part of high-fructose corn syrup) and the rise of these conditions, but there is some biological rationale behind these concerns as well.

The metabolic syndrome is a constellation of five different risk factors, each leading to an increased risk of heart disease, diabetes and stroke (Figure 7). Various studies on small-size test samples have shown that fructose consumption, but not glucose consumption, can increase visceral adipose tissue, increase triglyceride levels and lower HDL cholesterol levels. Other studies have shown that fructose consumption may increase liver enzymes, suggesting potentially altered hepatic function and a possible rationale behind the development of NAFLD.

Unfortunately, most of these studies have been relatively small studies of short duration so the data are not conclusive one way or the other. In addition, the fact that fructose is almost always ingested with glucose may make it difficult to ever have conclusive evidence of the isolated impact that either nutrient is having in the body.

There are a couple of questions still being debated without full agreement, but that are key to understanding the implications for consumer, sugar companies, and food and beverage manufacturers.

**8. Is sugar as addictive as caffeine?**

Some of the most vocal critics of the sugar industry have expressed concerns that not only is sugar toxic, but it may contain some addictive properties that lead people to desire more and more sugar over time. Addiction is a powerful term and, from a medical perspective, requires some specific criteria to be met. Specifically, in order for someone to be addicted to a substance, they must (1) have cravings for the substance, (2) be unable to control

Figure 7

**Metabolic syndrome is made up of a group of five metabolic risk factors**

Source: National Heart, Lung, and Blood Institute

Metabolic risk factors
Large waistline/abdominal obesity
High triglycerides
Low HDL ("good") cholesterol
High blood pressure
High fasting blood sugar

their use or consumption of the substance, (3) use the substance compulsively, and (4) continue to use it despite the harm it is causing.

Sugar may not pose the clear addictive characteristics of illicit drugs such as cocaine and heroin, but to us it does meet the criteria for being a potentially addictive substance. It is clear that a preference for sweet taste is innate in many people, with sweeteners increasing the pleasure that people obtain out of eating. The consumption of sweet tasting foods and drinks has been shown to trigger the release of the chemical dopamine in the basal ganglia portion of the brain, the same response that the brain has to stimulation by sexual arousal, narcotics and other pleasurable stimuli. Most people can also attest, at least anecdotally, to people developing cravings for and compulsively consuming certain sweet foods and drinks, even when they are not necessarily hungry or thirsty. In addition, many (if not most) people who are overweight or obese continue to eat sugary substances even if they realize that it is contributing to their calorie intake and weight gain.

The more formal scientific data supporting the view that sugar is addictive is somewhat limited and based mainly on animal studies. Studies on laboratory rats have shown that rats can develop cravings for sugar water. They also binge on sugar water and show signs of withdrawal when the sugar water is withheld. Rats have also been shown to develop a tolerance to sugary substances. Over time, rats that have been fed a sugary diet have a reduction in the number of dopamine receptors in their brain, leading to them needing to ingest more sugar to achieve the same amount of dopamine release and pleasure response.

Studies of this sort are more difficult to conduct in humans. However, studies using functional brain imaging techniques such as functional magnetic resonance imaging (MRI) scans and positron emission tomography (PET) scans have shown that obese individuals tend to have fewer dopamine receptors in their basal ganglia, suggesting that they may also need to eat more sweet foods to

Figure 8

**Withdrawal from caffeine can cause symptoms similar to those seen with other addictive drugs**

Source: American Psychiatric Association

Symptoms of caffeine withdrawal
Headaches
Fatigue
Anxiety
Irritability
Depressed mood
Difficulty concentrating

generate the same dopamine release and pleasure response. What is sometimes left out of the sugar discussion is the fact that caffeine is often in the same food and beverages that have significant amounts of added sugar. Energy drinks, carbonated beverages and chocolates are just some of the examples of substances that have caffeine included with added sugars. Caffeine also does not pose the same risk of addiction as some other drugs but it does stimulate the central nervous system, leads to positive feedback loops and can cause withdrawal symptoms when it is discontinued (Figure 8). Given that caffeine and sugar are often ingested together, it is sometimes difficult to isolate the impact of one substance as opposed to the other. Regardless, an addiction, or at least a mild-to-moderate dependence, does seem to occur in some people to one or both substances, contributing to people ingesting more of the substance than they know they should.

**9. Is there a threshold sugar intake level we have crossed?**

Most of the focus around sugar intake has assumed that there is a linear dose response to increased sugar consumption. As the consumption of sugar has increased (along with the consumption of other calories) there has been an increase in various medical conditions. However, newer data suggest that a linear dose response may be too simplistic.<sup>10 11</sup>

There may be a threshold level in the body below which sugars are without harm. Should this be supported by additional studies, then it could impact how future dietary guidelines are written. It may also help explain why the prevalence of certain conditions continues to rise even if the rate of consumption of soft drinks and some other sugar-sweetened beverages may have leveled off.

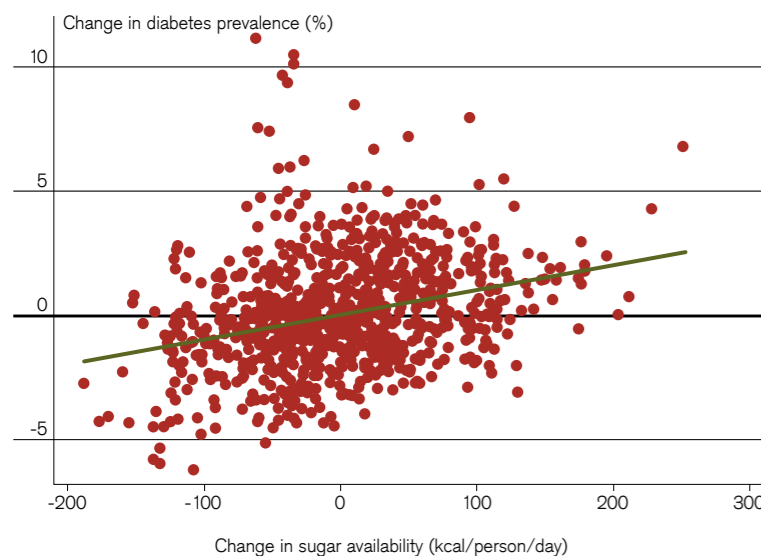
<sup>10</sup> Johnson, RK, et al. AHA Scientific Statement: Dietary Sugars Intake and Cardiovascular Health. *Circulation* 2009; 120: 1011–1020.

<sup>11</sup> Rennie KL, Livingstone BE. Associations between dietary added sugar intake and micronutrient intake: a systematic review. *British Journal of Nutrition*. 2007; 97: 832–841.

Figure 6

**Increased sugar availability has been associated with increased diabetes prevalence**

Source: Basu et al, PLoS ONE 8(2): e57873.

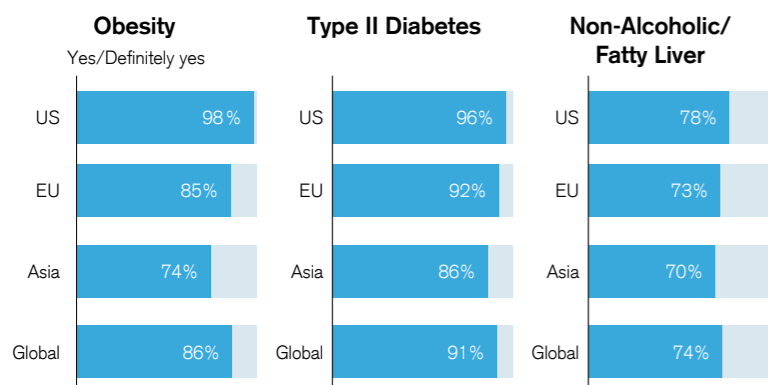




## The medical profession

**Figure 9**  
Would you say sugar consumption is linked to the development of...?

Source: Credit Suisse Equity Research Nutrition Survey, 2013



While research has yet to prove direct causality between excess sugar consumption and obesity, diabetes type II or metabolic syndrome, the medical profession is regularly confronting these issues in their day-to-day practice. It is interesting to observe what doctors think of these issues. With this in mind, we conducted a proprietary survey of 152 doctors in the USA, Europe and Asia. The results are quite startling.

While most doctors do not appear to have much specialized knowledge or training about nutrition (and more specifically sugar or HFCS), 82% of the doctors in the USA and Europe think that sugar calories are handled differently by the body, compared to only 60% in Asia. On the question "is sugar addictive," 65% think this is the case. There is more: 98% of the doctors in the USA think that

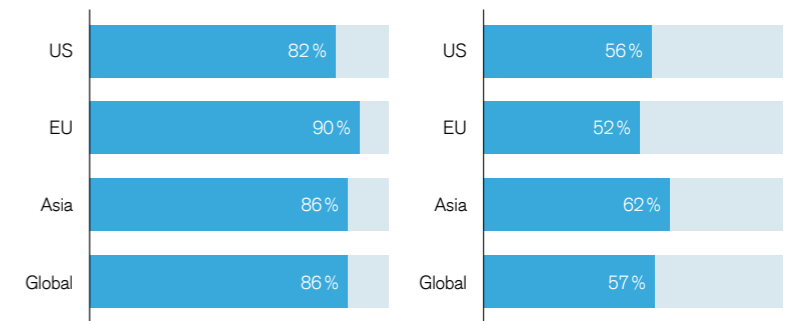
PHOTO: ISTOCKPHOTO.COM/SKYNESHER

increased sugar consumption is linked to the development of obesity, compared to 85% in Europe and 94% in Asia. The same question regarding diabetes type II shows that 96% of the doctors we surveyed in the USA believe there is a link with increased sugar consumption versus 92% in Europe and 86% in Asia.

Finally, we asked the survey participants if they thought that the government or health authorities should be doing more to reduce sugar and HFCS consumption. Eighty-two percent of the doctors answered yes in the USA, 90% in Europe and 86% in Asia. It is also interesting to notice that when we asked whether they believed the government or the health authorities are likely to do more to reduce the consumption of sugar and HFCS, only 57% responded yes.

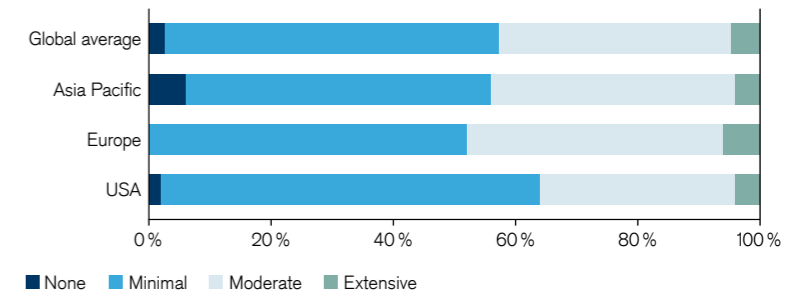
**Figure 10**  
Should the government and health officials do more to reduce consumption of sugar, and will they in your opinion?

Source: Credit Suisse Equity Research Nutrition Survey, 2013



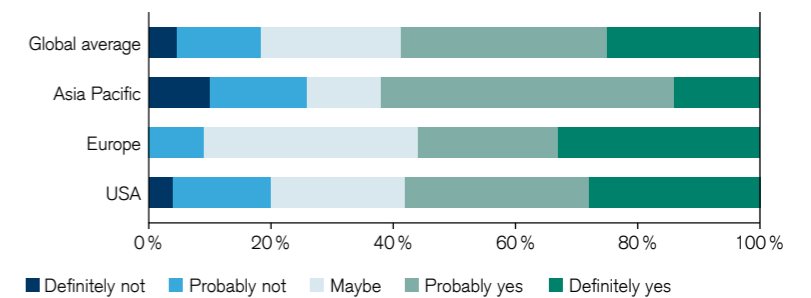
**Figure 11**  
How would you describe the extent of training/coursework you received on nutrition during your medical training?

Source: Credit Suisse Equity Research Nutrition Survey, 2013



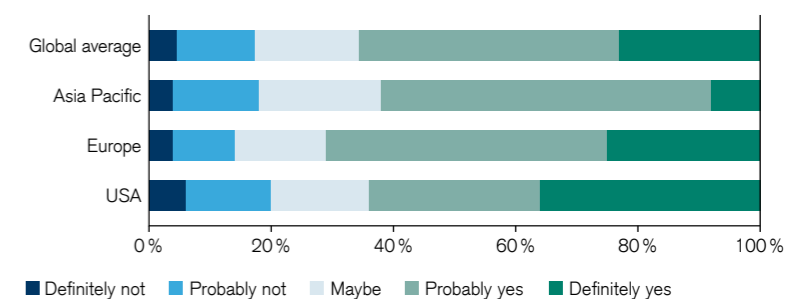
**Figure 12**  
Do you believe there is a difference between how sucrose and fructose are handled by the body?

Source: Credit Suisse Equity Research Nutrition Survey, 2013



**Figure 13**  
Do you believe sugar is addictive?

Source: Credit Suisse Equity Research Nutrition Survey, 2013





# The world sweetener market

Sugar accounts for over 80% of the sweetener market. Growth has been basically in line with global population growth (2%), but “free market” prices have suffered from excess supply. Among high-intensity sweeteners, the fastest-growing segment is natural sweeteners, while artificial sweeteners are under increased scrutiny due to potentially negative “health effects.”

