ERASMUS UNIVERSITEIT ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS

Bachelor Thesis

Department of Health Economics

The Implication of the 2006 European Sugar Market Reform on the Incidence of Overweight in the Netherlands

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Abstract

The purpose of this bachelor thesis is to study the effect of the 2006 European sugar market reform on the incidence of overweight in the Netherlands. Countless products consumed on a regular basis do partly consist of this sweet and irresistable stuff. Consequently, policies affecting the sugar market can have vast impacts on the diet and health of people. How did the Comman Agricultural Policy (CMO) affect the sugar price? Does sugar consumption change as a result of price decreases? How could this have an effect on the prevelance of overweight in the Netherlands? I use macroeconomic data from the Netherlands and find a positive effect of the imported raw sugar price on overweight. Furthermore, the policy was the major contributer of a price decrease imported raw sugar. Yet, interestingly, the policy did not have an effect on the incidence of overweight in the Netherlands up to this point.

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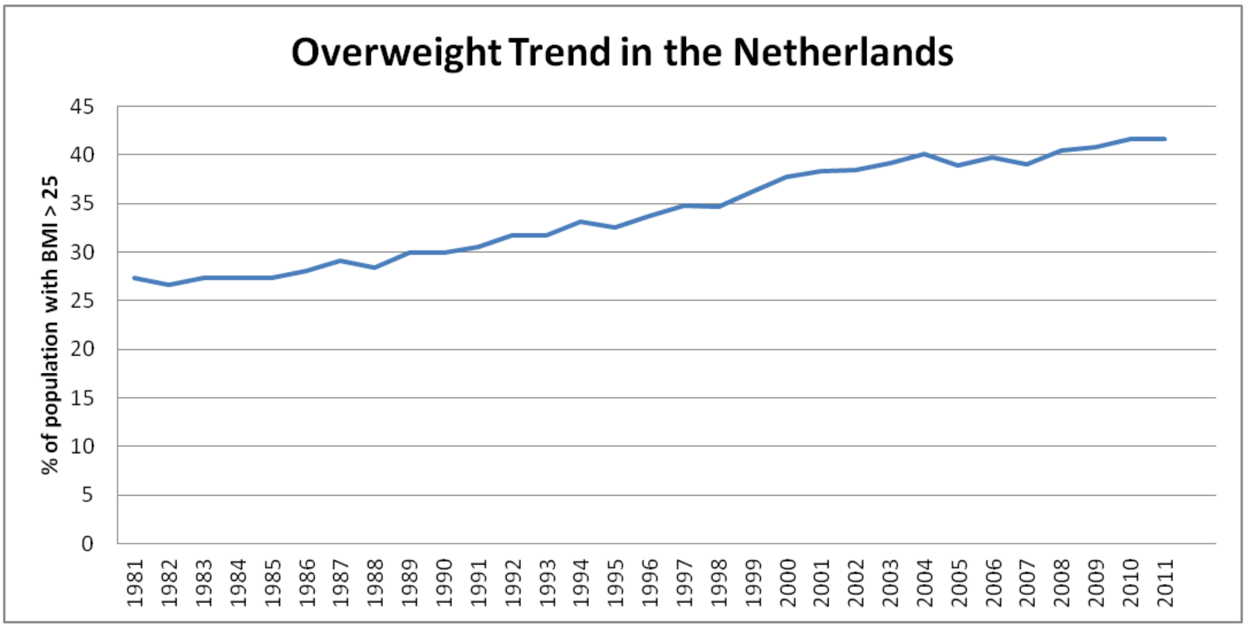
Introduction

Overweight has become a major health problem in the world. In the U.S. alone an estimated 365.000 people died due to causes of obesity in 2000 and according to the projections based of the National Health and Nutrition Examination Surveys, this number is expected to further increase (Catenacci et al., 2009). Despite the vast media coverage and high awareness about the issue, the prevalence of obesity is still increasing (Catenacci et al., 2009). This is not only a problem faced by the United States but also by many other developed nations in Europe like the Netherlands. Below, in Figure 1, the trend of overweight incidence in the Netherlands is illustrated. Since the year 1981 the percentage of Dutch overweight people has risen from around 26 percentage points to an astonishing 41 percentage points in 2011. Many determinants of obesity have been identified. In general, evidence suggests socioeconomic status to play a major role in causing obesity (Catenacci et al., 2009). Individuals with low socioeconomic status are more likely to be obese as they are prone to consume cheap food, which tends to contain the highest amount of energy (Catenacci et al., 2009). Sugar can definitely be seen as energy dense nutrition and its indirect consumption within energy dense food and sugar-sweetened beverages has been rising (Catenacci et al., 2009).

Figure 1: Overweight Trend in the Netherlands. Source: Statline, Statistics Netherlands



Sugar has been one of the most protected commodities within developed countries and its price has been influenced by a variety of trade protections including quotas, import tariffs and export subsidies in Europe as well as the U.S. (Lopez, 1989, Nocentini, 2011). In Europe, before 2006, the Common Market Organization of the sugar sector (CMO) has guaranteed sugar growers a fair income with the intent to self-supply the community (Nocentini, 2011). Hence, the average European sugar price was much higher than the world sugar price. Custom duties were set at very high levels in order to restrict the import of foreign sugar (Nocentini, 2011). Severe criticism from the World Trade Organization (WTO) and many other sugar growing countries, have lead the EU to conduct a sugar market reform in 2006 (Nocentini, 2011). The intention was to continually free the market and reduce trade protections (Nocentini, 2011).

In general, when discussing the removal of trade barriers and other trade dampening constructs, like export subsidies and import tariffs, only the economic effects of these policies are mentioned. According to the theory of comparative advantage by David Ricardo, it is clear that free trade not only benefits one party but rather all who are involved in the exchange (Brue et al., 2013). However, there may also be some negative aspects resulting from trade liberalization. It is estimated that, on average, sugar prices in developed countries are twice as high as the prevailing world price (Borrel et al., 1999). These high prices may indirectly decrease demand for sugar as an ingredient in the production of processed food and hence, negatively affect the prevalence of overweight.

The aim of this study is to investigate if there is a link between the European sugar policy in 2006 and the prevalence of overweight in the Netherlands. Past research suggests consumption, price and health effects due to food policies. For example, in a paper on the effect of agricultural policies on caloric consumption in the United States, Rickard et al. (2011) suggested significant consequences of food subsidies and tariffs on food consumption. However, there has not been much research conducted on this specific sugar policy.

Thus, the research question is as follows:

“To what extent has the 2006 sugar market reform affected the prevalence of overweight in the Netherlands?”

Undoubtedly, this topic is of great economic as well as social importance. On the on hand, trade liberalization may benefit the economy and the cooperation between countries. On the other hand, it may have severe social health impacts. With an increasingly globalized world, structural reforms like the one in 2006 can have vast impacts on various aspects of life on a multilateral scale. It is therefore important to have a greater insight into what causes overweight in order to prevent it and inform policy makers about the implications.

