CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

ECONOMIC ANALYSIS OF CHOSEN AGRICULTURAL COMMODITY: CASE STUDY OF WHEAT

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Economic Analysis of Chosen Agricultural Commodity: Case Study of Wheat

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Objectives of thesis

explain economics of this commodity. Furthermore familiarize with factors affecting the price of wheat, choosing the appropriate factors and analyze the strenght of the relationship between wheat and those factors and suggest recommendations for the investors interested in wheat

Methodology

Literature review is conducted using methods of extraction, synthesis, induction and deduction. Goals of the analytical part are achieved using various particular methods of fundamental and technical analysis of quantitative data (SMA, EMA, correlation).

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Agricultural commodity, wheat, economic analysis, empirical research, investment, USD, United States of America

Recommended information sources

ADAMS, F a Jere R BEHRMAN. Econometric models of world agricultural commodity markets: cocoa, coffee, tea, wool, cotton, sugar, wheat, rice. Cambridge, Mass.: Ballinger Pub. Co., c1976, xi, 160 p. ISBN 08-841-0290-4.

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Prague March 5, 2013

Declaration

I declare that I have worked on my bachelor thesis "Economic Analysis of Chosen Agricultural Commodity: Case Study of Wheat" by myself and I have used only the sources mentioned at the end of the thesis.

In Prague ………………………

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Nicole Doležalová

Acknowledgement

I would like to thank Ing. Petr Procházka, Msc. Ph.D. for his support, supervision and assistance during assessment of my bachelor thesis.

Author: Nicole Doležalová

EKONOMICKÁ ANALÝZA VYBRANÉ ZEMĚDĚLSKÉ KOMODITY: PŘÍPADOVÁ STUDIE PŠENICE

Klíčová slova: Zemědělská komodita, pšenice, ekonomická analýza, fundamentální analýza, technická analýza, korelace, investice, USD, Spojené státy americké, pšenice ozimá

Souhrn

Tato bakalářská práce je zaměřena na pšenici jako zemědělskou komoditu pro možné investice. Jako oblast zkoumání byla během výzkumu vybrána oblast Spojených států amerických. Cíl práce byl dosažen užitím rozlišných metod, a to konkrétně fundamentální analýzou, technickou analýzou a korelací. Cílem bylo určení faktorů ovlivňujících cenu pšenice. Konkrétně byly tyto faktory vysvětlené na komoditě zvané U.S. Wheat a byly dále analyzovány a vysvětleny. Hlavními faktory objevenými během fundamentální analýzy jsou produkce, vliv počasí, spotřeba, exportní poptávky, ceny substitucí, průmyslové výrobky a hodnoty měn. Technická analýza jako taková se dá také považovat za faktor ovlivňující cenu pšenice, neboť na základě jejích nástrojů se investoři rozhodují ke koupi. Závěrem se pšenice ukázala jako nestabilní komodita k investici, nicméně stále nabízí investorům zajímavou možnost investice, kterou je nezbytné podpořit znalostmi této oblasti.

ECONOMIC ANALYSIS OF CHOSEN AGRICULTURAL COMMODITY: CASE STUDY OF WHEAT

Keywords: Agricultural commodity, wheat, economic analysis, fundamental analysis, technical analysis, investment, correlation, USD, United States of America, Hard Red Winter Wheat

Summary

This bachelor thesis focuses on wheat commodity and its investment in the United States as the willed area which had been chosen during the research. Using the fundamental analysis, correlation and technical analysis reaches the goal of determining factors affecting the price of U.S. Wheat commodity, represents their influence and explains them in particular. The main factors revealed to be the production level, weather effects, consumption, export demands, the price of different substitutes, industrial products and values of currencies in the fundamental analysis. Every tool used in the technical analysis can be considered to be a factor affecting the price of wheat because with their knowledge the investors are making decisions of purchase. In conclusion the wheat appeared to not to be a very stable investment article but still offers the investor interesting option based on the gained information about the subject.

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Abbreviations

AD	Amber Durum Wheat
CBOT	Chicago Board of Trade
CME	Chicago Mercantile Exchange
EU	European Union
FAO	Food and Agriculture Organization
FOB	Free on Board
HAD	Hard Amber Durum Wheat
HRS	Hard Red Spring Wheat
HRW	Hard Red Winter Wheat
HWW	Hard White Winter Wheat
ICE	Intercontinental Exchange
KCBT	Kansas City Board of Trade
MGEX	Minneapolis Grain Exchange
NYBOT	New York Board of Trade
NYSE	New York Stock Exchange
OTC	Over the Counter
SRW	Soft Red Winter Wheat
SW	Soft White Wheat
U.S.	United States of America
USDA	United States Department of Agriculture
WPG	Winnipeg Commodity Exchange

1. INTRODUCTION

Wheat as a one of the main grain crop cultivated in the world always played the important part in the human life for tens of centuries and helped primeval tribes to become powerful ancient civilizations and got us even in the 21st century. The role of wheat has been changing over time and from the symbol of abundance it transformed in the tool of economic/political influence. Nowadays the production of wheat covers all continents of the world apart from Antarctica[1].

This thesis has been written to clarify issue of investment in wheat commodity and to reveal and explain the most of factors affecting the price of wheat on the market. The goal is to define whether wheat commodity is good for investment and what the investors should focus on. There is also inseparable part which covers the theoretical page of wheat and explains the reader basic facts.

Main reason of creation of this thesis is the general importance of this commodity and its spread in the region of the Czech Republic. Furthermore the investment in the stock or commodity market is one of the options for deposition and increase of your money. Definitely the acquisition of money (for pensions, housing etc.) is the hot topic not only in the Czech Republic and this work should provide a preview in this non-traditional investment as a one of the possible ways.

The market in the United States of America has been chosen during my research study because of the significant role in the wheat exports and wheat trade in general so the theoretical part is mainly focused on the U.S. manner.

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[1] KHAN, Khalil and SHEWRY, Peter R., *Wheat: chemistry and technology*, p.1

2. OBJECTIVES AND METHODOLOGY

2.1. Objectives

The main goal of this thesis is to create an economic analysis of wheat global commodity market with the focus upon the U.S. market and to reveal and explain the factors affecting it. Research questions are set to cover the issue and to provide the reader meaningful explanations. Main question of my research is focused on what are the factors affecting the price of wheat. The further step is to answer why these factors are affecting the price and in particular how exactly are these factors moving with the price.