We have probed into the latest medical research on the effects of sugar and HFCS. In order to better assess the potential implications of this research for consumers and corporations, we need to analyze the main features of the global sweeteners industry (sugar, HFCS and other sweeteners).

The global sweetener market is estimated to be around 190 million tons of “white sugar equivalent,” and is unsurprisingly dominated by sugar. Each of the major groups (high-intensity/artificial sweeteners, sugar, and high-fructose corn syrup) has been growing at a similar rate of circa 2% per annum, though the most recent numbers have natural high-intensity sweeteners growing rather faster.

Sugar is one of the most important agricultural commodities traded internationally. The annual value of world trade exceeds USD 24 billion. However most sugar (71%) is consumed in the country of origin, so the global trade (imports/exports) totals around 60 million tons, and Brazil accounts for 25–30 million tons of this. As the world market is a smaller market, it is thus rather more sensitive to changes in

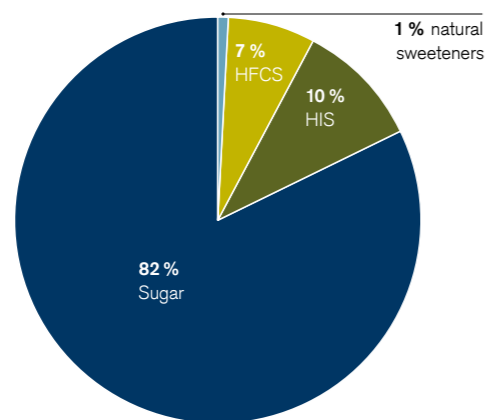
production – particularly in Brazil – than might otherwise be thought. This means that, although there are several producers globally, the key is to understand what is happening in Brazil in particular, and to a less extent in India, Thailand and China.

The market for high-intensity sweeteners, both natural and artificial, is completely open, but the products are the most heavily regulated among sweeteners. These regulations vary from country to country. A high-intensity sweetener cleared in one country may be banned in another. The artificial sweetener industry’s profile on health is somewhat colored and many still see some of these products in a bad light. This is not the case for natural HIS, the largest portion of which is made of polyols (sugar alcohols)

Finally, the market for HFCS is similar in size to that of HIS, but is concentrated in three major markets: USA, China and Japan. The principal requirement for HFCS to flourish is government support. HFCS can only truly become established where it is allowed and where there is enough supply of starch.

**Figure 14**  
**Global sweetener market 2011**

Source: ISO Estimates – Volumes



**Figure 15**  
**Growth rates 2005–11**

Source: ISO estimates

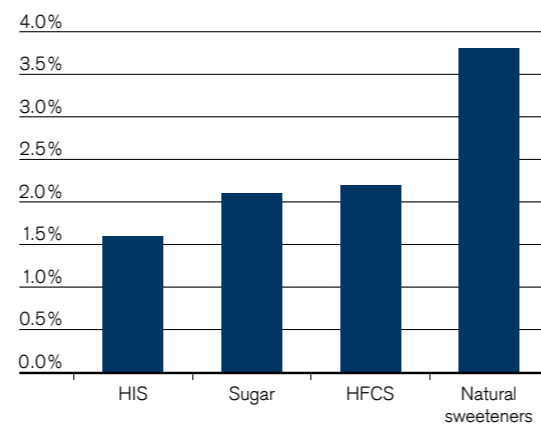
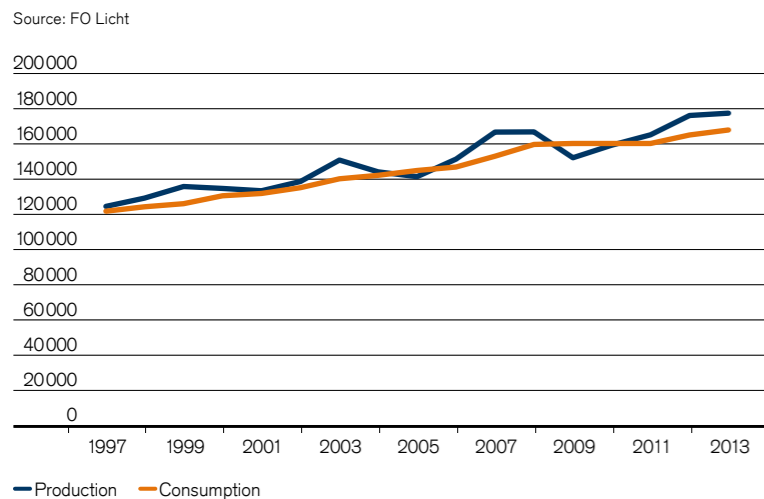


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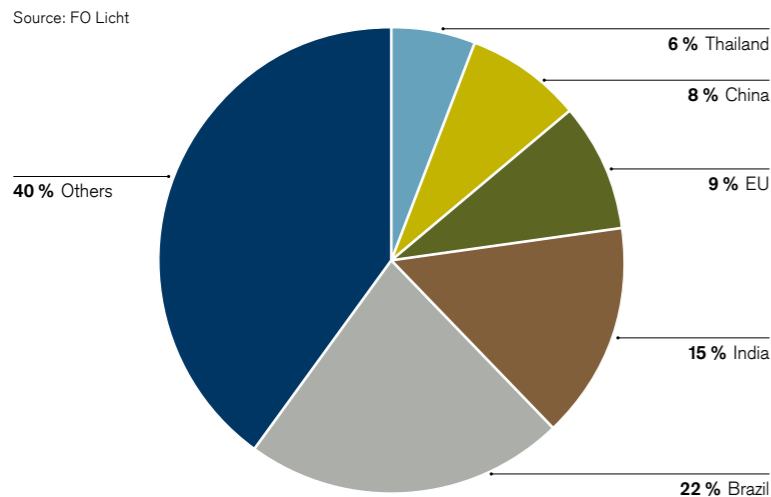




**Figure 16**  
Supply/demand of world sugar ('000 tons)



**Figure 17**  
World sugar production



## Sugar<sup>12</sup>

### Supply/demand

Sugar comes in two forms: (1) cane sugar (75%–80% of world supply, grown in tropical climates), and beet sugar (20%–25%, grown in temperate climates). Some countries are large enough to grow both crops (e.g. China and the USA). The world sugar market is around 165 million tons and is growing relatively steadily by around 2% per annum. Supply is more cyclical, however, and can depend on crop yields/weather, and the willingness of farmers to plant crops (dependent on price). Beet is a perennial so farmers' decisions can be influenced by the price of other crops (notably cereals). Cane takes 18 months to reach maturity and can yield sugar for typically five years (though this can vary), after which yields will drop.

Many countries have regimes that protect the local production through various mechanisms including support prices, import restrictions, production quota, etc. Examples include the US Farm Act, the European Union Sugar Regime, or the Chinese government's controls on imports. Put simply, the complexity of the infrastructure surrounding sugar is significant. Thus, the traded market (or the "world market") is only 55–60 million tons, and is sometimes referred to as the residual market (where the sugar that is not a part of the special agreements is bought and sold). The largest producer of sugar by some distance is Brazil (22% of world production), followed by India

<sup>12</sup> For more details about the dynamics of the sugar market please refer to "LatAm Sugar & Ethanol - More Challenges Than Opportunities in Brazil's Sugar & Ethanol Sector", Credit Suisse IB Equity Research, 29 July 2013.

PHOTO: ISTOCKPHOTO.COM/PALLOLOM

(15%), China (8%) and Thailand (6%). However, India and China consume all they produce, so if we look at the supply to the "world market" instead, this is dominated by Brazil (supplies typically half the "world market") and Thailand (10%–15%).

### Sugar prices

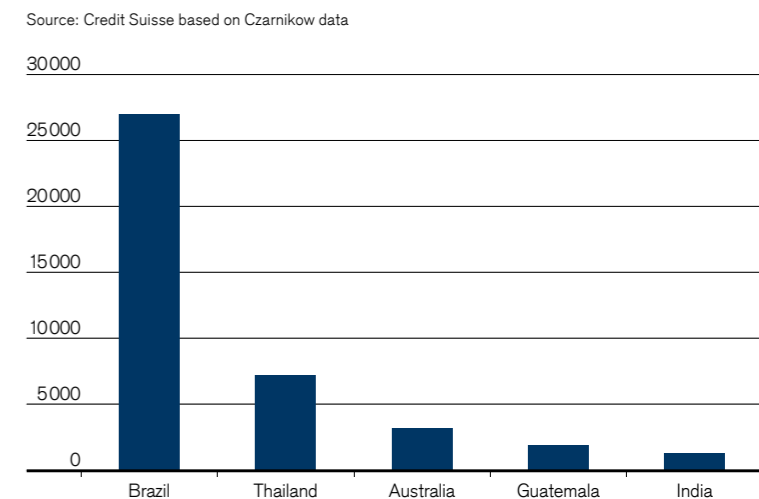
The "residual" nature of the world market has made the "world price" very volatile and sensitive to movements in global supply versus demand. It has generally been in surplus (see Figure 19), but can react sharply when a deficit is recorded or expected, much as it did happen in 2009–11.

Brazil's cost of production is generally thought to be USD 18 cents/lb. and, in the long term, this should be the floor of the market. As we mentioned earlier, most of the markets are protected/controlled, which means the local price bears little significance to the world price – and trades at a significant premium (see Figure 20). These regimes have been in place for many years and are designed to protect the local farmers from the vagaries of the world price and guarantee them an economic return.

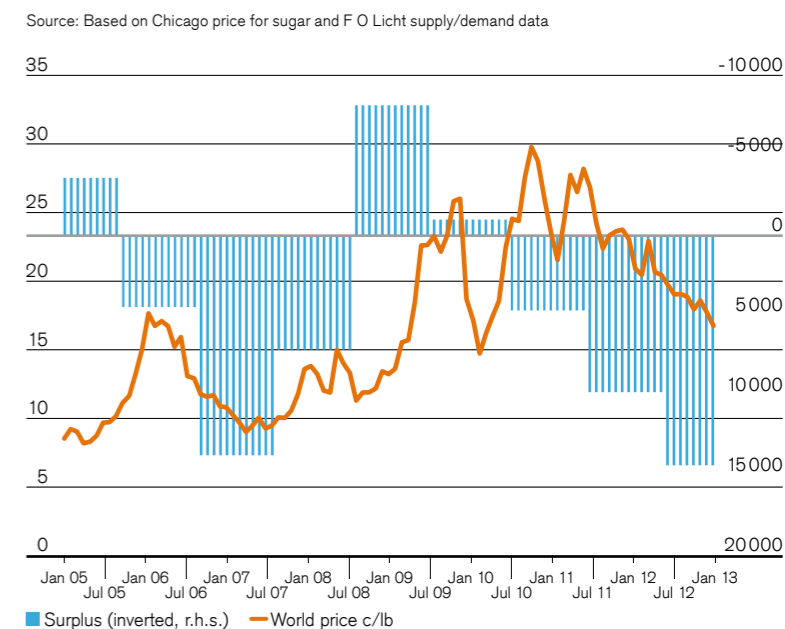
### Politics versus economics

Hence, the dynamics of sugar have two principal drivers: (1) Economics: The economics of supply/demand, that have weather, crop yields, supply and demand at their core; and (2) Politics: The extensive lobbying power of the sugar industry is legendary (it is often referred to as the second most political commodity in the world – after oil). The industry is a huge employer across the globe (there are 15 million cane growers in China, and 350,000 beet growers in Europe). Politicians are very sensitive to protecting these businesses, and tailor regimes to do exactly that. Leaving politics aside, we could see a slight rebound in sugar prices in 2013–14 due to the combination of three main factors: (1) A potential reduction in yields in some areas, (2) The current low sugar prices are encouraging some producers to shift their land use to other crops (mainly grains) given better profitability, and (3) The planting mix should continue moving toward ethanol production as a consequence of recent government incentives (and these incentives should continue because of trade deficits caused by gasoline imports). Our long-term price assumption USD 20 cents/lb (from 2014–15 onwards) is based on the level needed to remunerate the cost of capital for this type of project in Brazil. On the other hand, demand could be weaker and keep prices around the current level. Consensus points to demand growing around 2% per year, very much in line with the 2% increase seen over the past ten years. However, as we will see later, consumption in developing countries is likely to grow at these rates or even slightly higher, but developed markets could see much slower growth as concerns about the "medical" effects of sugar gain further momentum.