2 Background

In the subsequent section of this bachelor thesis, the hypotheses are discussed and supported by underlying past literature and background information about the European CMO policy. Throughout the paper, the words obesity and overweight are used on a regular basis. In general, obese individuals exceed a Body Mass Index (BMI) of 30 while overweight individuals have a BMI in excess of 25. The BMI is calculated by dividing the weight of an individual by the square of his height.

2.1 The Common Market Organization

Before the establishment of the European Union, some European countries already cooperated in a variety of sectors. One of the earliest collaborations was the Common Agricultural Policy (CAP) founded in 1958 (ecpa.eu, 2014). The purpose of this policy was to support farmers and the food supply for the European Community. Despite the very high productivity of European farmers, they were not able to compete on a global scale (ecpa.eu, 2014). Due to high input, land and fuel costs, farmers in other countries were more competitive (ecpa.eu, 2014). As a result, the community introduced import tariffs, quota systems, guarantees, direct payments and many other instruments to support local farmers (ecpa.eu, 2014). These trade barriers and support instruments have allowed European farmers to survive and produce their products up to the present day (ecpa.eu, 2014).

The Common Market Organization (CMO) is a legal framework that serves some agricultural sectors on a European level and it is part of the CAP policy discussed above (Nocentini, 2011). The sugar market falls within this framework. It was established in 1968 and its purpose is in line with the CAP. The main intent was to support community growers of sugar beet and to assure the continuous self supply of sugar within the community (Nocentini, 2011). In return, the farmers agreed on producing close to the community needs and thus, strong quotas were placed (Nocentini, 2011). Furthermore, a price intervention system was introduced which would dampen price shifts on the market (Nocentini, 2011). Additionally, exports were supported in order to offset the price difference between the community price of sugar and the world price (Nocentini, 2011). As a result, European consumers had to pay more for sugar (Nocentini, 2011).

After the CAP was reorganized in 2003 in order to better fit the community needs, the CMO was also restructured in 2006 along a number of lines. Firstly, as already mentioned, the sugar policy had to be adjusted to the CAP (Nocentini, 2011). Secondly, due to the accommodation of a duty abolishment for Least Developed Countries (LDC), the EU expected imbalances in the production of domestic sugar (Nocentini, 2011). Furthermore, higher sugar imports were expected due to the lower price of foreign sugar traded at the world price (Nocentini, 2011). Lastly, as a result of international pressure, in particular from the WTO, the EU decided to approach a more competitive free market for sugar (Nocentini, 2011).

2.2 Literature Review and Theoretical Background

2.2.1 How does the CMO policy affect the sugar price?

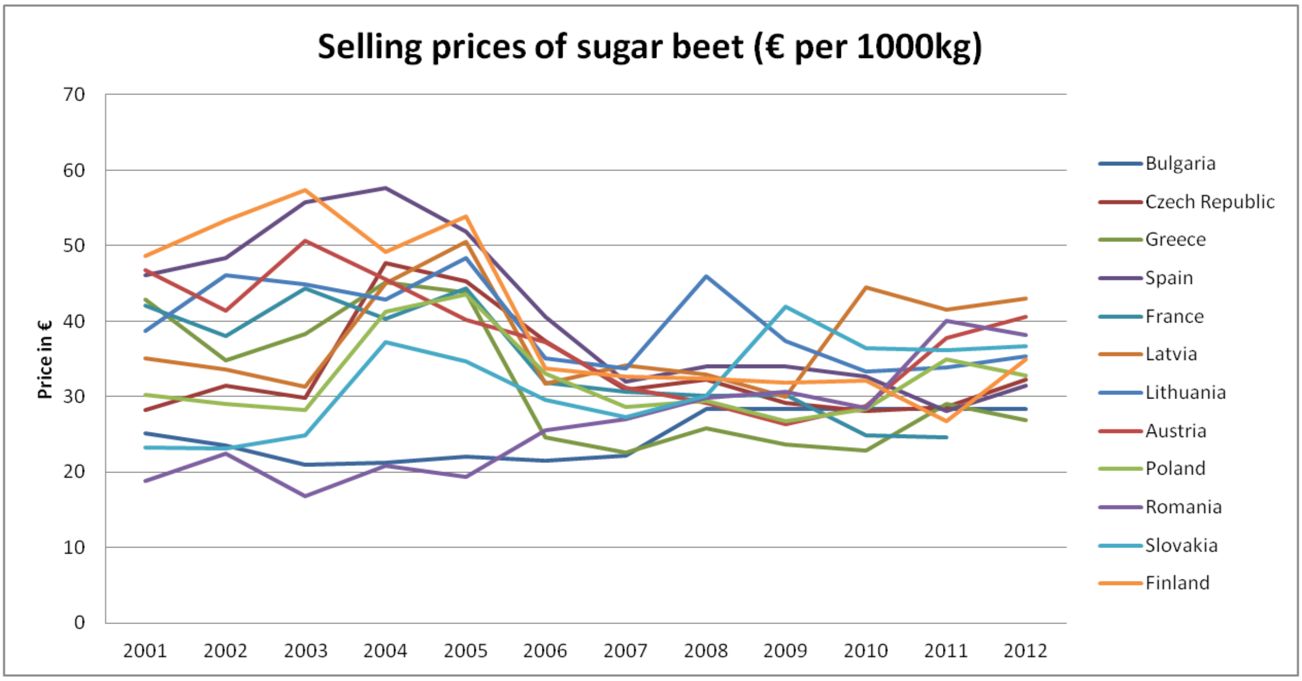
The implications of removing trade barriers from the sugar market can be viewed from different lenses, depending on the economic theory used. Classical economists believe in the free market and consequently, they can be seen as advocates for the removal of trade barriers (Brue et al., 2013). These include import tariffs, export subsidies, quota regulations, etc. When Ricardo introduced the theory of comparative advantage, he showed that trade can be very beneficial to society (Brue et al., 2013). The theory states that instead of producing a product at home it is advantageous for a country to acquire a good via trade if it is cheaper this alternative (Brue et al., 2013). Ricardo's principle may be at the heart of the decision to reorganize the European sugar market. This may in particular apply to the WTO ruling discussed above. Yet, trade liberalization may not always be beneficial for society. There may be situations where the costs of free trade outweigh the benefits. Evidence suggests that these policies have lead to negative impacts with respect to health, inequality, etc. (Vos et al., 2006). Similar problems may be faced by European and, in particular, Dutch citizens as a result of the CMO reform.

When analyzing the common agricultural policy conducted by the European Union and its effect on the prevailing average European sugar price, the following subsections suggest a resulting substantial decrease of the European sugar price.