This work can be divided into three parts. The first part is dealing with necessary theoretical attitudes to problems investigation. The next one determines and briefly describes the solving territory. The last one is dealing with analysis of the concrete commodity market, position on the market and reaching the answer for my research questions.

2.2. Methodology

In this part are introduced methods which were used in this thesis. Literature review is formed through the methods of extraction, synthesis, induction and deduction to maintain basic awareness of this commodity and its meaning in the society. In the practical part of this bachelor thesis are used two investing analyses. These methods were chosen because of its real use in the agricultural commodity markets and each of these methods offers investors different point of view on wheat price changes. First is called a fundamental analysis and second a technical analysis. Fundamental analysis was used for the factors determination, their explanation and final influence on the price. On the other hand technical analysis was used for explanation how actually speculators are acting on the market using this slightly different method from fundamental analysis. In the last part of methodology is simply defined a method used in empirical researches which takes a part in statistics. This method is called a correlation and is used as a tool for the relationship and its strength detection between two variables. Respectively the calculation of correlation coefficient (R^2) is used in this thesis as an investing tool which is used in the real life. Furthermore are simply explained main analyses used in this thesis as are defined by sources.

2.2.1. Fundamental Analysis

Following definition: *"fundamental analysis is an approach to analyzing market behaviour that stresses the study of underlying factors of supply and demand. It is done in the belief that such analysis will enable one to profit by being able to anticipate price trends. A fundamentalist is a market observer, a participant who relies principally on supply/demand considerations in price forecasting[2],"* states that if the investors reveal the factors which run the supply and demand, they can be very successful if they know how to finally act.

Ben McClure on the Investopedia web page introduces the fundamental analysis as the cornerstone of investing. He has also stated that almost all investment strategies use the fundamental analysis as the base in some steps. This analysis includes economic analysis which provides the look on whole economy situation and the factors affecting it. Then there is industry analysis and finally company analysis which focuses on a concrete company, its revenues, expenses, assets, liabilities etc. to measure real value of this company. The investors usually compare the results with the value of securities of this company and decide how to act. But even if this tool should provide as it is believed investors good approach to enlarge their profits, there is also criticism from the opposite side where are mainly proponents of technical analysis and others.[3]

2.2.2. Technical Analysis

Murphy (1999) who has written an innovative book about technical analysis has defined this analysis with following statement: *"Technical analysis is the study of market action, primarily through the use of charts, for the purpose of forecasting future price trends. The term market action includes the three principal sources of information available to the technician – price, volume and open interest. (Open interest is used only in futures and options.)"[4]*

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[2] BANTA, Keith. Western Risk Management Library Market: Fundamental Analysis, 1998 (online)

[3] MCCLURE, Ben. Investopedia: Fundamental Analysis: Introduction, 2013, (online)

[4] MURPHY, John J. *Technical analysis of the financial markets: a comprehensive guide to trading methods and applications*, 1999, p. 1-2

2.2.3. Correlation

This method is defined by Investopedia (2013) as follows:"*In the world of finance, a statistical measure of how two securities move in relation to each other. Correlations are used in advanced portfolio management. Correlation is computed into what is known as the correlation coefficient, which ranges between -1 and +1. Perfect positive correlation (a correlation coefficient of +1) implies that as one security moves, either up or down, the other security will move in lockstep, in the same direction. Alternatively, perfect negative correlation means that if one security moves in either direction the security that is perfectly negatively correlated will move in the opposite direction. If the correlation is 0, the movements of the securities are said to have no correlation; they are completely random. In real life, perfectly correlated securities are rare; rather you will find securities with some degree of correlation.*"[5]

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[5] Investopedia, 2013, (online)

3. LITERATURE REVIEW

After the necessary introduction of the topic and important methodological part the literature review is the next one which should provide you the basic information about the main concepts. Wheat, basic history, production and utilization are described in the first part. The information is mainly related to the production of wheat in the United States of America, because this country has been chosen as a subject of analysing. The term agricultural commodity is closely defined in the second part of this chapter.

3.1. Wheat

3.1.1. Introduction

Wheat belongs in the oldest and most extensively grown grain crops in the world. As a relatively short existence of humankind, wheat is closely connected with developed civilizations and has followed us since 10,000 B.C. It is the main reason of transition from the hunter-gatherer nomad to the settled agriculturalist.[6]

3.1.2. History and the Meaning

When people transferred into the ancient civilizations (Babylonia, Egypt, Greece, Rome etc.); wheat was a principal food plant in that time. Its importance was reflected in their everyday lives and projected into the religion as well. The god called Osiris has gifted the Egyptians as they believed with wheat[7]. The Greeks believed that the "goddess of the earth and its fruits" Demeter is the reason of gifting the people with this precious crop[8]. Even the Romans had their goddess with the name Ceres. The name "Ceres" came from the Latin verb *creare*, to create, but the meaning became relate to agriculture and grains, especially wheat and appeared in later form as a word cereals where wheat belongs to. At this time the Roman Empire was even called "Wheat Empire" and utilization of wheat was mainly as human food.[9]

But wheat was not always in the first place. Barley in this time was even more extensively produced than wheat and after migrations from north; wheat production was partly replaced by rye.[10] However, the comparison of wheat to total grain used for food was considerably larger, because barley and rye were used as animal feed, whereas almost

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[6] Diamond, J., 1997, *Guns, Germs, and Steel. The Fates of Human Societies*

[7] BULLER, A. H. R., 1919, *Essays on Wheat*

[8] Fowler, W. W., 1908, *The Roman Festivals of the Period of the Republic*

[9] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.3

[10] Weaver, J. C., 1950, *American Barley Production,*
  Takahashi, R., 1955, *The origin and evolution of cultivated barley*

all wheat was used for human food[11]. The availability of wheat for food has always been considered as a sign of a high stage of civilization. The quality of bread gradually improved, and became an important food for the Western world and new products slowly appeared when the society was more civilized. As Boals (1948) has stated; wheat had become a world symbol, reflecting the food situation for many millions of people and, equally important, indicating economic prosperity and political stability.[12]

3.1.3. Wheat as Human Food

As Khan and Shewry (2009) had proven in the part before, wheat has always played an important role in human diet. As a matter of this fact, not just wheat but all activities of cultivation, processing and using have improved during the time.