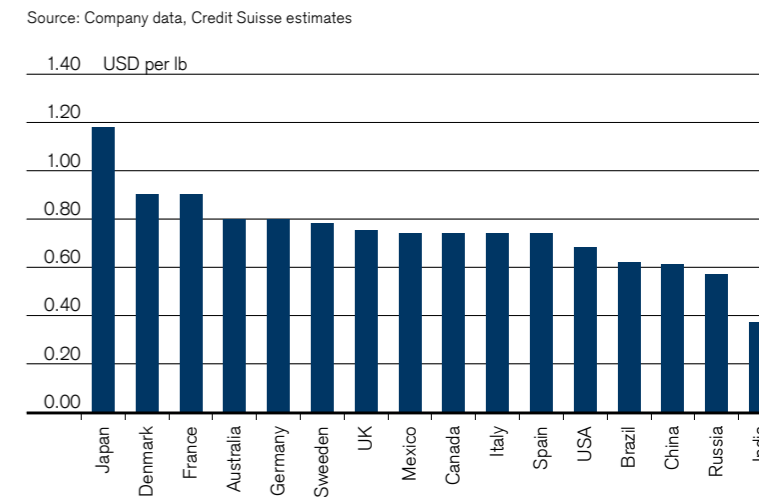
**Figure 18**  
World sugar production less consumption (m tons)



**Figure 19**  
World price of sugar, versus world surplus/deficit



**Figure 20**  
Average retail prices of sugar (USD/lb.)





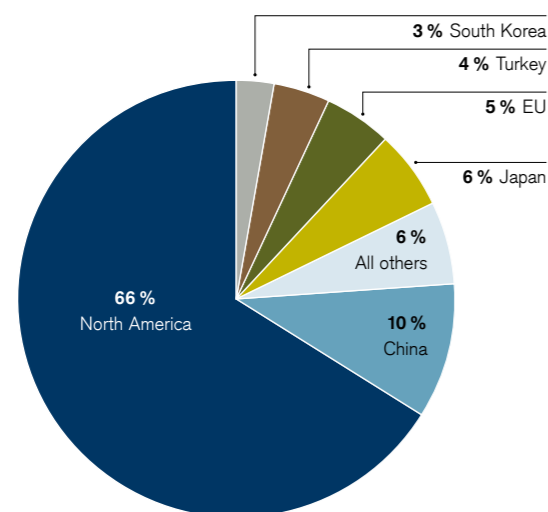
## High-fructose corn syrup (HFCS)

As we mentioned before, the principal requirement for HFCS to flourish is government support. With many (indeed most) sugar industries around the world subject to some form of government support and regime, HFCS can only truly get established where it is allowed and where there is enough supply of starch. 80% of the HFCS production is found in the USA, Japan, China and the EU. Global demand is growing very modestly (up 1.3% per annum), reflecting current low sugar prices (as seen in 2008/9). The current spot price of bulk HFCS in the USA is now USD 29 cents/lb. versus 17 cents/lb. for sugar cane and 26 cents/lb. for beet sugar.

HFCS is obtained through an enzymatic process to convert some of the glucose from corn syrup or starch into fructose to deliver the desired sweetness. Normally cheaper than cane or beet sugar, it is sold in liquid form and has been widely adopted by the food and beverage industry since 1975. Advocates of sugar cane and beet sugar, contend that HFCS is not a natural product and have been waging a legal battle in the USA to disallow the use of the word "corn sugar" by HFCS producers. The FDA has not allowed the use of this term and the debate is then centered on whether HFCS is "natural." This is clearly a "marketing" battle. For the scope of our study, sugar and HFCS are basically the same.

**Figure 21**  
High-fructose corn syrup production by country

Source: FO Licht



**Figure 22**  
Global production of HFCS

Source: FO Licht

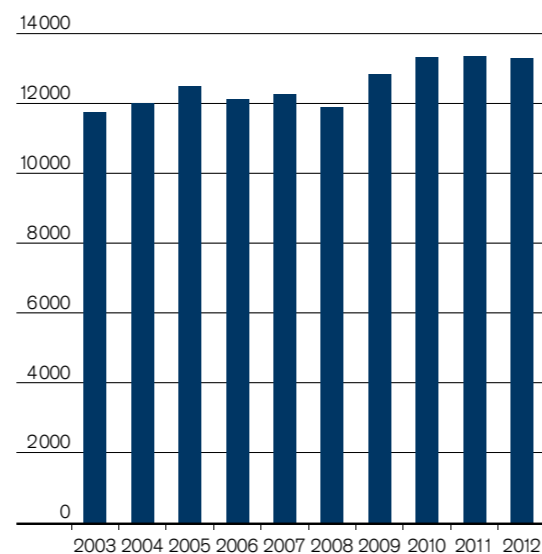


PHOTO: ISTOCKPHOTO.COM/GEORGECLERK

## High-intensity/artificial sweeteners (HIS)

Finding a high-intensity (or artificial) sweetener that mimics sugar but without any health or taste issues has long been the holy grail of the industry. There have been a number of products over the year that have significantly advanced the industry (Aspartame, Sucralose, and possibly Stevia recently), but thus far – despite the huge levels of R&D – no one has managed to exactly mimic sugar.

The relative sweetness of these products by weight to sugar varies significantly too, from 30 times to 1500 times, so that comparisons are best made on a white sugar equivalent (WSE). The global market is 18–19 million tons of WSE.

The relative prices of these sweeteners (again on a WSE basis) are so far apart that the value share of the market is materially different to the volume share.

• **Saccharin** is the original artificial sweetener, and dominates in volume terms, but sells at a fraction of the price of sugar (less than USD 1 cent/lb. versus sugar over USD 25 cents). Often used as a replacement for sugar on cost grounds in developing markets.

• **Aspartame** was first allowed in food and beverages in the 1980s (launched by GD Searle), but has always suffered from debates over its safety. It is the principal sweetener in diet soft drinks and sells at around USD 8 cents/lb.

• **Acesulfame potassium** (also known as Ace K); launched by Hoechst in the 1980s. sells at around USD 5 cents/lb., and is often combined with Aspartame to form a cocktail of artificial sweeteners in diet beverages.

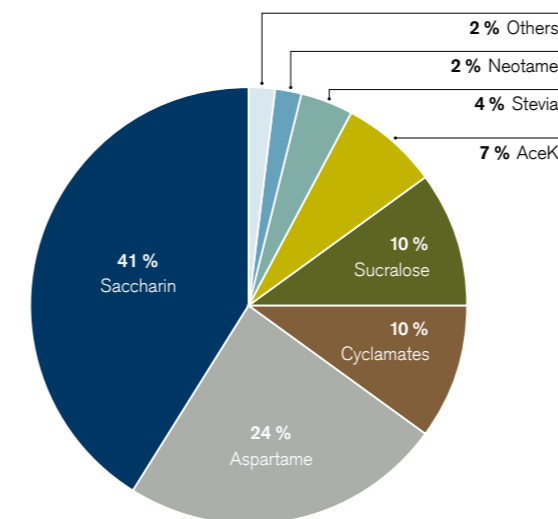
• **Sucralose** was developed by Tate & Lyle in 1975 (marketed under the Splenda brand name) and, finally gaining approval in 1998, it quickly established itself as one of the pre-eminent artificial sweeteners (it is actually chlorinated sugar) that, unlike other HIS, is able to be heated (thus bringing in new industries where traditionally most HIS were sold in beverages). T&L still dominates supply with an 80%+ global share. Sucralose sells at USD 20+ cents/lb.

• **Stevia**: Stevia is the only true natural product in this list (polyols are too, but not the ones used commercially). Prepared in different forms, Stevia has been around for many decades, but recently refining and improving its purity (notably by PureCircle) has led to somewhat of a renaissance of the product, which has helped it to gain significant tranches of market share notably in the US table top market.

• **Other**: There is a lot of research going into natural HIS. The most recent launches are derived from the Monk fruit and from the Oubli fruit, but there is more to come. This is a fast-growing area where we expect the market to expand rapidly.

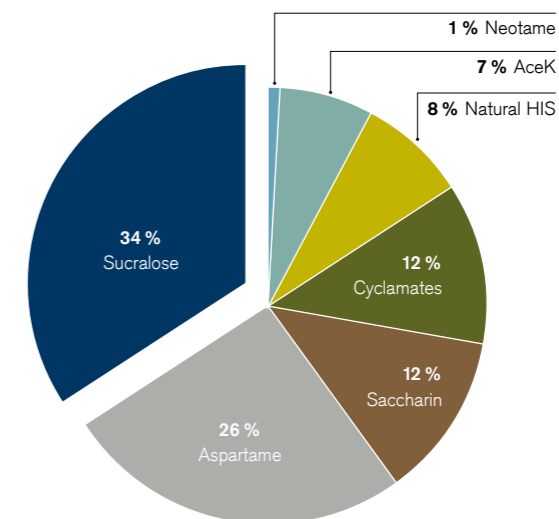
**Figure 23**  
High-intensity sweetener volume shares (WSE)

Source: ISO



**Figure 24**  
HIS value shares (of global USD 1.2 billion market)

Source: ISO



# The consumers

Added sugars now represent 17% of a normal US diet and we estimate that 43% of added sugars come from sweetened beverages. As public awareness of the potential negative effects of excess sugar consumption has increased, consumers have been favoring “diet” soft drinks over the “full-calorie” offerings. This is particularly true among people with higher income and higher education.

While the largest contributor to the increase in calories has been the consumption of grains, fats and oils, the consumption of sugar and sweeteners has also increased, but at a somewhat slower rate than overall calories.

Added sugar now represents 17% of a typical US diet for a normal person, but if we evaluate the

diet as a whole, we estimate that sugars in their different forms represent 38% of the typical intake. Consumers “like” all sugar types, but we are now beginning to see a shift in attitude when focusing on added sugars and HFCS. Sugar in fruit for example is still perceived as good, but added sugar and HFCS may not be.

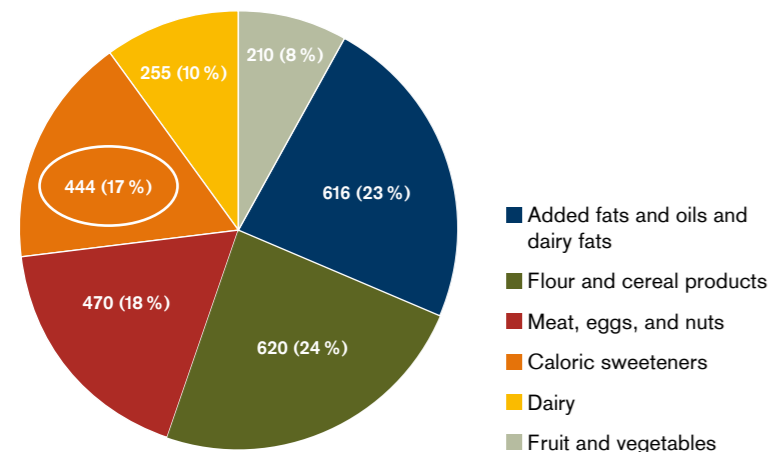
Is 17% a “healthy” level? According to the World Health Organization, the recommended dietary allowance is 2900 calories for men (aged 19–50) and 2200 for women. In practice, many countries are way above these guidelines. Furthermore the World Health Organization recommends that added sugars should contribute no more than 10% of the total caloric intake. This would imply that the total added sugar calories in the average diet should be no more than 290 for men and 220 for women. Many countries are clearly ahead of this level by a significant margin.

It should be noted that added sugar is consumed largely through processed foods and drinks, and not as the basic product. Our estimates of the caloric intake of sweeteners (HFCS and sugar) by country is considerably higher than the recommended 220–290 implied above.