2.2.1.1 The European Beat Sugar Sector

According to the European Commission, the EU is the largest producer of beet sugar in the world with around 50 percentage points of the total production. As a result of the CMO reform, a lot has changed with regard to the quantity and price of beet sugar production in Europe. Production quotas were introduced to produce close to the community needs and in order to preserve the price level (Parkin, 2007). Due to the policy in 2006, the European Union has been reporting a beet sugar production quota reduction from 17.4 million tons to 13.2 million tons (Nocentini, 2011). This may suggest that the least efficient producers have stopped growing beet sugar as foreign competition has increased. One of the main causes for the big renouncement of production quotas was the substantial reduction in the reference price of beet sugar (Nocentini, 2011). The reference price dropped from 628€ per ton of sugar in 2006/07 to 483€ per ton in 2008/09 (Nocentini, 2011). Even though the price is still not equal to world prices, it has approached it substantially. Figure 2 illustrates the downward trend of the sugar beet selling price in a sample of European countries. Furthermore, evidence for the decreasing trend of the total beet growing area in Europe is illustrated in Figure A1 in the Appendix. Both figures clearly show a negative impact on the sugar price during the restructuring process of the policy.

Figure 2: Selling price of sugar beet; Source: Eurostat



2.2.1.2 The European Cane Sugar Imports

As a result of the Common Agricultural Policy in 2006, it was expected that the European raw cane sugar imports would increase to approximately 3.5 million tons (Nocentini, 2011). This didn't happen and raw cane sugar imports have been fluctuating around 1.9 million tons between 2000 and 2009 (Nocentini, 2011). It was suggested that ACP countries (African, Caribbean and Pacific Group of States), which belong to the major suppliers of raw cane sugar, are increasingly refining sugar themselves before exporting it to the European Union (Nocentini, 2011). Furthermore, European sugar companies have been forming strategic alliances with ACP sugar companies in order to directly refine the raw sugar within the respective countries (Nocentini, 2011). Moreover, the EU granted special trade agreements to LDC countries which were expected to further increase imports (Nocentini, 2011). As a result, the average European import price of raw cane sugar has experienced a drastic drop in the years after the policy. This is clearly illustrated in Figure 3.

Figure 3: Historic European Import Price of Raw Sugar; Source: World Bank

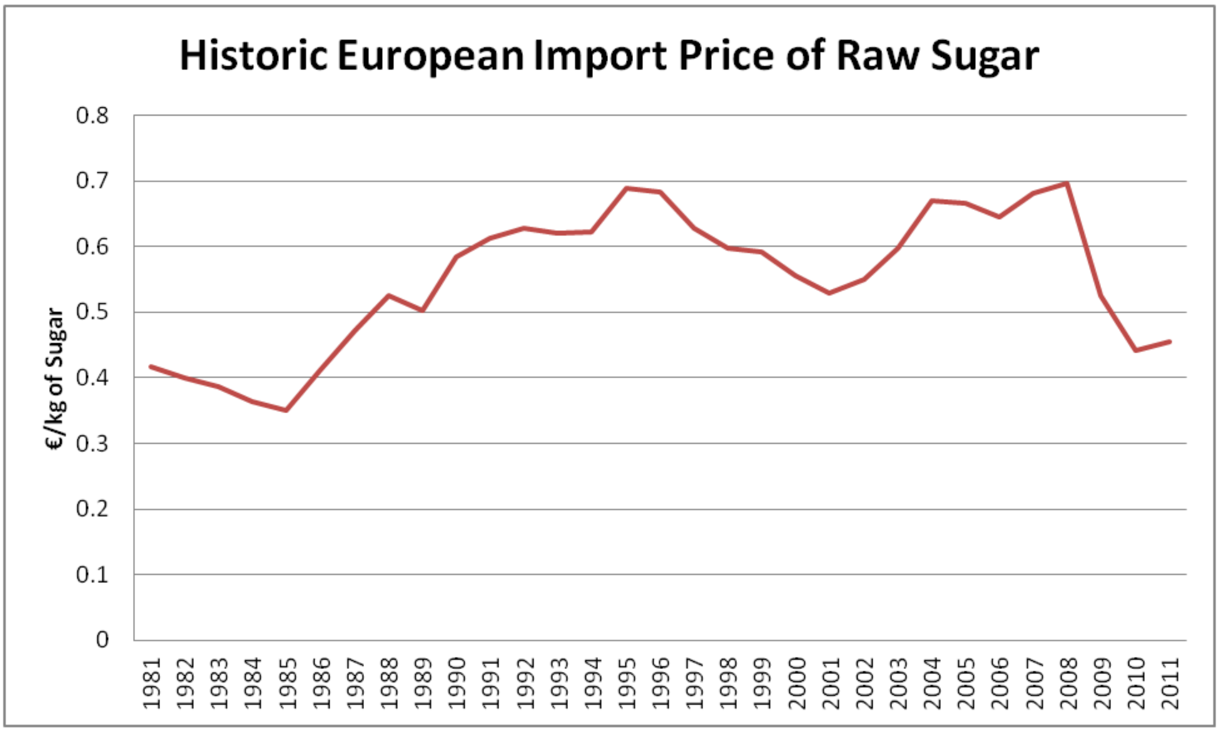


Figure 1 to 3 and in particular the report on the Common Agricultural Policy conducted by Agrosynergie suggest a decrease in the European sugar prices and the adjustment to the prevailing world price. Some of the price decreases have resulted from the deliberate adjustment of the European reference price for different sorts of sugar, while other reductions can be attributed to the partly liberalized trade of sugar. Evidence suggests a price reduction of sugar in Europe after the policy in 2006.

2.2.2 How does the sugar price affect overweight?

It is a well known fact that the increase in the prevalence of overweight is due to the individual person's imbalance of caloric intake (Rickard et al., 2011). This means, that the calories burned are fewer than the calories consumed (Rickard et al., 2011). Furthermore, fundamental economic theory states that a decrease in the price of a good, ceteris paribus, leads to an increase in demand, while an increase in the price of a good leads to a respective decrease in demand (Frank, 2010). The concept of price elasticity of demand assesses the percentage change in demand for a product due to a one percent decrease in price. Although the following part of this bachelor thesis mainly focuses on the macroeconomic implications of price changes and the resulting effects, it is important to understand the microeconomic fundamentals affecting consumption decisions.

Empirical evidence suggests the existence of demand and substitution effects due to price changes in the sugar manufacturing industry. Sugar-sweetened beverages belong to the main contributors of weight gain and obesity (Malik et al., 2005). The Harvard School of Public Health offers free online information about various topics concerning nutritional intake. In one of their articles about sugar-sweetened beverages they state, that sugar drinks make up a stunning nine percent of a U.S. individual's caloric intake a day (hsph.harvard.edu, 2014). The beverage/soft-drink industry is well known for the immense amounts of added sugar used in production. In the past, famous companies like Coca Cola, have substituted cheaper high-fructose corn syrup for sugar as a result of price changes (Hawkes et al., 2011). Due to these implications, unit prices were decreased and bottle sizes increased, resulting in higher consumption levels (Hawkes et al., 2011). The increasing intake of beverages, which consist of substantial amounts of added sugar, may therefore be directly related to the increasing prevalence of overweight. In a paper on food price policies and their effects on the prevalence of obesity, Asfaw (2006) clearly shows that subsidised food does have an effect on overweight. Basically, this means that food prices do influence consumption decisions. He estimated a -0.112 price elasticity of demand for sugar, suggesting that a 1% increase in the sugar price, per 100 calories, is likely to decrease BMI by more than 0.11%. According to Malik et al. (2005) sugar-sweetened beverages belong to the main contributors of weight gain and obesity.