The improvement might be seen in the bread evolution. The perfection of ancient civilizations should be neglected because there had been highly developed bakery art in the time of ancient Egyptians but then all these treasures were forgotten. "*In the Stone Age, grains were crushed between flat stones; the crushed material was moistened with water and made into a flat cake, which was dried in the sun. At some later period, the practice of placing the cakes on hot stones or covering them with hot ashes was developed. Early efforts in the art of baking involved only meal, water, and heat, producing bread without fermentation, which we designate as "unleavened." Such breads are common today in the oatcakes of Scotland, the Passover cakes of the Jewish people, and the chapatti of India and Pakistan.*"[13]

The progress came with the Industrial Revolution and movement of people from agricultural regions to the cities. On one hand this change had led to higher appearance of bakeries in the cities and machinery in the processing of wheat[14]; on the other hand farms had to produce more wheat for city flour mills and the needs of production had far exceeded the need of the small family. In this time lot of new and different products was invented. They were not different in the shape from the ancient time loaves and products but the great variety of ingredients and other flours gave them higher disparate.

"*Certain types of baked products became associated with particular countries or places, such as the dark breads of old Russia, French bread, and Vienna bread. These products probably had some degree of standardization at one time, but at present none of them is*

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[11] Jasny, N., 1944, *The Wheats of Classical Antiquity*

[12] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.4

[13] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.5

[14] Matz, S. A., 1960, *Bakery Technology and Engineering*

well defined. For example, Vienna bread originally was a light crusty loaf, usually in the form of rolls, made from matured Hungarian flour, with a liberal amount of yeast, baked quickly in a hot oven containing steam. French bread was crisp, contained little crumb, and was usually made without the addition of sugar or fat. The dough was formed into sticks about 50 cm (18 inches) long. These and other types are now included under the general classification of hearth breads."[15]

Nowadays wheat is used for production of pan bread, noodles, cakes, biscuits/cookies, steamed bread, doughnuts, croissants, bagels, pizza, flat breads, and chapatti and each of these products requires different composition and characteristics of wheat and its kernels. Khan and Shewry (2009) have discovered that Moss (1973) summarized the requirements for the balance of grain hardness and protein content for several common products used in the last few decades.
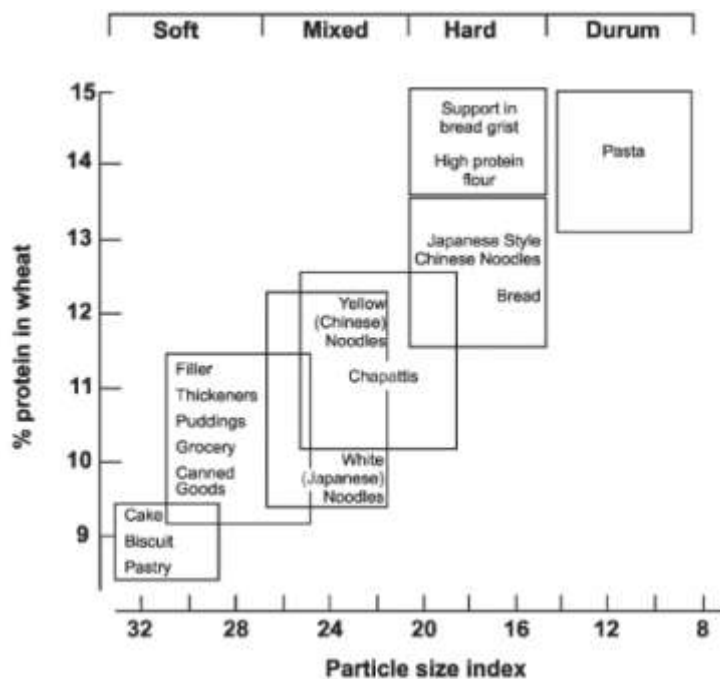
Figure 1: Utilization of wheat for food purposes *(Source: KHAN, Khalil, Wheat: chemistry and technology, 2008, p. 5)*

3.1.4. Food Classes of Wheat in the United States

Wheat can be divided in many groups according to purpose of using in human food. Wheat has two distinct growing seasons which are following: winter wheat, which is sown in autumn (in the Czech Republic: the best before the half of the October)[16] and harvested in the spring or summer; and the spring wheat which is planted in the spring and harvested in the late summer or autumn. Following part is taken almost word to word from the feature

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[15] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology*, p.4
[16] Zimolka, J., 2005, *Pšenice: pěstování, hodnocení a užití zrna*

in McCook Daily Gazette (2002) with the name "*Six Basic Classes of Wheat*" and each class is quoted as it is in the book called "*Future of Flour*" by Popper Lutz, Schäfer Werner and Freund Walter.

Wheat is the principal U.S. cereal grain for export and domestic consumption. In terms of value, wheat is the fourth leading U.S. field crop and leading export crop. In the U.S. winter wheat, which normally accounts for 70 to 80 percent of U.S. production, is sown and harvested in the same time as in Europe and Czech Republic as well as the spring wheat.

Furthermore there are several hundred varieties of wheat produced in the United States, all of which fall into one of six recognized classes. Each class of wheat which is grown depends largely upon rainfall, temperature, soil conditions and tradition. Generally speaking, wheat is more often grown in arid regions where soil quality is poor.

Wheat classes are determined not only by the time of year they are planted and harvested, but also by their hardness, colour and the shape of their kernels. Each class of wheat has its own similar family characteristics, which are related to milling and baking or other food use. In the Figure 2 are shown planting areas in the Unites States.

3.1.4.1. *Hard Red Winter Wheat*

It is important bread wheat, accounts for almost 40% of the U.S. wheat crop and wheat exports. This autumn-seeded wheat is produced in the Great Plains, which extend from the Mississippi River west to the Rocky Mountains and from the Dakotas and Montana south to Texas. Significant quantities are also produced in California. HRW as it is abbreviated has a reddish-brown bran coat; it is of moderate hardness and has mid-level protein content, usually averaging 11–12 %. It is considered a good milling and baking wheat with characteristics that make it the wheat of choice for much of the North American white pan bread and bun products. There are no subclasses for this class of wheat.