Added sugar and HFCS are present in numerous foods and beverages: from pasta sauces,

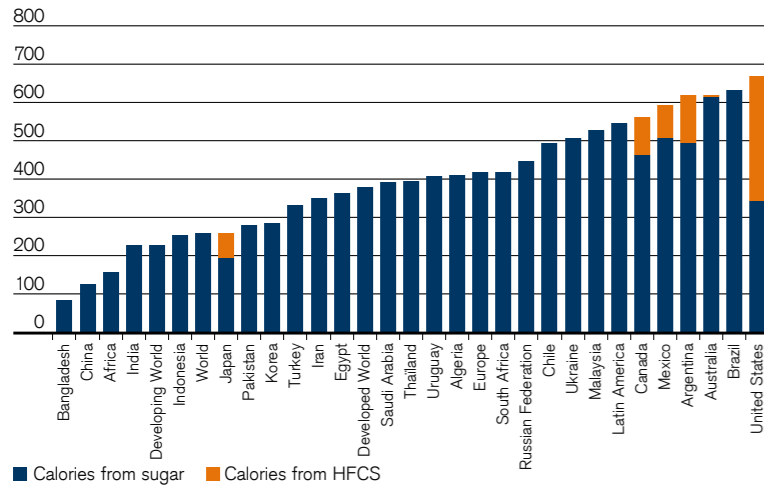
**Figure 25**  
**US per capita daily calorie consumption in 2010**

Source: United States Department of Agriculture Economic Research Service



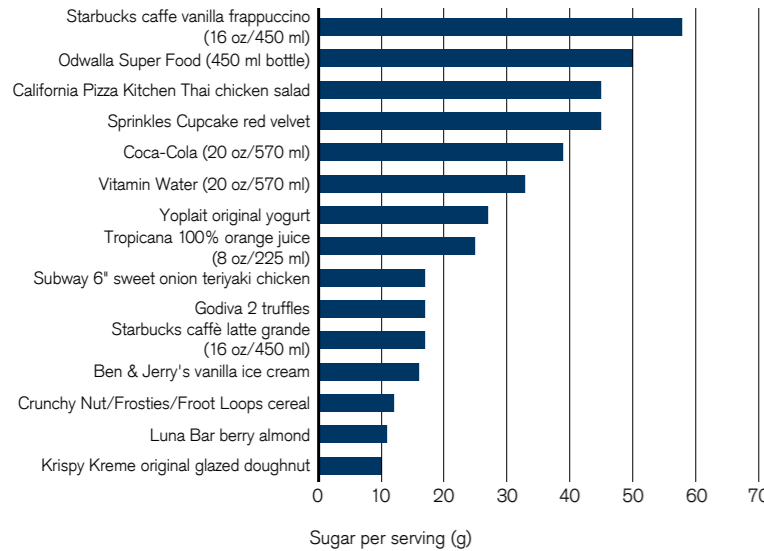
**Figure 26**  
**Caloric intake of sweeteners by country**

Source: USDA-ERS, Conadesuca, OECD, Credit Suisse Research



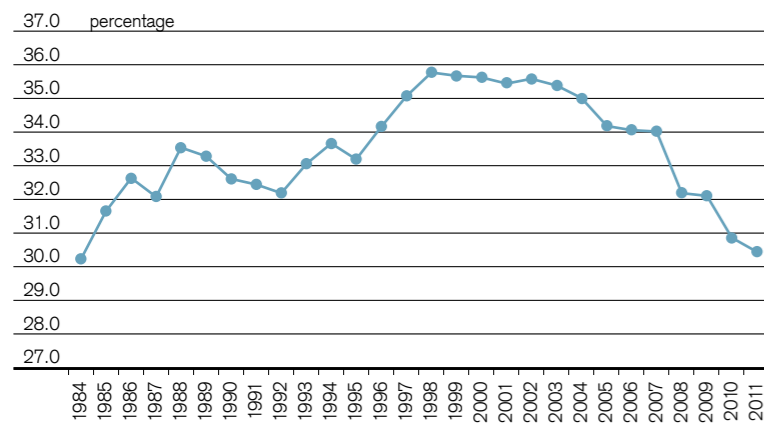
**Figure 27**  
**Sugar per serving in various foods and beverages**

Source: SummerTomato.com



**Figure 28**  
**Sweetener deliveries to the USA beverage industry as a percentage of total sweetener deliveries**

Source: Sugar and Sweeteners Outlook (SSS-M-293), USDA Economic Research Service, 2013



ketchup, pizza and cereals to a full array of beverages. Note that 4.2 grams of sugar make up a “teaspoon.” We are, therefore, referring to a large number of teaspoons in most cases. Yet the main focus for consumers regarding the potential health issues tied to sugar has been on beverages and particularly soft drinks. Why?

Sweetened beverages are now delivering an increasingly greater percentage of the sugars that are ingested in an average diet. Between 1955 and 2000, the consumption of soft drinks in the USA increased from about ten gallons/person to 54 gallons/person and then declined by around 20% until 2012, but with an equivalent increase in the consumption of fruit juices and bottled water. According to the USDA, the beverage industry now accounts for 31% of total sweetener deliveries and we estimate that 43% of added sugars in a normal US diet come from sweetened beverages.

A similar stabilizing trend can be seen in most other developed markets, while consumption is still on the rise in emerging markets. Why are we seeing stabilization or even a decline in some developed countries? Information is key. There is a growing perception – not completely wrong as we discussed – that caloric soft drinks have been responsible for some of the health issues mentioned before. This perception is stronger among people of higher education or higher income.

**The consumers' options**

So what is likely to happen? Four main things:

1. As long-term trends in consumption are set by those with higher education and higher income, we expect the world to gradually move away from full-calorie soft drinks to the diet versions of the same drinks, when available.
2. In the USA and Europe, the diet or zero version of the soft drink peaked around mid-2000 and then declined gradually in line with the full-calorie version. This reflects a growing concern with artificial sweeteners, particularly in Europe. We expect this to be the case in other markets, but as we discuss in the company section, we expect soft-drink manufacturers to make attempts at substituting artificial sweeteners with natural ones, as the taste profile of the latter improves. Consumers will determine the success or failure of these newer versions. The key is acceptance of new tastes or delivering the same taste with fewer calories.
3. We expect consumer associations to be a lot more proactive in raising potential health issues and monitor advertisement and availability, particularly for children. This applies to soft drinks sweetened with sugar, HFCS or HIS.
4. Growing public support for regulation and potentially taxation.

Mexico is a good example of what we can expect on a more global scale in the next couple of years.

Here, the debate is centered around introducing taxes on full-caloric drinks as a part of the new budget, increased advertisement by food and beverage manufacturers, attempting healthier positions of their brands, and increased “educational” advertisement by health officials and consumer organizations.

A few months ago, Coca-Cola launched a simple but subtle campaign promoting Coke as a source of “needed” calories or – if you want to take a different view – being completely transparent about the caloric content of a coke bottle. The response to the ad was swift. The Alianza para La Salud Alimentaria (Alliance for Healthy Foods) launched an ad showing the amount of sugar in a bottle of soda (“would you drink twelve spoons of sugar?”) and linking sugar in soft drinks to diabetes (“the drink is sweet, but diabetes is not”). Another association – El Poder de el Consumidor – denounced the ad by Coke as misleading and dangerous and demanded its withdrawal. A similar advertisement in the UK, showing a bottle of Coke with the message “139 happy calories to spend on extra happy activities” had to be withdrawn after the UK advertising supervisory body ruled that the advertisement was misleading.

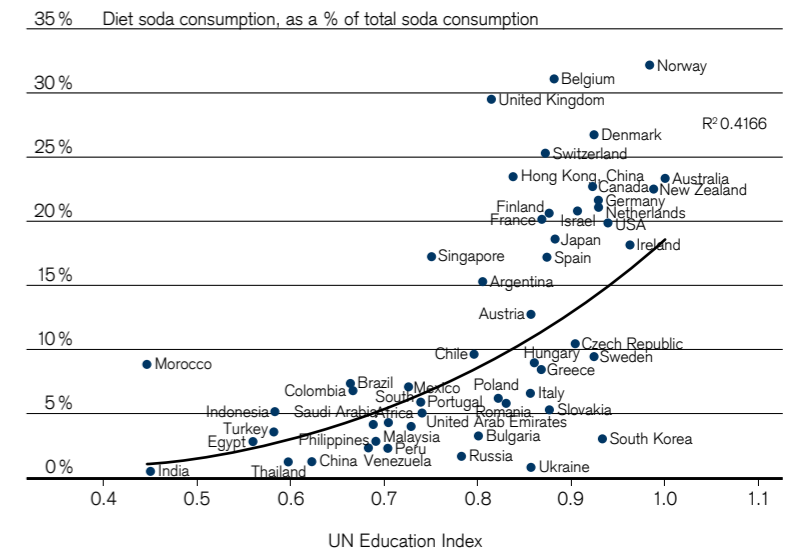
In this more contentious environment, Coca-Cola Femsa, the largest coke distributor in Mexico and Coke’s largest independent bottler globally, has moved quickly to address directly health and wellness issues. In its 2012 Sustainability Report, the company mentions the “Let’s Play” program, which was originally developed in Costa Rica, and is now being rolled out in Argentina, Colombia, Guatemala, Nicaragua and Panama. This is a project of technical and didactic training, aimed at school age children, focused mainly on issues of physical activity and enhancing students’ psychometric skills.

Another interesting fact that shows the growing concern of consumers about full-calorie drinks can be found in their willingness to support government regulation (including taxation) of sugar and HFCS-sweetened beverages. In California, 68% of the people polled were in favor of taxing full-calorie soft drinks if the revenues were used to support school nutrition and physical activity programs. In a 2010 poll run in the State of New York, 58% of the people interviewed supported a soft-drink tax, with a peak of 76% in New York City. However, a 2012 pool of 592 people across the USA revealed that 64% did not support a 20% tax on sodas.

Perhaps more interesting was that support for the tax was highest among those underweight or normal weight, those with the highest income (greater than USD 65,000/annum) and those with a higher education level. There was also a significant racial divide, with 39% of non-Hispanic whites supporting the tax versus 24% of black-Americans. We were unable to find similar polls in either Europe or Asia.

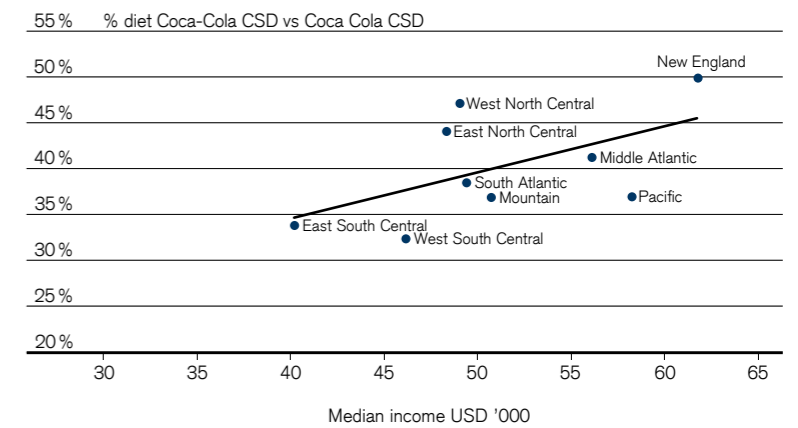
**Figure 29**  
**Diet soda consumption (as a % of total soda consumption) vs. relative educational standard**

Source: Euromonitor, Nielsen XAOC, Credit Suisse estimates



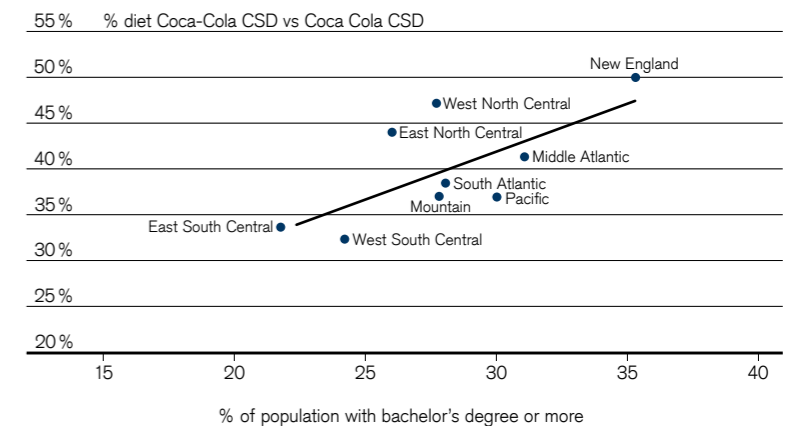
**Figure 30**  
**Correlation between diet Coca-Cola drink consumption and median income by region**

Source: Nielsen, http://www.census.gov/people/



**Figure 31**  
**Diet soda consumption relative to the % of the population with a bachelor's degree or more**

Source: Nielsen, http://www.census.gov/people/



# Public policy initiatives

With few exceptions, regulators and health officials around the world have done little to address the impact of excess sugar consumption. We believe higher taxation on “sugary” food and drinks would be the best option to reduce sugar intake and help fund the fast-growing healthcare costs associated with diabetes type II and obesity. However, lobbying in this area has been fierce and has watered down or stopped major initiatives.

Against mounting evidence of the negative impact of sugar and HFCS on obesity, diabetes type II, metabolic syndrome or rising levels of uric acid and cardiovascular disease, the reaction of regulators around the world has been limited to incremental taxes (mostly on soft drinks), stricter guidelines on labeling, bans on distribution of a few sugary products in public buildings and schools, limits on the size of drink packages, small changes in the official dietary guidelines and some educational advertisement.

Several issues have constrained, and will continue to limit the response of regulators, health officials and governments. Yet time is ticking by and the related healthcare costs are rising fast. While there is not one single action that will reverse the global epidemic of obesity, diabetes, etc., we believe that public opinion on this issue is gaining momentum. This will force regulators to do something and drive companies, or at least the largest ones, to self-regulate and take concrete actions to reduce the amount of added sugar in their products.

## Regulatory attempts: A limited response

Why have regulators been so slow in reacting? Three main motives emerge: (1) The “culprits” span across several businesses, and many of which are impractical to regulate, (2) there has been consistently strong lobbying from the affected parties, and (3) there is the lack of a proper legal framework (at least in the USA) to confront such a complex issue.

1. There is no “one-size-fits-all” solution to the

problems related to dietary caloric increase and the excess sugar we are now consuming. Calories, including those derived from sugar, are present across a wide array of products. Sugar exists not only in soft drinks and fruit juices, but also in sauces (even the most talented Italian chefs add a little sugar to a tomato sauce), bread, pasta, rice, ham and so forth.

The clearest “targets” in controlling dietary sugar consumption have been the beverage companies. We would argue that these companies have played the most prominent role in increasing the amount of sugar present in our diets through recent history. Combined with our body’s inability to recognize liquid calories and feel satiated, this has led to some of the negative health outcomes we mentioned before.