2.2.3 Hypotheses

Undoubtedly, prices do affect consumption decisions according to the theories and empirical findings mentioned above. Nevertheless, the demand elasticity of such price changes depends on the product as well as on the buyer. This may also hold in case of the European sugar price. Especially companies that buy sugar in vast scales see a reduction in costs as a result of a price decrease and thus, demand may increase accordingly. Indirectly, the decrease in the European average price of imported sugar may have supported the prevalence of overweight in the Netherlands. Consequently, the following hypotheses are tested:

Hypothesis 1: A decrease in the European price of imported raw sugar increases the incidence of overweight in the Netherlands.

Hypothesis 2: The European sugar market reform increased the prevalence of overweight in the Netherlands.

3 Data and Methodology

3.1 Data

Most of the time series used in the following analysis were already available from a prior research project conducted on the causes and consequences of obesity. They were gathered from StatLine, an electronic database from Statistics Netherlands. The data of the average European import price of raw sugar are from the database of the World Bank. The purpose of the time series analysis is to measure the relation between the Dutch sugar price and overweight on a macroeconomic level. Furthermore, it is of primary interest to identify any structural changes in the regression model which can be attributed to the 2006 EU sugar market reform.

3.1.1 Dependent Variable

Overweight **-** This is the dependent variable and it is defined as the percentage of people exceeding a Body Mass Index (BMI) of 25 in a certain year. BMI is used as a proxy because it is a very convenient method of assessing a person's relative weight. It is calculated by dividing an individual's weight by the square of the height.

3.1.2 Main Independent Variable

Sugar Price **-** This variable is defined as the average annual European import price ($/kg) of raw sugar and its effect on overweight is of particular interest in this bachelor thesis. In the following analysis, the macroeconomic relationship between *sugar price* and *overweight* will be assessed. The sign of the variable in the regression model is expected to be negative.

3.1.3 Control Variables

Smoking - *Smoking* refers to the percentage of Dutch people that smoke in a specific year. According to a paper on the influence of smoking cessation on the prevalence of overweight, the termination of smoking is connected with an increase in overweight (Flegal et al., 1997). Hence, this variable is suitable for the use as a control variable. This variable is expected to have a negative sign in the regression model.

GDP – The independent variable of *GDP* is defined as the absolute Dutch output per annum. Similar to smoking, this variable additionally serves as a control variable. In a paper on the association between stunting and overweight in Latin America and Caribbean preschool children, the authors have found a positive correlation between the prevalence of *overweight* and *GDP* (Duran et al., 2006). One of the reasons may be the increasing income due to globalization and the resulting introduction of global fast food chains (Tran, 2014). The expected sign of *GDP* is positive.

HCE – This regressor refers to the annual health care expenditures (million Euro) incurred by the Dutch government. This control variable may be of benefit to the analysis as it is assumed that an increase in *HCE* may have a negative association with *overweight*. According to an OECD report on obesity and the economics of prevention, overweight people tend to cost much more with respect to health care expenditures (OECD, 2010). Yet, due to the reduction of life expectancy, overweight people die earlier and thus, they incur lower total health care costs over their lifetime (OECD, 2010). Thus expected sign of the variable in the regression model is negative.

Alcohol – Similar to *smoking*, this explanatory variable refers to the percentage of the Dutch population that drink alcohol. Past research, which has investigated the relationship between *overweight* and *alcohol* consumption, has proven that people who drink alcohol are not more overweight than non-drinkers (Gruchow et al., 1985). Though, caloric intake is substantially higher for alcohol consumers as opposed to non-alcohol consumers (Gruchow et al., 1985). Due to this fact, no clear position is taken with regard to the expected sign of the variable in the regression model.

3.1.4 Descriptive Statistics

Table A1 in the appendix illustrates some more details about the various time series discussed before. The data comprises the years from 1981 until 2011 for the majority of variables. Data for *smoking* and *alcohol* was only available from the year 1989 onwards and hence, equation 5 and 6 in model 1 and equation 1 in the extension contain only 21 instead of 27 observations. Before estimating the regression model it is important to test the variables for stationarity. All variables, apart from *alcohol,* show a trend effect and do not have a mean of zero. (Appendix Figure A2 and A3). Thus, an intercept and a trend are included in the equation. For a*lcohol* only an intercept is included in the test equation. After performing a Dickey-Fuller test, *overweight*, *HCE*, *smoking*, *alcohol* and *GDP* resulted in a p-value in excess of the 10% level acceptable in this bachelor thesis. Consequently, the null-hypothesis of stationarity cannot be rejected. Further details on the outcome can be found in Table A1 in the appendix. The results show the risk for spuriousness to be substantial as the variance of the dependent variable increases with time (Hill et al., 2008).

3.2 Methodology

Throughout the research, two time series models were formed in order to investigate the effect of the average European imported sugar price, as well as the CMO policy, on the prevalence of Dutch *overweight*. Due to the risk of spuriousness, a set of control variables are included in the models. In order to estimate the linear regression model, the ordinary least squares method was used.

A variety of tests were performed to assess the validity of the outcomes and of the regression equations themselves. This is of great importance as the underlying assumptions of OLS have to be satisfied. First, as already described in the data part of this paper, all time series were inspected for stationarity. After the transformation, A Dickey-Fuller test with only an intercept was significant for s*moking*, *overweight*, *alcohol* and *GDP*. Moreover, the Dickey-Fuller tests including a trend and intercept for *HCE* and a Dickey-Fuller test including no intercept and no trend for *sugar price* were significant. The null-hypotheses of non-stationarity were consequently rejected. (Appendix Table A2) Conveniently, this process has not affected the means of model interpretation. Second, a heteroskedasticity and autocorrelation consistent (HAC) standard error was included in the regressions. Third, as a result, there is neither a sign for autoregression, nor any sign of heteroskedasticity in both models. When performing the Breusch-Pagan-Godfrey Test, the null hypothesis of homoskedasticity cannot be rejected. (Appendix Table A3) Furthermore, evidence for the non-existence of autoregression is illustrated via a correlogram. (Appendix Table A4&A5) Finally, a goodness-of-fit test shows that the underlying sample data is normally distributed. This was assessed with the Jarque-Bera Test. The null hypothesis of normality is not rejected. (Appendix Table A6)

3.2.1 Model 1

This model is estimated in order to test the first hypothesis - *A decrease in the European average price of imported raw sugar increase the incidence of overweight in the Netherlands.* A set of distributed lag regressions (DL) as well as autoregressive distributed lag regressions (ARDL) were used. As opposed to many other regression models, DL and the ARDL models are dynamic in nature, suggesting that the effects of the independent variables on the dependent variable occur over time (Hill et al., 2008). In addition, ARDL models include one or more lags of the dependent variable. These regression forms are chosen, because it is assumed that a sudden price decrease of sugar does not lead to an immediate increase in the prevalence of *overweight*. Furthermore, it is likely that the effects of the control variables on the dependent variable are not immediate. In a paper on the vertical price transmission along the food chain, Vavra et al. (2005) have proposed that the speed of price adjustment depends on the agents involved in the food chain. These include wholesalers, distributors, supermarkets, etc. Price changes that cause substantial amounts of transaction costs may not be translated immediately and hence, take some time to adjust (Vavra et al., 2005). Generally, these transaction costs are not only caused by menu costs, but also by government intervention (Vavra et al., 2005). Furthermore, the incidence of *overweight* happens over time and does not occur from one day to another. This fact also suggests a time lag between a *sugar price* change and the resulting effect on *overweight*.