3.1.4.2. *Hard Red Spring Wheat*

Further important bread wheat, has the highest protein content, usually 13-14%, in addition to delivering excellent milling and baking characteristics. This spring-seeded wheat is primarily grown in the north central United States – North Dakota, South Dakota, Minnesota and Montana. HRS comprises just over 20% of U.S. wheat exports. Subclasses based on the dark, hard and vitreous kernel content include Dark Northern Spring (DNS), Northern Spring and Red Spring. HRS also has a reddish-brown outer layer.
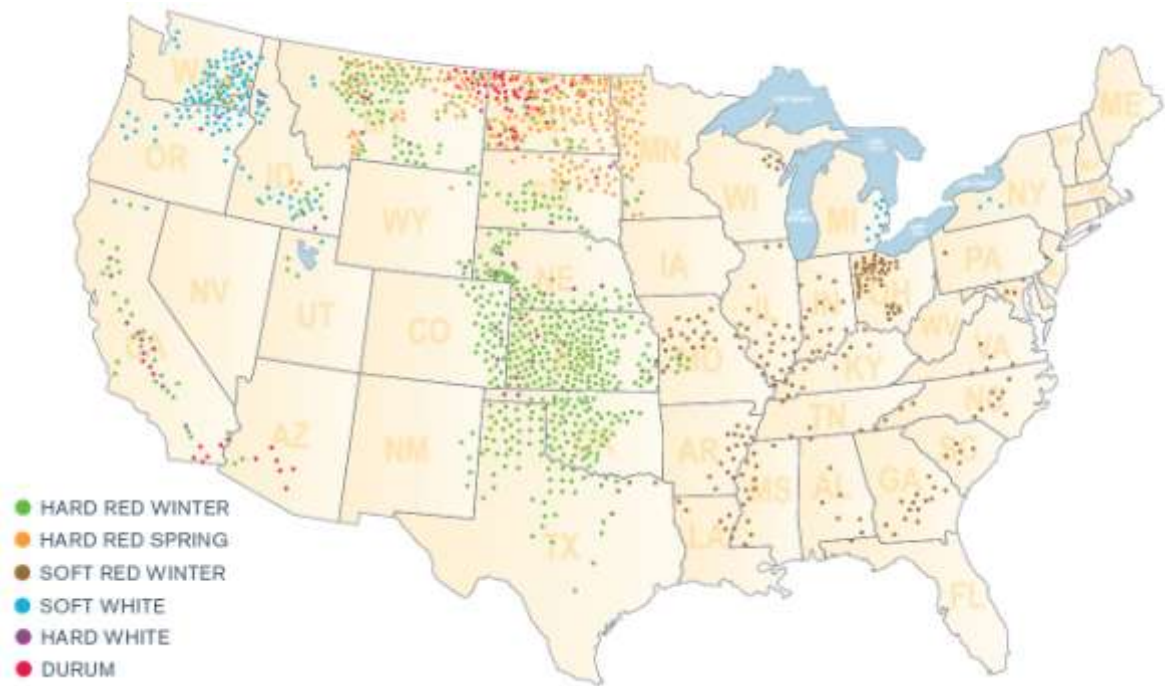
Figure 2: Growing areas of wheat in the U.S. *(Source: Wheatworld.org: About Wheat Production By Class, 2012, online)*

3.1.4.3. *Soft Red Winter Wheat*

This specie is grown in the eastern third of the Unites States. Soft Red Winter wheat yields well for farmers, but is relatively low in protein. Although it contains only about 10% protein, this wheat is considered a capable supplier of extensibility to a baker's formula and is therefore used as blending wheat in many export markets. SRW is used for cakes, pastries, flat breads, crackers and snack foods. This autumn-seeded wheat comprises about 14% of U.S. wheat exports. There are no subclasses of this class.

3.1.4.4. *Durum Wheat*

It is the hardest class of all U.S. wheat, provides semolina for spaghetti, macaroni and other pasta products. This spring-seeded wheat is grown primarily in the same northern areas as hard red spring, while smaller winter-sown quantities are grown in Arizona and California. Durum comprises nearly 5% of total U.S. wheat exports. Subclasses based on the percentage of vitreous kernel are Hard Amber Durum (HAD), Amber Durum (AD) and Durum.

3.1.4.5. *Hard White Wheat*

Hard white wheat is the newest class of wheat to be grown in the United States. It is used for noodles, yeast breads and flat breads and is grown in California, Idaho, Kansas and Montana. There are no subclasses. Currently, HWW is used primarily in domestic markets with limited quantities available for export. While similar to HRW in its hardness profile,

HWW has a white outer layer that is believed to improve its taste profile in certain products. HWW is not a new crop. Farmers in China grow white wheat varieties and Australia is a major producer of white wheat.

3.1.4.6. *Soft White Wheat*

Soft white wheat is preferred for flat breads, cakes, pastries, crackers and noodles and is grown primarily in the Pacific Northwest. Soft White is low-protein wheat with soft endosperm and a white outer layer. There are both winter and spring varieties of soft white, but SW is not classified by its growing season. The protein content of this wheat rarely exceeds 10%. SW represents just over 20% of total U.S. exports, primarily to Asia and Middle East. Subclasses are Soft White, White Club and Western White.

3.1.5. Utilization of Wheat

As a matter of fact wheat was used mainly as human food in the past; the trend is slightly different in the last decade. According to the information from FAO (Food and Agriculture Organization); the forecast for global wheat utilization has slowly rising tendency in last 10 years. It has stated that: "*While food consumption of wheat is expected to follow the world population growth, the increase in total utilization since 2007 is further driven by a rebound in its utilization for animal feed and industrial use (ethanol production), especially in the European Union. The increase in feed use in the European Union contrasts with the expectation of small contractions in feed utilization in most other developed countries, particularly in the United States.*"[17] Last but not least is the utilization of wheat for its seeds.