2. Lobbying in this area has been quite fierce. At the top, stands the “global sugar lobby,” often regarded as the most powerful commodity lobby behind that dedicated to preserving the interests of the oil industry. With governments promoting artificially high prices for sugar, and implementing quotas to protect the labor bases devoted to sugar beet and sugar cane (equivalent to government subsidies), there is little interest to reduce sugar consumption among those in charge of agricultural policies.

While health officials would justifiably support measures aimed at reducing the availability of sugar, one could argue that the votes available to politicians supporting sugar-reducing actions are fewer and far between than those supporting the farmers. As a side note, the general consensus has



also been that any attempt to regulate the beverage industry in the USA would be more likely directed at the corn industry (responsible for manufacturing HFCS). That industry simply has less leverage than the sugar industry, and its farmers can always substitute their crop into biofuel production. These interests, in turn, are reinforced and supported by another powerful lobby, the beverage and food manufacturers lobby.

As an example, when New York State considered introducing a tax on sugary beverages in 2009, the American Beverage Association (the largest US trade organization for soft-drink bottlers) formed a "New Yorkers Against Unfair Taxes" coalition, spending a not insubstantial USD 9.4 million on a widespread campaign to halt the proposal. Another prominent group formed by the manufacturers and food retailers has operated under the name of "Americans Against Food Taxes." It would be reasonable to assume similar groups will emerge on other occasions where taxes or other financially burdensome measures are being considered.

**3.** It is unclear what agency or government body should or could take the lead on this, particularly in the USA. In the case of tobacco, the US Congress passed an extraordinary measure empowering the FDA to deal with the issue. However, it is a contentious debate whether the federal government would be entitled to act in a similar manner over sugar. Local and state authorities, on the other hand, can act faster, as they have the power to introduce laws to protect public health, safety and welfare. In Europe and Asia, individual countries continue to drive change in this area rather than collective bodies like the European Community. France and Hungary have been most active on this front.

#### Health-based legislation versus the power of lobbying

Economists generally agree that government intervention, including taxation, is justified when the market fails to provide the optimum amount of a good for society's well-being. In the USA, 33 states have either enacted taxes (albeit very small, 5% on average) on soft drinks, or put legislation into place stating that soft drinks are non-exempt from state taxes unlike other basic foodstuffs. The UK shows a similar picture, whereby the tax on soft drinks (and all other non-essential, "luxury" foods for that



matter) is value-added tax (VAT); not a direct tax in itself, but one that implicitly treats soft drinks as non-essential. We expect some states in the USA to become more active in this area. After Mayor Bloomberg's recent attempt to limit the size of the offerings of sugary sodas, California is considering pushing through a penny-per-ounce excise tax on soft drinks. As we mentioned, a recent poll shows that 68% of the people interviewed would be in favor of this.

On a more national level, the FDA is currently not considering any proposals to control or regulate sugar consumption. According to the legal experts we consulted, even if the FDA decided to tackle the issue tomorrow and analyze whether excess sugar consumption is toxic, it would take at least three years to draft a proposal, followed by a further two years of debate. A less-than-swift response to a growing concern, by anyone's standard.

Over in Europe, the French government appears to be the most advanced in taking action. Just over a year ago, it imposed a tax of EUR 0.02 on sugary drinks and artificially flavored drinks; close to 5% of the overall value. The potency of the lobbies could be seen here once again: a very small tax in itself, which was then also applied to zero calorie soft drinks flavored with artificial sweeteners. The tax has had the desired effect, with the carbonated soft drink market dropping by 5% in volume last year (according to market researcher Canadean). However, this could be attributed more to psychological effects than financial ones. Fundamentally, it is bad PR to have your industry taxed for health

reasons. Aside from that, there are proposals to increase this tax to 20% by next year. Whether this legislation is again diluted, or materializes at all, is difficult to know. We should note that France is the largest sugar-beet producer in Europe.

Hungary and Ireland, going one step further, have taken a wider stance and are already imposing taxes on perceived "unhealthy" foods in general. Just this May in Ireland, a further 10% tax on soft drinks was proposed and supported by a wide majority of the public. In the UK, 61 organizations, including the Academy of Medical Royal Colleges, are advocating a GBP 7 tax per can of soft drink (around 20% of the retail price) to be included in the spring budget.

Yet, contrary to this prevailing trend, Denmark reduced a long standing tax on soft drinks of EUR 0.22 per liter to half that in July, with plans to scrap it completely by early 2014. The reasoning behind this change, however, has been driven more by financial considerations as opposed to social-health concerns. Danes often cross into neighboring countries in order to import cheaper soda from border shops; affecting both state taxes and local retail shops. Essentially, the closer the consumer was to the German border, the less soft drinks they purchased domestically.

This shows that a cohesive action is much needed. So where is the European Union on all this? The European Union is in some ways behind the curve and, by our accounts, focusing solely on two issues: labeling and artificial sweeteners. With regard to labeling, all companies will be required to

clearly show the amount of calories, fat, salt and sugar on their product labels by the end of 2014. At the same time, the European Union has focused on artificial sweeteners and Aspartame in particular. Nothing on sugar. The legislation in the works, if implemented, will limit the ADI (average daily intake) level for Aspartame to 40 mg per kg of body weight (a can of diet coke contains 180 mg). The French authorities, however, have suggested they would prefer somewhere in the region of 5–10 mg as a maximum recommended level (two cans for a person weighing 70 kg or 154 pounds).

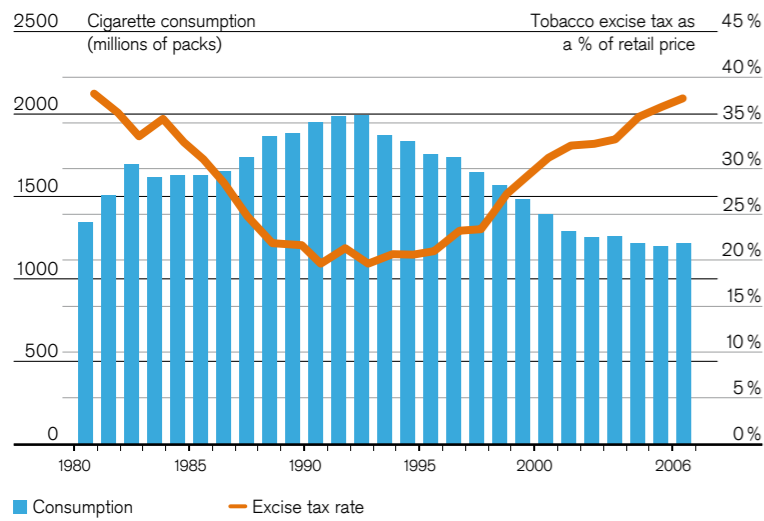
In Asia and Australia, the debate is only just on the horizon. Given the rising levels of obesity, particularly in China and the Middle East, we believe the status quo could soon be confronted. Again we expect different countries to implement different measures to reduce sugar consumption, looking west to assess the pros and cons of all the available options.

#### Focusing taxation on where it matters most

While taxation may be not enough to address obesity concerns and may vary from country to country, or from state to state, we argue that this would be the most effective way of dealing with the related concerns. Effectiveness here is measured simply as the overall reduction in consumption of added sugar. Taxing at the right level should theoretically achieve this, and academic studies have shown it to work. After all, price is an important determinant of food choices and diet. Theoretically, all foods

**Figure 32**  
Cigarette consumption and excise tax rate in South Africa, 1980–2006

Source: WHO report on the Global Tobacco Epidemic, 2008



**Figure 33**  
US price elasticity estimates, by food and beverage category, 1938–2007

Source: American Journal Public Health, Canadian  
Note: Values were calculated based on the 160 studies reviewed. Absolute values of elasticity estimates are reported. The price elasticity of demand measures the percentage change in purchased quantity or demand with a 1% change in price.

Food and beverage category	Absolute value of mean price elasticity estimate (95% CI)	Range	No. of estimates
Food away from home	0.81 (0.56, 1.07)	0.23–1.76	13
Soft drinks	0.79 (0.33, 1.24)	0.13–3.18	14
Juice	0.76 (0.55, 0.98)	0.33–1.77	14
Beef	0.75 (0.67, 0.83)	0.29–1.42	51
Pork	0.72 (0.66, 0.78)	0.17–1.23	49
Fruit	0.70 (0.41, 0.98)	0.16–3.02	20
Poultry	0.68 (0.44, 0.92)	0.16–2.72	23
Dairy	0.65 (0.46, 0.84)	0.19–1.16	13
Cereals	0.60 (0.43, 0.77)	0.07–1.67	24
Milk	0.59 (0.40, 0.79)	0.02–1.68	26
Vegetables	0.58 (0.44, 0.71)	0.21–1.11	20
Fish	0.50 (0.30, 0.69)	0.05–1.41	18
Fats/oils	0.48 (0.29, 0.66)	0.14–1.00	13
Cheese	0.44 (0.25, 0.63)	0.01–1.95	20
Sweets/sugars	0.34 (0.14, 0.53)	0.05–1.00	13
Eggs	0.27 (0.08, 0.45)	0.06–1.28	14

containing added sugar should be targeted in an attempt to reduce daily intake; however, soft drinks could effectively bear the brunt of any financial levy.

A neutral observer would argue that governments are simply “picking on” an easy target – the beverage manufacturers. However, due to the poor satiating properties of sugar in liquid form, it could be argued that they are a major contributor – if not the largest – to the current epidemic of obesity, diabetes and metabolic syndrome and, at the same time, they are clearly easier to regulate and tax from a social perspective. Soft drinks are not essential to our diet as are bread, pasta or rice. Water is always a viable alternative. In addition, the beverage industry accounts for one third of all added sugars in our diet.

So, if the sole objective is to reduce the consumption of full-calorie soft drinks, one does not need to reinvent the wheel. Tobacco and alcohol provide relevant test cases, and unequivocally show that, in both cases, taxation has been able to affect consumption on the downside.

In the case of tobacco, several studies sponsored by the WHO would suggest that a 10% increase in taxes leads to a 4% drop in consumption in high-income countries and 8% in low-income countries. The pattern of events in South Africa provides further confirmation of this (see Figure 32). During the 1990s, tobacco tax rates rose 250%, eventually accounting for 50% of the retail price. For every 10% increase in the price of cigarettes, consumption fell by 5% to 7%. There are now 26 countries in the world where tobacco taxes represent more than 75% of the retail price, a factor clearly correlating with the overall reduction in smoking globally. Similarly, in the case of alcohol, governments and policy makers have utilized taxes as a way to reduce consumption and, in parallel to this, fund education to help cover the related healthcare costs.

**How high?**

Studies by professors Brownell and Frieden, Mytton and Rayner have attempted to ascertain the price elasticity of several foods and beverages. Specifically for soft drinks, the estimate has been that a roughly 10% increase in prices would bring about an 8%–10% reduction in consumption. While we would agree there is a relationship, we do not believe it is one that is perfectly linear. Empirical evidence would suggest that, at low levels of taxation, consumption is not affected on a one-to-one basis, but significantly less. Conversely, the higher the price increase, the higher the multiplier. Empirical evidence supports these findings. There have been few randomized controlled trials (RCTs). In Ireland, a 10% increase in the price of soft drinks in the 1980s led to an 11% decrease in consumption. In this case, the price increase affected all soft drinks.

So what would be the effect of introducing a 1% tax per ounce on soft drinks? This would be equiva-

lent, in reality, to increasing the price of a can by 20%. We see only positive implications if health is the main consideration.

One could expect it to reduce consumption by an equivalent amount or at least induce a switch from high-sugar-content soft drinks to lower- or zero-sugar soft drinks. The effect could be even higher than the theoretical 20% (one-to-one price elasticity), as most larger beverage manufacturers have a lower- or zero-sugar content offering with a similar flavor. We would also expect the impact to be higher on soft drinks than juices, based simply on the perception that juices are “healthier” and a substitute (albeit a poor one) for eating the real fruit.

The tax is likely to be a regressive one (e.g. affecting more people at lower income levels). However, this might be positive not negative, as the poorer and less educated seem to be affected the most on relative basis by obesity and metabolic syndrome. Figure 34 shows that, within the lower income segment, 26% of non-hispanic blacks and 43% of hispanics in the USA are obese versus a 20% national average. So a hefty excise tax is likely to impact more those segments of the population where the problem is more acute.