Table 1 illustrates the different steps taken from equation 1 to equation 6. Equation 1 only includes three lags of *sugar price* as explanatory variables. The first and the second lag of *sugar price* are not significant and thus, they were removed. From equation 2 to equation 6 the control variables were constantly added in order to control for confounders.

The final equation of Model 1 is as follows:

$$\Delta B_t = \alpha + \beta_1 * \Delta S_{t-3} + \beta_2 * \Delta B_{t-1} + \beta_3 * \Delta G_{t-2} + \beta_4 * \Delta H_{t-3} + \beta_5 * \Delta F_{t-1} + \beta_6 * \Delta A_{t-1} + \varepsilon$$

Where:

B_t= Overweight, at time t

S_{t-3}= Sugar Price, at time t-3

G_{t-2}= GDP, at time t-2

H_{t-3}= HCE, at time t-3

F_{t-1}= Smoking, at time t-1

A_{t-1}= Alcohol, at time t-1

ε =Error term

Δ Indicates first-differences

3.2.1 Extension of Model 1

This extension of the first model is used in order to test the second hypothesis - *The European sugar market reform increased the prevalence of overweight in the Netherlands.* As opposed to the first model, a dummy variable is included in this model. In order to identify any structural changes due to the CMO policy on the prevalence of overweight, a *policy variable* was used, which takes the values one in the year 2008, 2009 and 2010. The 2006 sugar market reform was not a policy with an immediate noticeable effect. This means that the decision to reform the European sugar sector happened in 2006, while the reduction in the reference price of in-quota sugar took place in 2008/09 and 2009/10. It is assumed that the policy can only affect *overweight* through prices and thus, the *sugar price* is removed from the model. Otherwise, the *sugar price* would control for the price and the policy would have to affect *overweight* by other means than the price of sugar. The introduction of a *policy variable* into model is of great interest as it is expected to explain a rise of the incidence of *overweight* right after the CMO policy was conducted. Equation 1 of the extension of model 1 looks as follows:

$$\Delta B_t = \alpha + +\beta_1 * \Delta B_{t-1} + \beta_2 * \Delta G_{t-2} + \beta_3 * \Delta H_{t-3} + \beta_4 * \Delta F_{t-1} + \beta_5 * \Delta A_{t-1} + \beta_6 * v_t + \varepsilon$$

Where:

B_t= Overweight, at time t

S_{t-3}= Sugar Price, at time t-3

G_{t-2}= GDP, at time t-2

H_{t-3}= HCE, at time t-3

F_{t-1}= Smoking, at time t-1

A_{t-1}= Alcohol, at time t-1

ε =Error term

v_t= Policy variable

Δ Indicates first-differences

4 Results

4.2 Testing Hypothesis 1

In the following paragraph the effect of the European raw sugar import price on overweight in the Netherlands is analysed. This was tested by means of times series analysis. Table 1 shows the regression results when *overweight* was regressed on the *sugar price* and the control variables. The regression was run six times in total, starting with the most basic equation including the dependent variable *overweight* and the independent variable of *sugar price.* The effect of the difference in the average European import price of raw sugar on the difference in *overweight* was only significant for the third lag. In equation six a one dollar per kilogram decrease in the raw price of imported sugar would lead to a 13.76 percentage point increase in the proportion of overweight people in three years. This effect is quite large and it suggests that the current *sugar price* does not have an immediate effect on *overweight* and rather takes some time until it has a noticeable effect.

In order to test for the robustness of the results in equation one to six, five control variables were included in the model. This is of great importance because they would explain changes in the results due to the control of possible confounders. Even after the insertion of the control variables, *sugar price* stays significant. Yet, the magnitude of the effect on *overweight* does change slightly, the direction stays the same. It is interesting to note that the adjusted R-squared increases from 0.002 to 0.307 after the inclusion of *overweight* as a lagged independent variable in equation two. This substantial jump may suggest that this variable explains a great amount of the variation in the dependent variable. Indeed this is plausible, as a person who was overweight last year is very likely to be overweight this year. Throughout all equations the explanatory variable of *overweight* is significant. The insertion of *gdp* in equation three does not alter the model in any different direction and the variable itself is not significant in any of the six equations. Despite the statistical significance of *health care expenditure (HCE)* in all remaining equations, the effect is very small and hence, negligible. For example, a one million Euro increase in *HCE* compared to the previous year would lead to approximately 0.15 percentage point decrease in overweight three years later.

Table 1: Regression Results of Model 1 and the extension

Dependent variable: d_overweight	Model 1						Extension of model 1
Variables	**Equation 1**	**Equation 2**	**Equation 3**	**Equation 4**	**Equation 5**	**Equation 6**	**Equation 1**
Constant	0.604*** (0.110)	0.879*** (0.133)	0.760*** (0.174)	1.045*** (0.299)	1.542*** (0.303)	1.520*** (0.301)	1.088*** (0.290)
D_Sugar Price(-1)	-1.376 (2.352)						
D_Sugar Price(-2)	1.722 (1.782)						
D_Sugar Price(-3)	-7.333* (3.630)	-7.434** (3.487)	-6.890* (3.705)	-7.017* (3.685)	-11.674*** (2.553)	-13.760*** (2.821)	
D_Overweight(-1)		-0.507*** (0.121)	-0.507*** (0.121)	-0.508*** (0.131)	-0.505*** (0.131)	-0.549*** (0.085)	-0.428** (0.174)
D_GDP(-2)			0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
D_HCE(-3)				0.000* (0.000)	0.000*** (0.000)	0.000* (0.000)	0.000** (0.000)
D_Smoking(-1)					-0.133** (0.055)	-0.054 (0.051)	-0.128 (0.155)
D_Alcohol(-1)						0.203* (0.098)	0.051 (0.107)
Dummy_Policy							0.264 (0.290)
N	27	27	27	27	21	21	21
R-Squared	0.117	0.360	0.371	0.441	0.679	0.740	0.410
Adjusted R-Squared	0.002	0.307	0.289	0.340	0.572	0.630	0.157

***Significant at 10% level, **Significant at 5% level, ***Significant at 1% level**
Standard errors are the values written in the parenthesis

Like hypothesised in the data part of this paper, *smoking* has a negative impact on the dependent variable when included in equation five. Interestingly, when *alcohol* is included in the model, *smoking* turns insignificant. This may imply that alcohol explains some of the variation in the dependent variable, which was previously explained by smoking. The correlation coefficient between *alcohol* and *smoking* is -0.37. Obviously, to some extent, there is collinearity between the two variables. In a paper on the contrasts and parallels between heavy smokers and drinkers, Room (2003) has found evidence for complementary effects of smoking and alcohol consumption.