3.1.6. Production of Wheat

Wheat is produced in regions with many diverse climates and differently developed countries. The production is more spread in the northern hemisphere where this cereal crop dominates. As it was mentioned before in the chapter "Food classes of wheat in the United States" wheat can be grown as a winter or spring crop. In colder regions spring wheat is preferred and is sown in spring because of its faster maturation and is harvested before first autumn snows. Winter wheat is usually grown in temperate climate regions with milder winters. It is sown before the first snows, which cover prepared field and cause the seedlings to vernalize and enable them the proper development as soon as the snows and winter pass. In the warmer regions (i.e. Mediterranean) is also possible to sow spring

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[17] *Food Outlook: June 2009* [online]. FAO 2009. s. 13-18 [cit. 2013-02-08]. ID259634.

wheat as it is winter wheat because of the warmer winter and important role here plays preference of the long or short time of maturity.[18]

3.1.7. Harvesting of Wheat

Times of sowing and harvesting differ in the world but they are mainly dependent on the location of the regions. Whether they are in northern or southern hemisphere but also the distance from the equator and height above sea level plays important role.

In the Table 1 are shown harvest times for the world. As you can see wheat is being harvested somewhere around the world every month. Almost half of wheat is produced in developing countries, and approximately one fifth is being produced in the Eastern Europe and in the Russian Federation. Most wheat (more than four fifth of whole production) is consumed as human food or animal feed within the producing country.[19]

Times of Wheat Harvest Around the World	
Month	**Region**
January	Argentina, Southern Australia, Chile, Uruguay
February	Upper Egypt, Southern India
March	Egypt, India, Libya
April	Southern Egypt, India, Iran, Iraq, Mexico, Syria
May	Algeria, Morocco, Central and Southern Asia, Tunisia, Southern USA
June	Central China, Southern France, Greece, Italy, Portugal, Spain, Turkey, Central USA
July	Austria, Bulgaria, Northern China, France, Southern Germany, Hungary, Japan, Romania, Southern Russia, Central USA
August	Belgium, Britain, Southern Canada, Denmark, Germany, Holland, Poland, Central Russia, Northern USA
September	Canada, Sweden, Northern Russia, Northern USA
October	Northern Canada, Northern Russia, Northern Scandinavia
November	Northern Argentina, Brazil
December	South Africa, Argentina, Central Australia

Table 1: Times of Wheat Harvest Around the World *(KHAN, Khalil, Wheat: chemistry and technology, 2008, p. 7)*

3.1.8. Storage of Wheat and Transportation

At the beginning, there is the important fact that regions, where wheat is grown, are distant from the places where wheat is usually processed and brings many challenges in the whole process. And proper long-term storage takes important part because the grain must be stored even from one harvest to another before it is sold. At farms wheat is usually stored

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[18] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.6
[19] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.7

in silos, which are created to face all issues of storage of wheat and might be constructed in horizontal, vertical or circular option.[20]

Transportation occupies important role in this chain and might bring some risks. Rail transport is the essential mean in the inland transportation and mainly connects the place of production and the processing site. Barge transport is used where the conditions are acceptable and is used for transportation of wheat in the export centres which are strategically located at harbours. For the international trade is used shipping as the best mean of transport because of the relatively low price, the possibility of transport in bulk and low risks of losing the cargo. Even if wheat is transported by barges on waterways (in the U.S.: Mississippi, Columbia rivers or the Great Lakes); it must be transferred to the naval ships used for cargo of this type. To make this possible, there are used special grain storage elevators. There are two options to store and transport wheat to the demanders; in its original form as kernels or in milled form. For this step there are usually flour mills near the exporting port.[21]

Transportation and storage process are very important and they need to provide the suitable conditions and fulfil requirements such as dryness of the product (e.g. under 14% of moisture), free of destructive pests (rodents and insects) and the premises should be sealable.[22] The importance is also in avoidance of mixture different classes of wheat and other seeds. Generally, whole maintenance of wheat during transportation and storage plays major role and any breach of rules can reduce the value of the grain.[23]

3.1.9. Wheat and Measurement

Generally, wheat is measured in bushels, pounds or tonnes. Following part is quoted from the book Wheat: chemistry and technology by Khan Khalil and Shewry Peter to give the imagination how these units are connected and show issues connected with different places around the world. This article is mainly focused on U.S. measurement standards.

"*Despite the long-standing arrangements of international trade in wheat and other grains, there is still no general agreement on the "language" to describe units of measurement. Much of the world has adopted the International System (SI) of units, but the British and U.S. versions of the Imperial System are still in use[24]. For example, the U.S.*

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[20] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.7
[21] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.7
[22] Heaps, J. W., Ed, 2006, *Insect Management for Food Storage and Processing*
[23] Reed, C. R., 2006, *Managing Stored Grain to Preserve Quality and Value*
[24] Wrigley, C. W. 2004a. Units of grain science

bushel (35.24 L) is equivalent to 32 dry quarts or 8 U.S. gallons, but it differs from the British Winchester bushel (36.37 L), which is equivalent to 8 British gallons. The bushel is a measure of volume, yet it is used as a measure of mass to indicate yield (e.g., bushels per acre). Accordingly, the U.S. government has defined Imperial mass units for a U.S. bushel of each of the major grains, namely, 60 lb for a bushel of wheat, 48 lb for a bushel of barley, 32 lb for a bushel of oats, and 56 lb for a bushel of maize. Conversion of yield figures from these Imperial units to metric is complex; for wheat, the equivalence is that 100 bu/acre = 6.73 t/ha. The equivalence is different for each of the cereal crops. The "tonne" (metric ton [t], 1,000 kg or 2,204 lb) has become the basic unit of international trade, but the "ton" can have more than one meaning. The U.S. short ton (2,000 lb) equals 0.9072 t, and the U.S. long ton is 1.016 t, equivalent to the traditional British ton (2,240 lb). This confusion is partly due to historical differences in the hundredweight (20 to the ton), which is 100 lb in the United States and 112 lb in Britain. One tonne is equivalent to 36.73 U.S. bushels of wheat."[25]*

3.1.10. Wheat Quality Factors in Trade and U.S. Grade

Before wheat is sold at the domestic or international market, it has to fulfil conditions and successfully pass specific measurements which should ensure complex quality of the commodity.

In the United States are special grading standards known as U.S. Grade which divides wheat in 5 groups (from 1 – 5 as a grading system in elementary education in the Czech Republic). These standards are focused on acceptance of wheat for flour and semolina products and do not cover requirements for other uses of wheat.