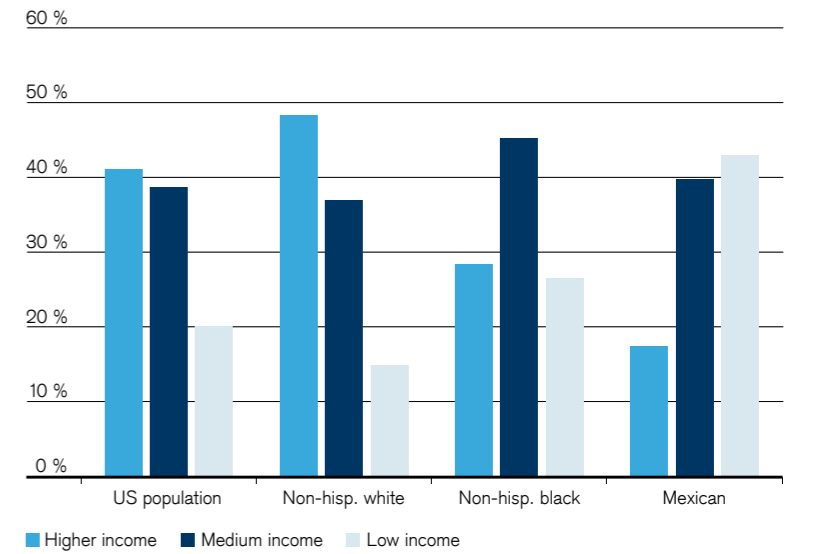
A tax of this nature should provide soft-drink and juice companies with an additional incentive to adapt their product lines and lower the sugar content. It should be noted, that many of them are already working toward this.

A tax would help local, state and federal governments raise much needed funds to address the related health issues and devote additional funding for better education and research on the topic. Estimates based on the current level of consumption, and a price elasticity of one, suggest that a 1% tax per ounce would be able to generate USD 15 billion in tax revenues in the USA, or USD 1 billion if we were to consider New York State alone. A few academic studies have gone further in trying to approximate the actual impact on weight reduction. Conservative estimates point to a 2 lb. per year per person decline, assuming that the consumer substitutes the 15% reduction in beverage intake (average of 10%–20%) with other more solid foods. It is by no means enormous, but still healthier than seeing incremental weight gain in the population

As is always the case with very public issues, critics and lobbyists have come up with a myriad of reasons why this would be prejudicial. Their main argument revolves around the claim that the tax would be regressive, would not solve the obesity crisis, and that it points the finger at one sector alone. We have already addressed the issue of its regressive nature. Critics are correct in the sense that this would not entirely solve the epidemic of obesity and diabetes, etc., but few are likely to disagree that it is certainly a start, and a step in the right direction. Reducing the growth of the obese population while funding some of the healthcare costs associated with these problems is an objective that is difficult to oppose in any regard.

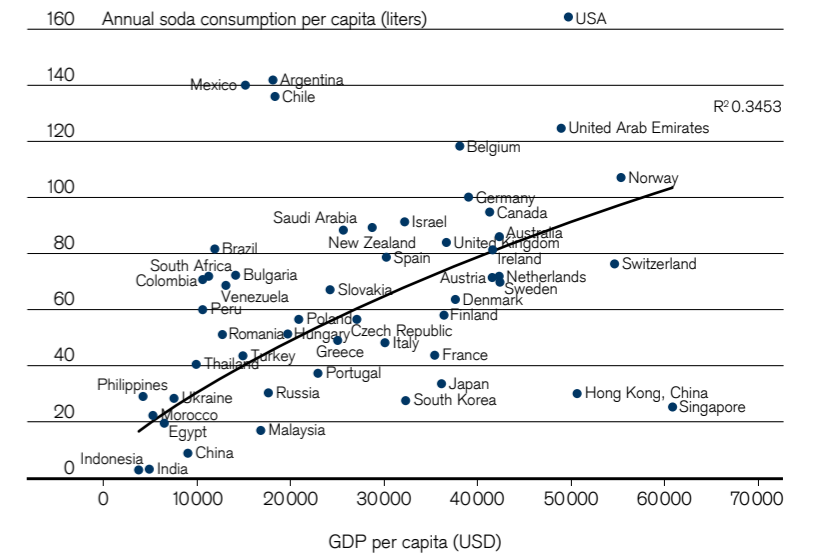
**Figure 34**  
Percentage of obese population by income and race – USA

Source: CDC/NCHS, National Health and Nutrition Survey, Credit Suisse analysis



**Figure 35**  
Annual global soda consumption versus GDP per capita

Source: Euromonitor, Nielsen XAOC, Credit Suisse estimates





# Corporates: Self-regulation and opportunities

Several sectors will be impacted by the increased focus on the health effects of excess sugar consumption: food and beverage companies, sugar producers, manufacturers of artificial and natural sweeteners and healthcare companies. We expect sugar consumption to decline with an impact on sugar prices. The beverage industry has the tools and marketing experience to embrace change and provide new offerings to better match consumer wishes. Natural sweeteners should be the main beneficiaries.

Lastly, we wish to focus our analysis on the impact on corporates: we can divide this into five groups: (1) food and beverage companies, (2) the sugar industry (sugar cane, beet sugar and HFCS), (3) HIS (artificial sweeteners), (4) natural sweeteners, and (5) the healthcare industry,

We believe that the implications of our analysis for the beverage industry and the natural-sweetener industry will drive the outlook for the other four sectors:

**1.** We expect companies in the beverage industry (mostly soft drinks) to react to the growing public concern and the threat of taxes on sugary drinks by moving as fast as they can to self-regulate and change tack. We will look at self-regulation in detail, but the most attractive option to achieve this will be to develop soft drinks that leverage natural sweeteners to reduce the overall caloric content or replace artificial sweeteners. If properly managed, we think these changes should have a neutral effect on the beverage industry, be negative for artificial sweeteners and very positive for natural sweeteners. The key issue is taste. Natural sweeteners need to be able to deliver a taste profile that is as pleasant as the full sugary drink or the one that uses artificial sweetener – something that the manufacturers have found very difficult over the past few decades.

**2.** We think the impact on companies in the food industry should be minimal as they do not suffer

from the same negative image as the beverage industry, they are more difficult to regulate and they are less affected by the biomedical issues linked to sugary beverages. We expect the industry to gradually substitute sugar or HFCS with natural sweeteners.

**3.** The sugar industry is likely to be negatively affected, but it will take some time. As the awareness of the medical risk tied to excess consumption of added sugars increases worldwide, and as the availability of natural sweeteners increases, we expect sugar consumption to grow below the growth rate of the global population. We should see this happen first in developed countries (2–5 years) and then gradually extend to developing countries (10 years). If just the beverage industry in the USA were to stop using sugar or HFCS and use natural or artificial sweeteners, demand for sugar would drop by 30%.

**4.** The healthcare industry should benefit from increased awareness, which in turn should lead to a reduction in the growth rate for obesity, diabetes type II and metabolic syndrome. We are still far away from this in many regards, so that, in the short term, this clearly means increased costs for the healthcare system. However, if sugar consumption is curtailed, pharma and biotech companies closely tied to the treatment of diabetes type II should – on a longer-term basis – see a reduction in the potential number of addressable patients.



Figure 36

### Taxes on soft drinks in Latin America

Source: Credit Suisse Equity Research, Fomento Economico Mexicano, S.A.B., Form 20-F 2007

	VAT rate	Excise rate	Excise taxes as % of sales (estimated)
Mexico	16 %		
Guatemala	12 %	0.18 cents local currency per liter	2.9 %
Costa Rica	13 %	22.53 local currency per 250 ml	13.8 %
Nicaragua	15 %	9 % consumption, 1 % gross income	9.4 %
Panama	0 %	5 % depending of cost of good, 10 % selective products	7.5 %
Argentina	17 %	8.7% if drink has less than 5 % lemon or 10 % fruit juice	8.5 %
Colombia	16 %		
Brazil	18 %	Average production 4.7 %, average sales 10.8 %	10.8 %
Venezuela	21 %		

Figure 37

### Volumes for both diet and regular carbonated drinks products continue to decline

Source: Euromonitor, Nielsen XAOC, Credit Suisse estimates

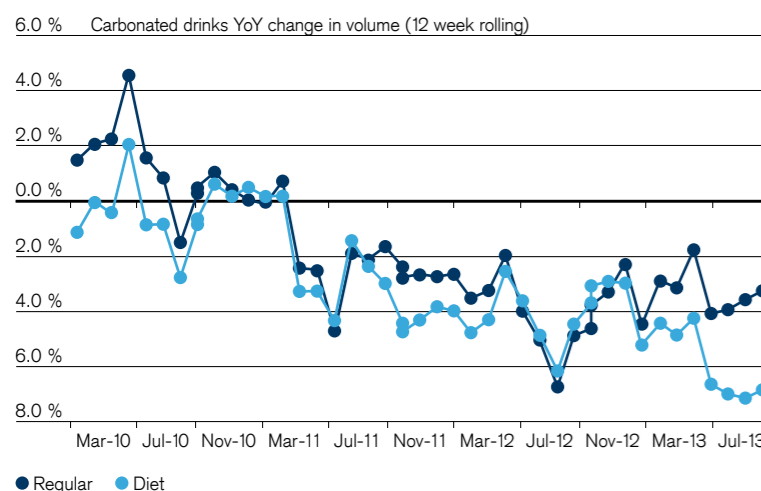


Figure 38

### Full-calorie versus diet carbonated-drink consumption – by region

Source: Beverage-Digest, Canadean

2012	Full calorie share of consumption	Diet share of consumption
Asia	96.9 %	3.1 %
Eastern Europe	96.7 %	3.3 %
Southern Africa	95.8 %	4.2 %
MENA	95.2 %	4.8 %
Latin America	93.0 %	7.0 %
Western Europe	75.5 %	24.5 %
North America	69.0 %	31.0 %
Australasia	64.7 %	35.3 %
Worldwide	85.9 %	14.1 %

### Beverages: Self-regulation

Let us go into more detail and focus first on the beverage industry. We believe that few countries will implement taxes on soft drinks at the level we suggest. Some countries already have taxes on soft drinks, but at lower levels (see Figure 36 for Latin America). Mexico might be a game changer in this area and become the first of the large soft-drink consumer markets to impose a significant excise tax on full-calorie soft drinks as part of the new government's budget later this year.

In our view, however, the most likely outcome is that the overhanging threat of higher taxes and the fast-growing public outcry over the purported contribution of soft-drink manufacturers to the health issues we mentioned will coerce the companies to self-regulate.

### So what are the major soft-drink and food companies (with the focus clearly more on the former) going to do in order to self-regulate?

Understandably, the soft-drink companies have little interest in reducing the overall consumption of soft drinks, but at the same time they can ill afford being seen by the public as responsible for a major obesity or diabetes epidemic.

We believe seven actionable responses are available to the manufacturers:

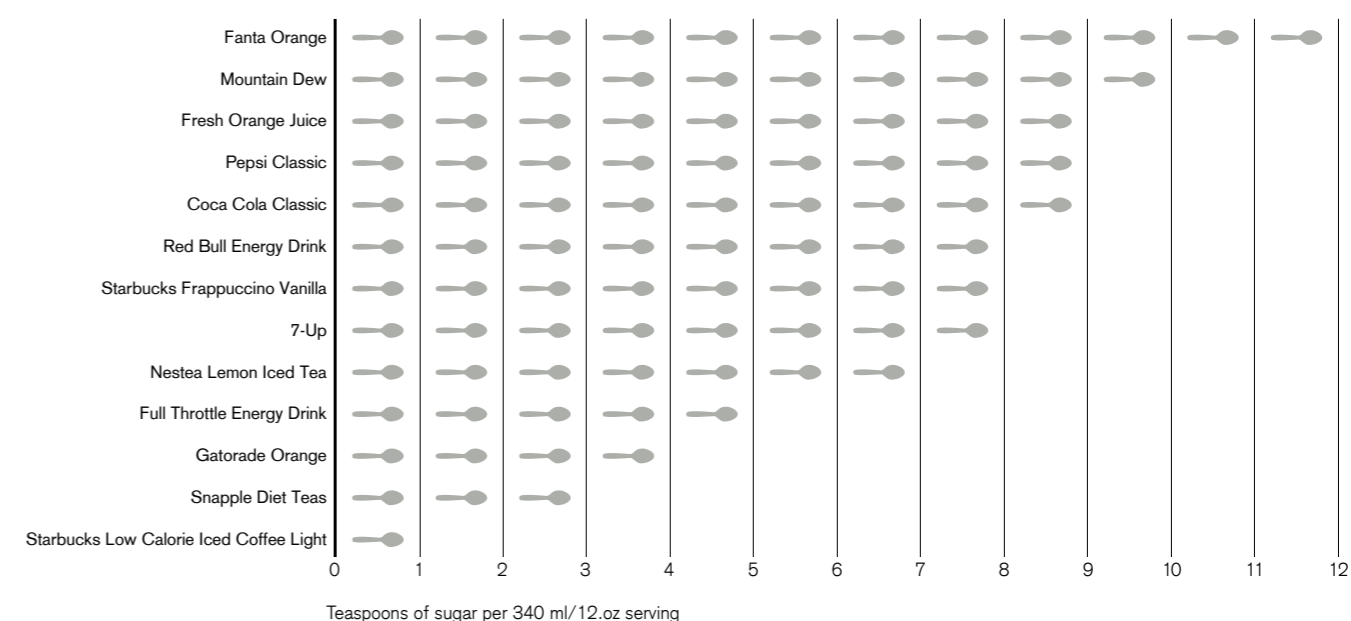
- Increase availability of the zero-calorie version in every region and country.
- Promote the marketing of “diet” drinks more than full-calorie drinks.
- Gradually reduce the calorie content of the full calorie version (although previous attempts to change traditional formulas, such as with “New Coke” have been known to backfire).
- Improve and make more visible the labeling of the sugar content of drinks; in some countries there is still no obligation to do so.
- Replace sugar and artificial, intense sweeteners with natural, low- or zero-calorie sweeteners.
- Expand portfolios to offer alternative drinks (fruit juices, vitamin waters, energy drinks or simply smaller sizes – as they have recently announced with the new 25 cl “slimline” cans in the UK).
- Launch public initiatives and campaigns to foster a healthier and more active way of life. In other words, take an active role in promoting a healthier lifestyle and educating people about diet choices.