The aforementioned facts and the regression results from table 1 suggest the effect of the European raw sugar import price on the incidence of overweight in the Netherlands to hold. In spite of the inclusion of five control variables, the magnitude and the direction of the effect have stayed approximately the same. Thus, the second hypothesis is not rejected.

4.3 Testing Hypothesis 2

The model created to test the effect of the CMO policy in 2006 on the incidence of overweight in the Netherlands is directly related to the first model. The only extension undertaken is the inclusion of the *policy variable* and the removal of the *sugar price* as an independent variable in order to account for the 2006 sugar market policy. This means, in this analysis, the implication of the policy is of primary interest. From Table 1 it can be observed that the *policy variable* has no significant effect on *overweight.*

Interestingly, the control variable for *alcohol* turned insignificant after the inclusion of the *policy variable*. In an article on the economic crisis and its implications for health, Notara et al. (2013) have found evidence for a strong correlation between alcohol abuse and unemployment as well as low income. Due to the nearly identical time period of the economic crisis and the implementation of the CMO policy, it is likely that the *policy variable* controls for the higher alcohol consumption during this time. All other control variables are behaving similar to the first regression model. The magnitude and the direction of these variables are in the same region as previously.

The results just illustrated propose a statistically not significant effect of the CMO policy in 2006 on the incidence of overweight in the Netherlands. Therefore, the second hypothesis has to be rejected.

5 Discussion

5.1 Interpretation of the Results

As already discussed earlier in the bachelor thesis, the policy conducted on the European sugar market indeed had an effect on the average European import price of raw sugar. The adjustment of sugar quota allocations and the vast renunciation of quotas of less efficient producers have spurred sugar imports. Moreover, the conformation of the reference price of in-quota sugar has led the sugar price to drop by approximately 36 percentage points. In fact, it is obvious that the initial goal of the EU was to be more market orientated and to conform to the trade rules set by the WTO. The continuous adaption of the European sugar price to the world price is definitely a major step in order to reach this goal.

The time series model tested shows a significant effect of the lagged sugar price on overweight prevalence in the Netherlands. It seems there is a connection between the policy, the sugar price and the effect on overweight. Even though the statistical prove for the policy-effect on the incidence of overweight in the Netherlands is still missing, it does not mean that there is no effect at all. As already discussed above, the *sugar price* affects *overweight* in the long-run and not immediately after a price change. This suggests that the policy-effect may be observable several years after the policy was conducted. Unfortunately, the data is not available up to now and hence, the analysis needs to be postponed. The very high world sugar prices and the economic downturn observed in recent years may also have affected this outcome and thus, diminished the effect of the policy on overweight (Nocentini, 2011). On the other hand, the OECD has suggested that the prevalence of obesity has increased in the aftermath of the crisis. Despite the fact that households generally spent less on food during the economic downturn, they consumed more energy dense food (OECD, 2014). With this in mind, the following answer to the research question can be stated:

The 2006 EU sugar market policy has had a clear impact on the raw sugar import price and hence, via this variable, influences the incidence of overweight in the Netherlands. However, the partial repercussion of the policy itself cannot statistically be proven yet.

5.2 Limitations of the Research and Suggestions

Even before estimating the model it was clear that the number of observations is quite low. The time series comprise 30 years, with the first three years missing. This is due to the differences taken in order to use lagged values in the model. Furthermore, after the inclusion of *smoking* and *alcohol* the number of observations decreased to 21, because these variables were only measured from the year 1989 onwards. This problem could be solved using monthly or daily observations, but most of the time series observed that frequently are not available. On the other hand, the regression model was not estimated in order to predict future values of overweight in the Netherlands, but rather to explain the consequences of the policy and the sugar price. In a paper on the sample sizes for multiple linear regressions, Kelley et al. (2003) state that the sample size used in a regression equation for prediction needs to be bigger than when used for hypotheses testing. Yet, this does not mean the sample size used in this bachelor thesis is perfect. Some more observations would definitely be preferable. Another solution for the abovementioned limitation would be to additionally use panel data and perform a repeated cross section analysis on the individual level. Generally, these data sets contain many more observations. With this method the policy effect could be additionally analysed and it may be easier to identify any structural changes from one year to another ceteris paribus.

After studying the CMO policy and the history about the European agricultural subsidy system it is still puzzling due to its complexity. For example, there are many different regulations depending on what kind of sugar is traded or produced. Even though the World Bank has calculated the average European raw sugar import price, the price still may vary depending on the country of interest. Additionally, it may be advantageous to calculate the average European sugar price from the domestically produced as well as the imported sugar price. Another limitation of the study is the still ongoing reform. The 2006 CMO policy was not conducted at one point at a time. The European sugar market has been continuously transformed since the agreement in 2006 until the present day. It may be better to conduct a similar research in the future after all the sugar prices have approached the reference price. Indeed, this would be beneficial in order to find evidence for the policy effect on the prevalence of overweight in the Netherlands.

6 Conclusion

The goal of this research is to analyse any consequences of the adaption of the CMO policy within the sugar market on the prevalence of overweight in the Netherlands. As already discussed in the previous section, the policy indeed has lead to a decrease of the average sugar price throughout Europe. While the implications of the policy on the incidence of overweight in the Netherlands cannot be measured yet, it was proven that an obvious effect of the sugar price on overweight exists. The results of the research are in line with the findings from other research in this field. In a paper on the EU sugar market reform, Bonnet et al. (2011) found evidence for the increase of soft drink consumption due to higher levels of added sugar used in production. This suggests the results to be generalizable within the sugar manufacturing sector and hence, proves the sensitivity of consumption due to price changes. Policy makers should clearly consider these far-reaching implications on consumer behaviour. They should not only focus on the economic benefits of these policies, but also estimate the potential costs that have to be incurred. Overweight has become a major problem around the globe and hence, it is of great importance know the causes.

In general there is much room for further research on this topic. As the results suggest, the *sugar price* has a long-term effect on the prevalence of *overweight* and thus, it is assumed that the major implications of the policy will appear in the near future. It would definitely be interesting to conduct a similar research in some years in order to maybe be able to statistically prove the policy effect on the incidence of *overweight* in the Netherlands.