Firstly a bulk is freed from dockage in special test procedure which should remove material lighter, larger or smaller than wheat. This part does not affect the final grade of wheat as following procedures. The test weight per bushel is a next step and is taken from the representative sample with device called Boerner Grain Divider. In the U.S. this test is usually measured in pounds per Winchester bushel (British). Higher test weight is often an indicator of better quality of wheat for milling but not always is this factor relevant because there are not considered other factors such as kernel size, shape, hardness, variety and other environment-related factors. This sample is then tested on grade factors such as animal filth, glass, stones, toxic seeds and unknown foreign substances or special grade

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[25] KHAN, Khalil, SHEWRY, Peter R., *Wheat: chemistry and technology* , p.8

factors such as ergot, smut, garlic etc. Furthermore the sample is tested for shrunken and broken kernels with special Mechanical /Hand Sieving Method and these kernels are excluded from the sample and monitored later for specifications of their damage. The rest of the sample is tested for foreign material which might be other grains and this amount is expressed in percentage of weight of the total sample.[26]

However not only these grading factors but also non-grading factors are important in the evaluation process. These factors are good for purchase decisions because they cover general attributes for milling, dough processing and baking. There are included factors: class of wheat, percentage of dockage in the sample, percentage of moisture content, percentage of protein content, percentage of ash and features of kernel such as hardness, weight and the weight of 1000 kernels.[27]

3.1.11. Wheat in the World Trade

As a matter of fact that in 2011 was produced 704 million tonnes[28], approximately only 153 million tonnes had entered into the international trade the same year. Even this relatively small number makes wheat the most-traded grain in the world. Despite the fact that half of the whole production is concentrated in the developing countries; only less than one fifth of the traded wheat is grown in developing countries. Surprisingly the main exporters vary from the main producers.

3.1.12. TOP 5 Producers of Wheat

In the last decade (data from 2001-2011) are relatively constant top 5 producers in the world and with ten year average in million tonnes are in descending order: the European Union (146.88), China (113.32), India (82.29), the United States (63.07) and Russia (54.22).[29]

3.1.13. TOP Consumers of Wheat

According to the information from Earth Policy Institute which has cooperated with U.S. Department of Agriculture; main consumers are European Union (126.8), China (120.5), India (81.6), Russia (38.5), United States (32.3), Pakistan (23.1), Egypt (18.9), Turkey (18.1), Iran (15.5.) and Ukraine (15.0). These data are valid from 11 July 2012. In this

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[26] POPPER, Lutz, Schäfer Werner and Freund Walter, 2006, *Future of flour: a compendium of flour improvement*
[27] POPPER, Lutz, Schäfer Werner and Freund Walter, 2006, *Future of flour: a compendium of flour improvement*
[28] FAOSTAT database 2013
[29] FAOSTAT database 2013 (online)

section we may see that not all top producing countries are efficient enough to cover all domestic demand for wheat and have to in some cases to join the market and import smaller or larger amount.

Another interesting fact is the purpose of consumption of wheat. On one hand China which has approximately 120 000 MT domestic consumption; divides 20% for feed and 80% for food, seeds and industry purposes. On the other hand EU with consumption 126 000MT consumes 54 000MT for feeding and the rest for food, seed and industry where industry purposes represent significant part.[30]

3.1.14. TOP Traders of Wheat

The 80% of traded wheat that is produced in developed countries comes from the United States (28% market share, 1993–2002), Canada (16%), the European Union (EU) (15%), Australia (14%), and Argentina (8%). Nevertheless, wheat production has increased in India in recent years, to the extent that India exported 3 million tonnes of wheat in 2003/04 and in 2012 has increased its exports from 2003/04 by 100%.[31]

Top ten exporters in 2012 are listed as follows: United States (29.9), Canada (19.0), EU (17.5), Australia (16.5), Russia (10.0), Kazakhstan (7.0), India (6.0), Ukraine (6.0), Argentina (5.5) and Turkey (3.5).

Top ten importers in 2012 are then: Egypt (9.5), Brazil (7.0), Indonesia (6.6), EU (6.0), Japan (5.9), Algeria (5.2), Morocco (4.5), The Republic of Korea (4.4), Turkey (4.3) and Mexico (4.2). They are followed by Nigeria, Iraq, United States, Philippines, and Iran etc.[32]

3.2. Commodity

"A basic good used in commerce that is interchangeable with other commodities of the same type. Commodities are most often used as inputs in the production of other goods or services. The quality of a given commodity may differ slightly, but it is essentially uniform across producers. When they are traded on an exchange, commodities must also meet specified minimum standards, also known as a basis grade." [33]

3.2.1. Agricultural Commodity

In the United States Code this term is defined as follows:"*Agricultural commodity", as used in this subchapter, means wheat, cotton, flax, corn, dry beans, oats, barley, rye,*

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[30] Index Mundi 2013 (online)

[31] Pena, R. J., 2007, *Current and future trends of wheat quality needs*

[32] Index Mundi, 2013, (online)

[33] Investopedia, 2013, (online)

tobacco, rice, peanuts, soybeans, sugar beets, sugar cane, tomatoes, grain sorghum, sunflowers, raisins, oranges, sweet corn, dry peas, freezing and canning peas, forage, apples, grapes, potatoes, timber and forests, nursery crops, citrus, and other fruits and vegetables, nuts, tame hay, native grass, aqua cultural species (including, but not limited to, any species of finfish, mollusc, crustacean, or other aquatic invertebrate, amphibian, reptile, or aquatic plant propagated or reared in a controlled or selected environment), or any other agricultural commodity, excluding stored grain, determined by the Board, or any one or more of such commodities, as the context may indicate."[34]

Richard C. Wilson has stated on his blog: "*An Agricultural Commodity can be defined as grain, livestock, poultry, fruit, timber or any other items produced from agricultural activities. The general price level of an agricultural commodity, whether at a major terminal, port, or commodity futures exchange, is influenced by a variety of market forces that can alter the current or expected balance between supply and demand. Many of these forces emanate from domestic food, feed, and industrial-use markets and include consumer preferences and the changing needs of end users; factors affecting the production processes (e.g., weather, input costs, pests, diseases, etc.); relative prices of crops that can substitute in either production or consumption; government policies; and factors affecting storage and transportation.*

Worldwide, there are 48 major commodity exchanges that trade over 96 commodities. The trading of commodities consists of direct physical trading and derivatives trading. Most trading is done in futures contracts, that is, agreements to deliver goods at a set time in the future for a price established at the time of the agreement. Trading of futures allows both hedging to protect against serious losses in a declining market and speculation for gain in a rising market.