Soft-drink companies are likely to continue lobbying against taxation of soft drinks through special-purpose and fully funded groups (e.g. Americans Against Food Taxes), but will have to be careful to not do so openly. The tone of the latest press release from the Coca-Cola Company shows a remarkable change – from ignoring the media linking obesity and diabetes to soft-drink consumption to taking steps to present Coca-Cola as being well

Figure 39

### Sugar content of popular beverages – teaspoons per serving

Source: California Center for Public Health 2011 study, Credit Suisse Research



aware of these issues and working to be part of the solution. For companies with brands as strong as Coca-Cola or Pepsi, the biggest risk to sales growth and profitability is a negative public image.

Here soft-drink companies have a huge advantage over tobacco and alcohol companies. Tobacco manufacturers could not offer nicotine-free or smoke-free cigarettes (only now, decades later, are we seeing the emergence of electric cigarette technology). Beer brewers experimented with zero-alcohol beers, but with very little success. Guinness launched 0% Kaliber in 1986 as an upmarket alternative to other alcohol-free lager brands, and it is now generally the only such product widely available in most markets. Clearly, we are still quite some distance away from a zero-alcohol wine or a zero-alcohol whisky. With this in mind, soft-drink companies have a real chance to take a proactive approach at making the right changes and come out on the winning side.

### What can change and what is likely to change?

If we evaluate the world as a whole, it becomes clear there is ample scope to improve the current situation, particularly in emerging markets, and most notably in Mexico, by offering and proactively marketing the “diet” version.

Is it just a coincidence that Mexico ranks No. 3 in per-capita-soda-consumption and No. 2 in global obesity rates, and at the same time sugary soft drinks representing 95% of total soft-drink consumed nationally? We do not think so. In this area, as we said before, showing causality is incrementally problematic, but assuming that all factors are

coincidental is undoubtedly worse. For further proof of the concept, it is interesting to note that, in Italy, sugary soft drinks account for 73% of the total soft-drink consumption, and the country itself ranks No. 35 in per capita soda consumption and No. 25 globally in obesity rates. Is this just a coincidence?

Analyzing this relationship in more granular form, we turn our attention to the USA, which is a country where soft drinks are fully available in every state. We can see that the level of sugary versus “diet” soft drinks varies across the country, with a clear pattern emerging. Using census data for education and average income, we note there is a remarkable correlation between the penetration of the diet version and the level of education and income. In other words, the higher the income and education level of the consumer, the higher the penetration of the “healthier” version of cola. We can conclude that better access to information may be a focal point in “controlling” the situation.

Generalizing this hypothesis elsewhere, one could assume similar interpretations as in the USA. There is one caveat, however. The availability of the diet version of any given cola may, traditionally, not be as extensive as it is in the USA, which goes some way to explain why emerging-market consumption of “diet” cola only accounts for 5% of the total, versus a considerably higher 28% in the western world. Regional sugar lobbies may also play a role in governmental support for one over the other, as most colas will use the locally available “sugars” to sweeten their beverages. Not surprisingly, in Mexico, the sugar in the full-calorie coke is derived from cane sugar (true for most of Latin America), while, in the USA, the sugar is provided by the corn industry in the form of HFCS.

Figure 40

### Beverage product portfolios – corporates are expanding their product portfolios

Source: Beverages Digest Factbook 2013, Credit Suisse Research

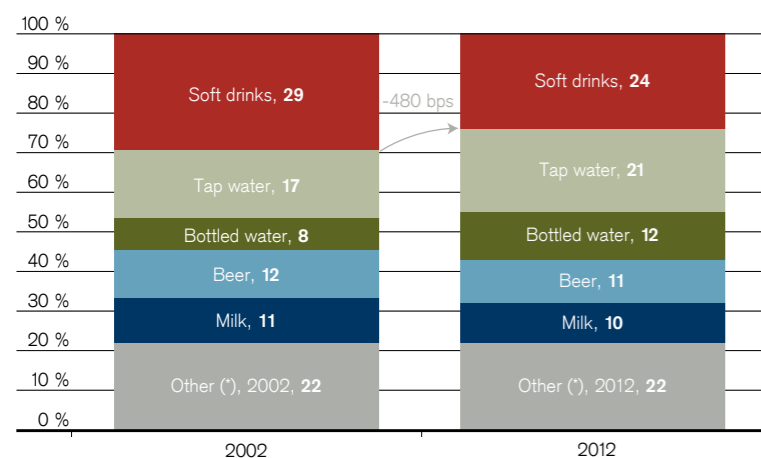


Figure 41

### Artificial sweeteners

Source: Prairie Moon Company

Sweetener	Sweetness relative to sugar	Manufacturer	Regulatory / FDA categorisation
Acesulfame potassium	200x	Nutrinova	FDA approved 1988
Alitame	2,000x	Pfizer	FDA approval pending
Aspartame	160–200x	NutraSweet	FDA approved 1981
Aspartame-acesulfame-salt	350x	Twinsweet	FDA approved
Cyclamate	30x	Abbott	FDA banned 1969, Pending re-approval
Dulcin	250x	Not applicable	FDA banned 1950
Neohesperidine dihydrochalcone	1,500x	Nutrafur	FDA no classification
Neotame	8,000x	NutraSweet	FDA approved 2002
P-4000	4,000x	Not applicable	FDA banned 1950
Saccharin	300x	Multiple	FDA approved 1958
Sucralose	600x	Tate & Lyle	FDA approved 1998

### Fruit juices and others

As mentioned, one of the responses of the soft-drink industry to the growing public concern about soft drinks has been to enlarge portfolios, expanding into bottled water, fruit juices and sport drinks. Water (both tap and bottled) has gained a significant share of total consumers' liquid intake, while carbonated soft drinks have lost 480 basis points over the last ten years.

We have largely omitted fruit juices from our analysis here, but in the spirit of an exhaustive study, we should draw attention to some key points. As can be seen in Figure 39, natural fruit juices and fruit juices derived from concentrate do not fare much better than full-calorie sodas when looking at this issue from a health perspective.

Yet there are certain discernible differences. The body reacts differently to fruit juices than sugary sodas, both in terms of physiology and the "satiating effect" we mentioned earlier (which works better with fruit juices). In addition, fruit juices contain other nutrients/vitamins that might be beneficial to our body. However, the impact of too much juice consumption is not vastly different than when too many cans of full-calorie soda are ingested. Yet the outcry is far less than that of sodas. Why?

First and foremost, fruit juices are perceived as "natural" products, and there has undoubtedly been a trend over the past decade to favor natural and organic products in our diets. But make no mistake. Our forefathers did not drink fruit juices (certainly not in the quantity that we do) – they simply ate the fruit. While eating the fruit may lead to ingesting roughly the same amount of sugar, the body fully "notices" the calorie intake when eating the fruit and, as a result, substitutes these calories for other food-derived calories, not simply adding to them. Also, natural fruits are rich in vitamin C, antioxidants, flavonols and other substances that combat the metabolic effects of fructose. Some of these benefits disappear in the "juice" version of the fruit.

As several fruit-juice brands are ultimately owned by the large soda manufacturers, there is hope that the same remedial actions we cited above will be applied to fruit juices as well. While substituting the "natural sugar" in fruit juices with natural non-caloric sweeteners, such as Stevia or Monk Fruit may sound "unnatural," this would be consistent and likely to happen, albeit at a much slower pace.

Beyond juices, it would be a little excessive to list each and every commercial foodstuff containing added sugar. Few are aware that, in a single serving of Prego's tomato sauce, there are 10 grams of sugar (almost three spoons in total). Although this is not quite the level seen in fruit juices (where a 500 ml orange juice can contain over 50 grams of sugar), it should nevertheless be considered incremental. In due course, we would expect these companies to gradually follow the lead of the soft-drink manufacturers.

### Tough times ahead for artificial sweeteners

A big debate has unfolded, particularly in the European community, on the use of artificial sweeteners. The word "artificial" plays a key role here, and the main focus of the examination has been Aspartame. While there is no conclusive proof that Aspartame is dangerous to people's health, there have been numerous, conflicting recommendations as to the maximum recommended daily limit.

As we mentioned, in the USA, the FDA turned down the use of Aspartame as a sweetener six consecutive times, before finally approving it. The European community had initially agreed to a recommended international standard of 40 mg per kg of bodyweight, but French authorities have suggested they would want this reduced further to a maximum of 5–10 mg per kg of body weight.

There are only a few medical studies on this topic, and ultimately no reliable conclusions. The combination of a growing negative public opinion on artificial sweeteners and new discoveries in the field of natural sweeteners should lead to a gradual decline in the use of Aspartame and other artificial sweeteners. Companies like Tate and Lyle that have been at the center of the sweeteners market are moving fast to develop new products in the area of natural sweeteners and to partner with beverage and food companies to reduce the level of sugar in their products without impacting the taste.

### The "sweet spot": Natural sweeteners

Soft-drink companies are working hard to introduce natural non-caloric or low-calorie natural sweeteners, into their product offerings. The main concern so far, however, has been that natural sweeteners simply do not taste the same as sugar, and in some cases leave a bitter after-taste. Coke is trialing Stevia in Sprite in France and has recently launched a new version of coke called "Coca Cola Life" in Argentina that is sweetened with 50% sugar and 50% Stevia. Coca Cola Life has 50% less calories than the full-calorie Coke version. The word "natural" is key in the development and adoption of a new generation of sweeteners by the food and beverage industry. Stevia derived from the Stevia plant is already available; Nectresse derived from Monk fruit is also now available both industrially and as table sugar. Xylitol or "alcohol sugar," which occurs naturally in some fruit, vegetables, mushrooms and cereals is used both in sport drinks and certain foods. The latest natural sweetener is a new product called Brazzein or Cweet which is derived from an African plant, the Oubli (*Pentadiplandra brazzeana*). We expect more to come in the near future as the race for a natural, non-caloric sweetener (that is widely accepted by the public) is heating up.

Figure 42

### Global product launches including Sucralose as an ingredient

Source: Mintel

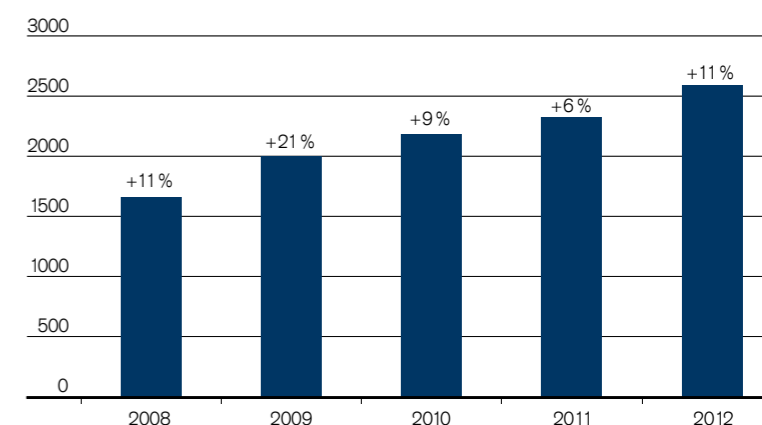


Figure 43

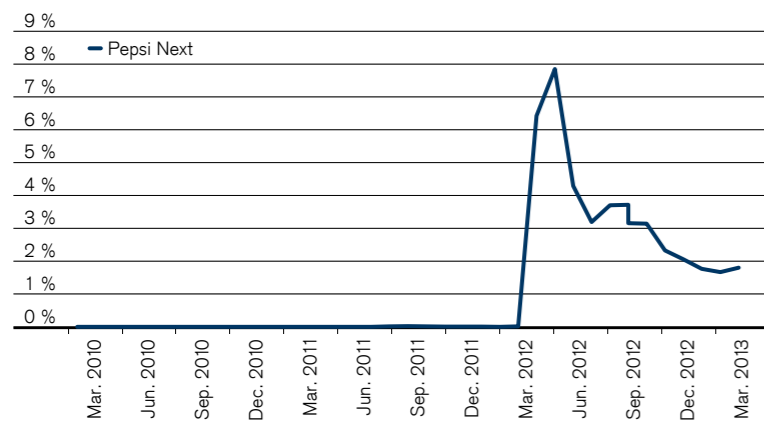
### Examples of natural sweeteners

Source: Credit Suisse Consumer Staples Research

Natural Ingredient	Commercial product	Sweetness	Company	Calories
Stevia	Truvia	10–15 times > sugar	Cargill	0
Monkfruit	Nectresse/Purefruit	150–300 times > sugar	Tate and Lyle	0
Oubli	Brazzein/Csweet	1000 times > sugar	Cargill and Natur Research	0
Xylitol in corn fibers, birch wood	Xylitol	15–30 times > sugar	24 companies in China, Canada and USA	40% < sugar
Oats	Oatsweet	same as sugar	Oat Tech	15%–20% < sugar