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Appendix

Figure A1: Total hectares of beet sugar growing per country. Source: Eurostat

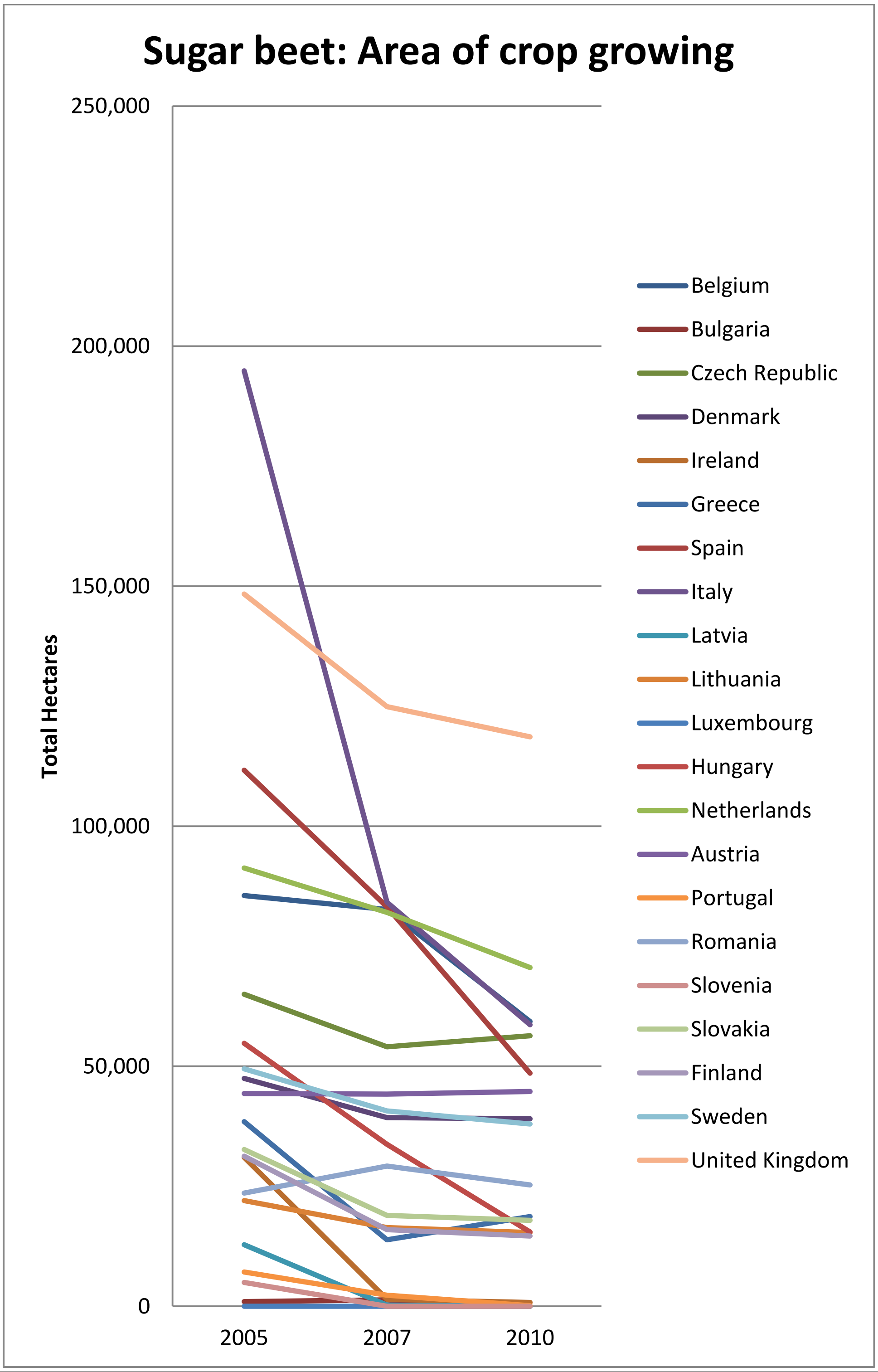

Figure A2: This graph illustrates the time series variables *Alcohol*, *Overweight* and *Smoking*. Source: StatLine, Statistics Netherlands

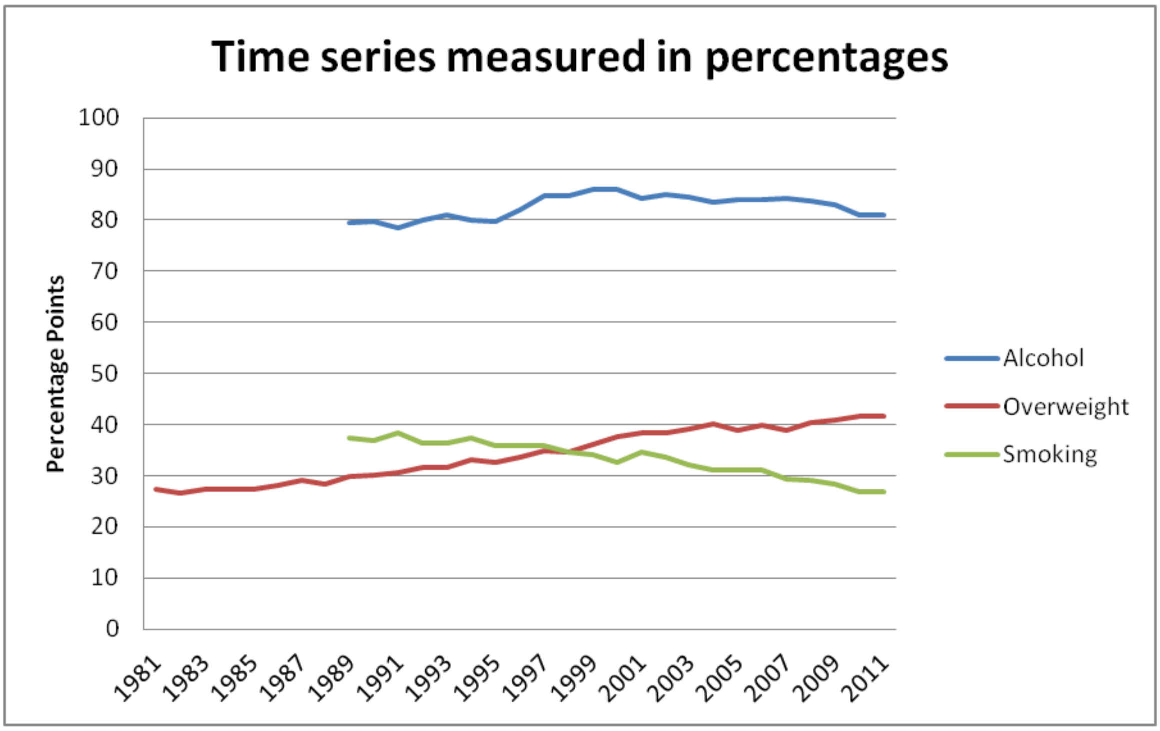

Figure A3: This graph illustrates the time series variables *HCE* and *GDP*. Source: StatLine, Statistics Netherlands