Some of the most well known agricultural commodities that are traded are; Corn, Mini-Corn, Wheat, Mini-Wheat, Soybean, Mini-Soybean, Soybean Meal, Soybean Oil, Soybean Crush, Oats, Rough Rice, Milk Class III, Milk Class IV, Nonfat Dry Milk, Deliverable Nonfat Dry Milk, Dry Whey, Butter, Cheese Spot Call, Random Length Lumber, Wood Pulp, Live Cattle, Lean Hogs, Feeder Cattle, and Frozen Pork Bellies."[35]

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[34] United States Code. In: *Title 7, Chapter 36, Subchapter I, § 1518.*
[35] WILSON, Richard C., 2013, *Hedge Fund Blogger: Agricultural Commodities Definition* , (online)

3.2.2. Way of Trading

Markets have been always places where everything what was needed has been traded firstly for other products and later on for money. In the most countries they should reflect free market principal even if they are regulated and well organized especially capital markets[36]. Financial markets which cover stock, bonds, commodity, currency and others are working two possible ways.

3.2.2.1. Over-the-Counter

Over-the-Counter (OTC) markets are markets which do not have a specific place, are less formal and are dependent on relationships with specific dealers. Dealers are asking and bidding (selling or buying) as a whole market would have acted and provide different prices to other dealers, clients or customers. OTC markets also do not have trading hours and withdraws from market making can happen at any time which may affect the liquidity of the market and disrupt any actions which the participants were going to make. They are less transparent and generally have fewer rules than exchanges. The negotiation about the price is taking place through a telephone, mass e-mails and instant messengers. The trading is usually bilateral because only two market participants directly observe the quotes or execution but it is not considered as the exchange because the participants had not the same options (Use i.e.: All of the securities and derivatives involved in the financial turmoil that began with a 2007 breakdown in the U.S. mortgage market were traded in OTC markets.)[37]

3.2.2.2. Exchange Trading

"Exchanges, whether stock markets or derivatives exchanges, started as physical places where trading took place. Some of the best known include the New York Stock Exchange (NYSE), which was formed in 1792, and the Chicago Board of Trade (now part of the CME Group), which has been trading futures contracts since 1851. Today there are more than a hundred stock and derivatives exchanges throughout the developed and developing world.

But exchanges are more than physical locations. They set the institutional rules that govern trading and information flows about that trading. They are closely linked to the clearing facilities through which post-trade activities are completed for securities (stocks,

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[36] Prague Stock Exchange, 2013, (online)
[37] DODD, Randal, 2012, *International Monetary Fund* (online)

bonds) and derivatives (futures, options) traded on the exchange. An exchange centralizes the communication of bid and offer prices to all direct market participants, who can respond by selling or buying at one of the quotes or by replying with a different quote. Depending on the exchange, the medium of communication can be voice, hand signal, a discrete electronic message, or computer-generated electronic commands. When two parties reach agreement, the price at which the transaction is executed is communicated throughout the market. The result is a level playing field that allows any market participant to buy as low or sell as high as anyone else as long as the trader follows exchange rules.

The advent of electronic trading has eliminated the need for exchanges to be physical places. Indeed, many traditional trading floors are closing, and the communication of orders and executions are being conducted entirely electronically. The London Stock Exchange and the NASDAQ Stock Market are completely electronic, as is Eurex, the world's second-largest futures exchange. Many others, as they phase out floor trading, offer both floor and electronic trading. The NYSE bought the electronic trading platform Archipelago as it moves increasingly toward electronic trading. Derivatives exchanges such as the CME Group maintain both old-style pits and electronic trading."[38]

Wheat as a derivative is usually traded electronically in the exchanges around the world and the speculator or hedger has to choose the place where he wants to start his actions. Many of these markets are connected and work on one big online platform. Wheat as a commodity is mainly sold in form of futures and options. Wheat can be also traded in spot trade where can belong this month expiring future contracts as well.

3.2.2.2.1.   Futures

Defined by Investopedia: "*A financial contract obligating the buyer to purchase an asset (or the seller to sell an asset), such as a physical commodity or a financial instrument, at a predetermined future date and price. Futures contracts detail the quality and quantity of the underlying asset; they are standardized to facilitate trading on a futures exchange. Some futures contracts may call for physical delivery of the asset, while others are settled in cash. The futures markets are characterized by the ability to use very high leverage relative to stock markets. Futures can be used either to hedge or to speculate on the price movement of the underlying asset. For example, a producer of corn could use futures to*

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[38] DODD, Randal, 2012, *International Monetary Fund* (online)

lock in a certain price and reduce risk (hedge). On the other hand, anybody could speculate on the price movement of corn by going long or short using futures".[39]

Wheat as other agricultural commodities is sold in form of futures in specific months which are called a delivery date. They are typically: March (H), May (K), July (N), September (U) and December (Z). The letters are abbreviation for these months on the CME exchange. Ticker symbols for wheat (might call codes) differ on each exchange. In the CBOT the July futures contracts are most-traded and offer the best liquidity[40].

3.2.2.2.2.   Options

"A fence or collar is an option strategy that establishes a trading band around a security or commodity, generally to protect profits. One form of a fence involves the sale of an out-of-the-money call option on an underlying security; all or part of the premium thus received is used to buy protective out-of-the money put on the security. Both the call and the put have the same expiration date. The call option establishes a ceiling price for the security, while the put option establishes a floor price for it, effectively 'fencing' in the option.