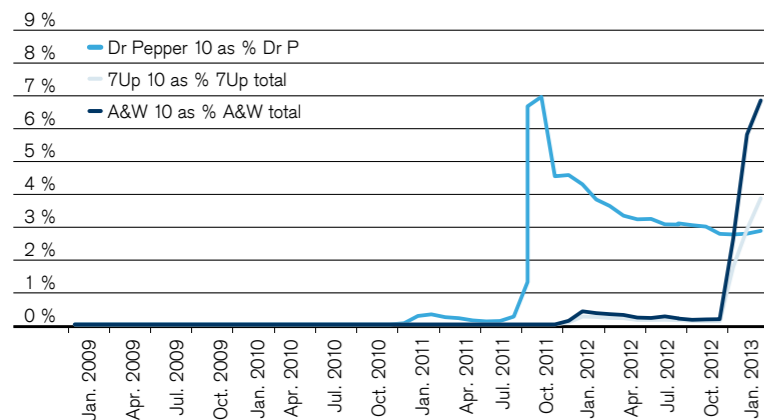
**Figure 44**  
**Pepsi Next hits 8% of total Pepsi volumes, but falls back to under 2% within a year**

Source: Based on AC Nielsen data XAOC



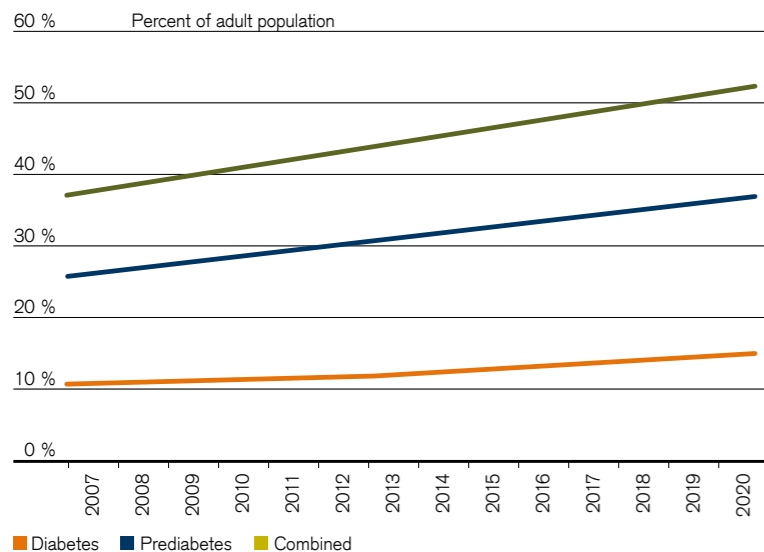
**Figure 45**  
**Dr Pepper 10-calorie hits 7% of total Dr Pepper volumes, but falls back to 3% in under a year**

Source: Based on AC Nielsen data XAOC



**Figure 46**  
**Prevalence of diabetes and prediabetes in the US adult population 2007–20**

Source: UnitedHealth Group Modeling, 2010 ([http://www.unitedhealthgroup.com/hrm/unh\\_workingpaper5.pdf](http://www.unitedhealthgroup.com/hrm/unh_workingpaper5.pdf))



“...we’ve been developing new natural sweeteners and flavoring aimed at reducing calories with no compromise on taste. We have some promising projects that are currently going through the FDA review process that once commercialized could potentially alter the trajectory of our cola business in a meaningful way.” Indra Nooyi, PepsiCo CEO, 2013 earnings call]

Both Coca-Cola and PepsiCo are experimenting with new sweeteners and have formed partnerships with smaller companies specializing in this field. Coca-Cola’s joint venture with Blue Circle to develop a Stevia-based sweetener called Rebaudioside X is another example of things to come. Experts assume breakthroughs will filter through in the next 3–5 years and a discreet substitution of Aspartame or Acesulfame Potassium will take a place initially in the “diet” sodas (consumers are more willing to try something different provided it ensures zero calories). More gradually, these switches will take place as a way to reduce the caloric content of the full-calorie drinks.

When that occurs, we expect big labels to heavily highlight the reduced calorie content version of the new drink, as Pepsi did with Pepsi Next, or more recently Dr Pepper with its 10-calorie versions of Sunkist, 7-Up and A&W root beer. As Figures 44 and 45 show, the limitation of many of these new, low-calorie drinks is that the encouraging initial customer response and uptake can soon be followed by a steady decline in consumption. Patrons are ready and willing to try new products, but soon fall back on old favorites. Public awareness of the negative health effects tied to sugar consumption and improved taste profiles could change this trend. Companies have now an added incentive to make a major change in not just marketing, but also in their overall product strategy.

**Potentially positive: US managed care**

Increasing prevalence of diabetes and other health issues has put significant pressure on the US health system, which today spends nearly USD 3 trillion annually on healthcare costs. Some numbers might help place this in a proper context.

Obesity alone accounts for 20% (or USD 190 billion) of US national health expenditures and diabetes and metabolic syndrome account for a similar figure (though there might be some double-counting). So 30%–40% of healthcare expenditures in the USA go to help address issues that are closely tied to the excess consumption of sugar. Diabetes is the fastest growing: 15% of US adults or close to 40 million are expected to be diabetic by 2020 compared to 12% now.

As we move forward, there is greater pressure under the US healthcare reform to control the unsustainable healthcare cost trend with a focus on chronic conditions. Large employers, individuals, state and federal governments have all looked to



managed care as a means of reducing costs. Controlling and managing the growth in obesity and diabetes are key elements of this effort. Similar issues apply to the rest of the world. In most countries, the growing costs for the healthcare system will be an added burden to public sector finances and ultimately to the tax payer.

So what are managed-care companies doing to help contain the costs to the system? Managed care has developed plans that for the most part offer health and wellness programs to individuals and corporate clients. The key words here are “prevention” and “proper treatment.” A large portion of the world population is in a pre-diabetic stage: over 60 million people in the USA and over 400 million globally. Proper diagnostics and then intervention could reduce the number of “new diabetics” drastically and significantly reduce the costs to the healthcare system. The same applies to a certain extent to people that already have diabetes. In both cases, reduction in the level of consumption of sugar would benefit the affected individuals and the system. As we discussed, education, taxation, proper labeling and a wider use of new natural sweeteners could help to improve the current situation and reverse this trend.

As costs have escalated, programs that can reduce or bend the cost curve have become increasingly important. The challenge is to demonstrate the return on investment (ROI) from an employer’s perspective from investing in health and wellness programs. As health plans work further to collect and synthesize data, we will have a clearer picture. If results show positive ROIs, health and wellness programs may become increasingly more important. The healthcare reform may accelerate this trend as more uninsured people gain access to coverage, thus increasing healthcare costs.

More broadly, the focus on lower costs and individual/employer engagement in healthcare is a significant opportunity for managed care in the longer term. If managed care is viewed as part of the solution, we see an incremental business opportunity (sharing the savings with government, privates and corporations). However, given the significant changes impacting health insurers in 2014 with healthcare reform, we think this particular theme is overshadowed by the uncertainty/potential disruption of next year’s events and it is therefore not necessarily priced into the managed-care stocks.

**Figure 47**  
**Estimated savings opportunities for initiatives to address obesity, pre-diabetes, diabetes in US adults, by public payers, 2011–20**

Source: UnitedHealth Group Modeling, 2010 ([http://www.unitedhealthgroup.com/hrm/unh\\_workingpaper5.pdf](http://www.unitedhealthgroup.com/hrm/unh_workingpaper5.pdf))

	Expected net health care cost savings by payer, 2011–20 (in USD bn)				
	Federal	State	Total public	% system savings	Health system
People without diabetes — lifestyle intervention (recommended weight loss)	23	1	24	53%	45
People with prediabetes — intensive lifestyle intervention like the Diabetes Prevention Plan	61	3	64	61%	105
People with diabetes — improved medication adherence (Asheville & ten cities)	21	1	22	63%	34
People with diabetes — intensive lifestyle intervention (Look Ahead)	53	2	55	62%	88
All initiatives (net of interactions)	144	6	150	60%	250

Figure 48

## Leading obesity medications 2006–10

Source: Company data, Credit Suisse analysis

Brand name	Therapeutic category	Peak year	Peak sales (USD bn)
Lipitor	Cholesterol	2006	13.7
Plavix	Anticoagulant	2011	9.9
Humira	Autoimmune	2012	9.3
Remicade	Autoimmune	2012	8.2
Seretide	Respiratory	2011	8.1
Enbrel	Autoimmune	2012	8.0
Abilify	Central nervous system	2012	7.6
Rituxan	Oncology	2012	7.2
Crestor	Cholesterol	2011	6.6
Lantus	Diabetes	2012	6.4
Herceptin	Oncology	2012	6.3
Losec	Anticancerants	2000	6.3
Avastin	Oncology	2010	6.2
Diovan	High blood pressure	2010	6.1
Seroquel	Central nervous system	2011	5.8
Singular	Respiratory	2011	5.5
Zocor	Cholesterol	2002	5.4
Nexium	Anticancerants	2007	5.2
Zyprexa	Central nervous system	2010	5.0

Figure 49

## Summary of approval dates

Source: Company data, Credit Suisse analysis

Medications	Company	Year approved	Current status
Fenfluramine	Warner-Lambert	1973	Withdrawn in USA, EU
Dexfenfluramine	Warner-Lambert	1996	Withdrawn in USA, EU
Phentermine	VarioUSA	1959	Marketed in USA, withdrawn in EU
Meridia/Reductil	Abbott	1997	Withdrawn in USA, EU
Xenical	Roche	1998	Marketed in USA, EU
alli	GSK	2007	Marketed in USA, EU
Accomplia/Zimulti	Sanofi Aventis	2006	Withdrawn in USA, EU
Qsymia	VivUSA	2012	Marketed in USA
Belviq	Arena	2012	Marketed in USA
Contrave	Orexigen	In clinical development	
Empatic	Orexigen		
liraglutide 3 mg	Novo Nordisk		

Figure 50

## Diabetes classes of drugs developed for diabetes

Source: Company data, Credit Suisse analysis

Diabetes class	Administration	Examples (brand name)
Insulin	Injectable	Lantus, Humalog, Novolog
GLP-1 Analog	Injectable	Byetta, Victoza, Bydureon
Sulfonylurea	Oral	Glucotrol, Amaryl
Biguanide	Oral	Glucophage
Thiazolidinediones	Oral	Actos, Avandia
DPP-4 Inhibitor	Oral	Januvia, Onglyza, Tradjenta
SGLT2 Inhibitor	Oral	Invokana

## Potentially negative in the long term: Biopharma and medical devices

On the product side of the healthcare industry, there are many companies that have invested significant resources in developing drugs to treat obesity, as well as drugs to treat some of the complications from obesity, such as type II diabetes, high cholesterol and high blood pressure. Five of the 20 most successful drugs of all time, in fact, are drugs that target some of these common complications (see Figure 48).

The development of drugs for treating obesity in particular has been challenging. These drugs have generally had a limited impact on weight loss or have had significant side effects that overshadowed any efficacy that patients experienced. In fact, many of the drugs that were previously approved have since been withdrawn from the market due to some of these safety concerns (Figure 49). While some newer agents have recently entered the market and others are in late-stage development, it remains to be seen if any of these will be more successful commercially.

Diabetes mellitus, on the other hand, has been an area of significant success for the biopharma industry. These drugs have focused on lowering blood sugar levels in patients with diabetes since better sugar control has been shown to limit some of the long-term complications of the disease, such as heart disease, kidney disease, neurological problems and visual disorders. There have been a number of different classes of drugs developed for diabetes over the past several decades, ranging from injectable products (such as insulin and GLP-1 receptor agonists) to oral medications (such as biguanides and DPP-4 inhibitors, Figure 50). Many of these classes include drugs that have generated multi-billion dollars in sales.

Beyond drugs, healthcare companies have also invested in other innovations to attempt to respond to the obesity epidemic and the dramatic rise in the number of patients with diabetes. Some have focused on developing inhalers or automated pumps that allow for potentially easier or more convenient dispensing of insulin. Other companies have focused on more invasive approaches such as the development of adjustable gastric bands that wrap around part of the stomach and attempt to slow (and ultimately reduce) the amount of food a person consumes during meals.

While we do not anticipate a rapid reduction in the rates of obesity or type II diabetes, if changes in sugar consumption were to materially impact the incidence or prevalence of these conditions, the addressable market for these companies might not be as large as projected. The companies that have focused significant research and development expenses on these areas may not see the return on their investment that they initially expected.

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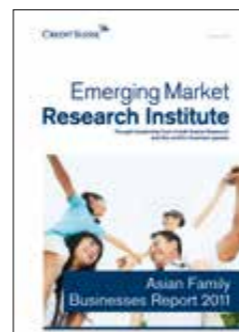
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