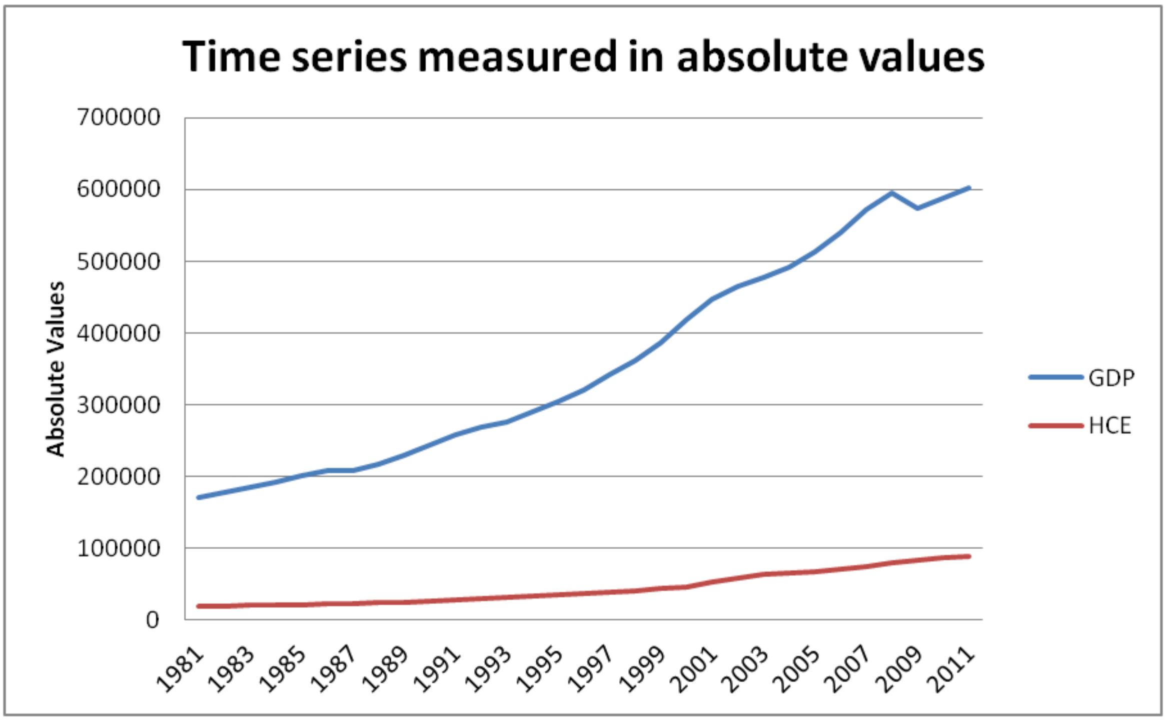

Table A1: Data and Details about the Variables; Results from the Stationarity Tests

Variable:	Overweight
Description:	Percentage of the Dutch population that exceeds a BMI of 25
Source:	Statistics Netherlands
Unit:	Percentages
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.6224
Variable:	Sugar Price
Description:	Average European Import Price of Raw Sugar
Source:	World Bank
Unit:	Dollar cents/kg
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.2088
Variable:	GDP
Description:	Annual Gross Domestic Product of the Netherlands
Source:	Statistics Netherlands
Unit:	Euro
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.4614
Variable:	HCE
Description:	Annual health care expenditures by the Dutch government
Source:	Statistics Netherlands
Unit:	Euro
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.8476
Variable:	Smoking
Description:	Percentage of the Dutch population that smoke
Source:	Statistics Netherlands
Unit:	Percentages
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.1204
Variable:	Alcohol
Description:	Percentage of the Dutch population that drink alcoholic beverages
Source:	Statistics Netherlands
Unit:	Percentages
Stationary:	No
Augmented Dickey-Fuller test P-value:	0.4939

Table A2: Variables after integration

Variable	**Stationary**	**Augmented Dickey-Fuller test P-value**	**Order of integration**
D_Sugar Price	Yes	0.0004	1
D_Overweight	Yes	0.0000	1
D_GDP	Yes	0.0329	1
D_HCE	Yes	0.0305	1
D_Smoking	Yes	0.0000	1
D_Alcohol	Yes	0.0092	1

Table A3: Test for heteroskedasticity

H_0: The residuals are homoskedastic		
	Breusch-Pagan-Godfrey F-Statistic	Probability
Model 1	0.677	0.671
Model 2	0.924	0.519

Table A4: Correlogram Model 1 (Equation 6)

<table>
<tr><th></th><th>Autocorrelation</th><th>AC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>1</td><td>. *| . |</td><td>-0.126</td><td>0.3833</td><td>0.536</td></tr>
<tr><td>2</td><td>. |* . |</td><td>0.136</td><td>0.8513</td><td>0.653</td></tr>
<tr><td>3</td><td>.**| . |</td><td>-0.207</td><td>1.9977</td><td>0.573</td></tr>
<tr><td>4</td><td>. *| . |</td><td>-0.106</td><td>2.3142</td><td>0.678</td></tr>
<tr><td>5</td><td>. *| . |</td><td>-0.137</td><td>2.8847</td><td>0.718</td></tr>
<tr><td>6</td><td>. *| . |</td><td>-0.076</td><td>3.0697</td><td>0.800</td></tr>
<tr><td>7</td><td>. | . |</td><td>0.025</td><td>3.0905</td><td>0.877</td></tr>
<tr><td>8</td><td>. | . |</td><td>0.007</td><td>3.0923</td><td>0.928</td></tr>
<tr><td>9</td><td>. | . |</td><td>0.011</td><td>3.0976</td><td>0.960</td></tr>
<tr><td>10</td><td>. |* . |</td><td>0.167</td><td>4.3259</td><td>0.931</td></tr>
<tr><td>11</td><td>. | . |</td><td>-0.055</td><td>4.4745</td><td>0.954</td></tr>
<tr><td>12</td><td>. | . |</td><td>0.000</td><td>4.4745</td><td>0.973</td></tr>
</table>

Table A5: Correlogram of the Extension of Model 1

<table>
<tr><th></th><th>Autocorrelation</th><th>AC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>1</td><td>.**| . |</td><td>-0.256</td><td>1.5815</td><td>0.209</td></tr>
<tr><td>2</td><td>. |**. |</td><td>0.226</td><td>2.8746</td><td>0.238</td></tr>
<tr><td>3</td><td>. *| . |</td><td>-0.083</td><td>3.0608</td><td>0.382</td></tr>
<tr><td>4</td><td>. | . |</td><td>-0.052</td><td>3.1383</td><td>0.535</td></tr>
<tr><td>5</td><td>. *| . |</td><td>-0.078</td><td>3.3223</td><td>0.650</td></tr>
<tr><td>6</td><td>.**| . |</td><td>-0.273</td><td>5.7142</td><td>0.456</td></tr>
<tr><td>7</td><td>. | . |</td><td>-0.006</td><td>5.7152</td><td>0.573</td></tr>
<tr><td>8</td><td>. *| . |</td><td>-0.129</td><td>6.3375</td><td>0.609</td></tr>
<tr><td>9</td><td>. | . |</td><td>-0.001</td><td>6.3376</td><td>0.706</td></tr>
<tr><td>10</td><td>. |* . |</td><td>0.090</td><td>6.6950</td><td>0.754</td></tr>
<tr><td>11</td><td>. *| . |</td><td>-0.097</td><td>7.1527</td><td>0.787</td></tr>
<tr><td>12</td><td>. |**. |</td><td>0.259</td><td>10.765</td><td>0.549</td></tr>
</table>

Table A6: Test for normality

H_0: The sample data is normally distributed		
	Jarque-Bera Test Statistic	Probability
Model 1 (Equation 6)	0.036	0.982
Model 2	0.240	0.887