The primary difference between options and futures is that options give the holder the right *to buy or sell the underlying asset at expiration, while the holder of a futures contract is* obligated *to fulfil the terms of his/her contract. "*[41]

3.2.2.2.3.   Spot Trade

"The purchase or sale of a foreign currency or commodity for immediate delivery. Spot trades are settled "on the spot", as opposed to at a set date in the future. Futures transactions that expire in the current month are also considered spot trades. It is also called "cash trade"."[42]

3.2.3. Commodity Markets

There are three main important markets with wheat in the United States: the Chicago Board of Trade, the Kansas City Board of Trade and Minneapolis Grain Exchange. Each of these markets offers different class of wheat. The Chicago Board of Trade, which is part of CME Group, specializes on soft red winter wheat (SRW). The Kansas City Board of Trade (KCBT) offers wheat futures and options for hard red winter wheat (HRW) which also

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[39] Investopedia, 2013, (online)
[40] Cummans Jared, Minyanville's Wall Street: *Commodity Trading Trends: Wheat Futures Soar*, (online)
[41] Investopedia, 2013, (online)
[42] Investopedia, 2013, (online)

become a part of CME Group[43] and the Minneapolis Grain Exchange (abr. MGEX) trades with hard red spring wheat (HRS) and is also traded electronically on the CME Globex® Platform[44]. MGEX also provides index-based futures and options contracts on HRS, HRW and SRW. Furthermore you can buy wheat commodity on the European NYSE Euronext exchange which is after CME the second biggest futures exchange. Feed wheat futures are bought in London with code T or options on Feed wheat futures also with the code T. Milling wheat futures are traded in Paris with the code EBM and options as OBM. There are also other exchanges around the world such as The Intercontinental Exchange (ICE) which owns The New York Board of Trade (NYBOT) and Winnipeg Commodity Exchange in Canada (WPG). CME provides the transparency on price, created a list of new futures contracts, sets the rules and governs trading, sets position limits as well as price limits.[45]

3.2.4. Volume of Trades

In the case of buying wheat in form of futures the volume is different depending on the exchange where you want to buy this commodity. The Chicago Board of Trade quotes futures prices in dollars and cents per bushel and are traded in lot sizes of 5000bushels (136 metric tons). European NYSE Euronext is trading Milling Wheat futures (EBM) in units of 50 tonnes and contract prices are quoted in dollars and cents per bushel and Euronext Wheat futures (WHT) in 100 tonnes and prices are quoted in pounds and pence per metric ton.[46]

3.2.5. Indices

"An index that tracks a basket of commodities to measure their performance. These indexes are often traded on exchanges, allowing investors to gain easier access to commodities without having to enter the futures market. The value of these indexes fluctuates based on their underlying commodities, and this value can be traded on an exchange in much the same way as stock index futures".[47]

There are also indices for wheat which are provided for example by Minneapolis Grain Exchange. Felix Salmon has posted a very interesting feature about the role of indices in

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[43] KCBT, 2013, (online)
[44] MGEX, 2013, (online)
[45] Farms: *Lesson 1 Program Introduction and How Grain Prices are Determined*, (online)
[46] The Options & Futures Guide: Wheat Futures Trading Basics, 2013, (online)
[47] Investopedia, 2013, (online)

the wheat futures market. In March 2008 a very interesting event had happened – large numbers of futures contract traded in CBOT were expiring at levels much higher than the spot cash price and this phenomenon has been studied under a special investigation. The result has conducted that index traders were the cause of this movement of futures price above the spot cash price. This rise in the basis between the futures price and the cash price is a function of the rise of commodity indices and investors buying a basket of commodities. Main cause of this huge leap is the ease of storing wheat, he believed.[48]

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[48] SALMON, Felix, Reuters: *How commodity indices broke the wheat futures market*, 2013, (online)

4. ANALYSIS

After the necessary theoretical background where we have discovered the role of wheat and its position on the global market, we are now heading to the analytical part of this bachelor thesis. In the following part are applied two important analyses which provide the investors important closer look on factors affecting the price of wheat. As it was mentioned in the methodology, where these analyses were introduced closely in theoretical way, there are many approaches how you can invest in agricultural commodities. In this section are applied the most relevant methods which should you provide the best information about investing in wheat commodity.

Firstly, there is introduced wheat price behaviour from 1983 till 2013 applied on HRW – the most traded class.
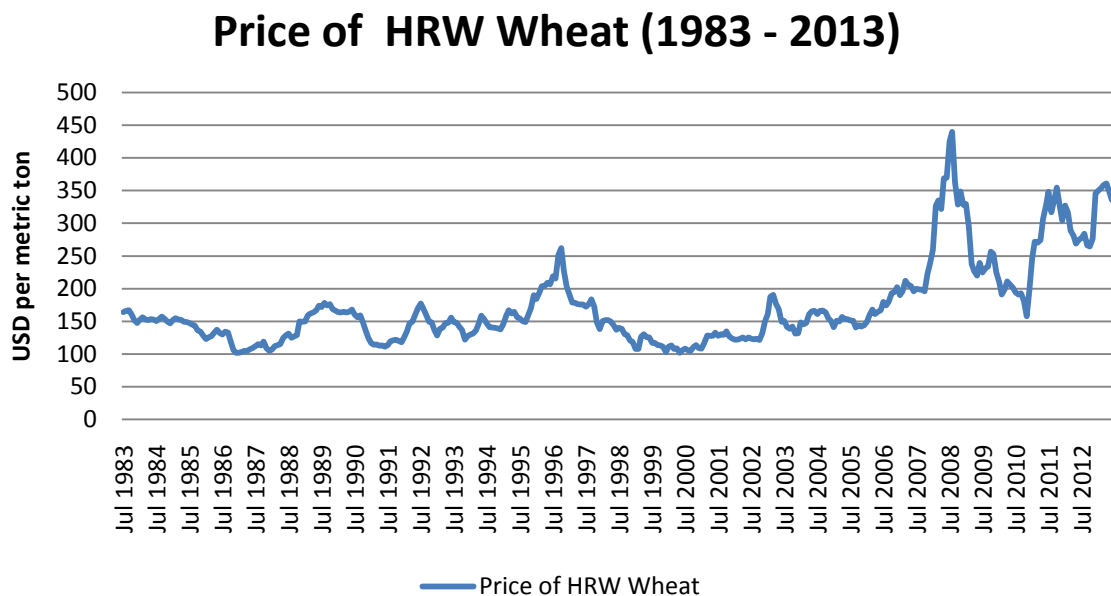
Price of HRW Wheat (1983 - 2013)

Figure 3: Price of HRW Wheat (Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, US Dollars per Metric Ton) (1983-2013) *(Source: own input, data source: Index Mundi, 2013, online)*

As you can see the price in the past was moving between 100 – 200USD per metric ton before the global economic crisis in 2007/2008 and after this event the price is very volatile and unstable and the range moved a little bit higher.

In the following part are closely introduced important factors which play more or less important role in the price determination of wheat and as a responsible investor you should not disregard them.

4.1. Fundamental Analysis

As it was introduced in the methodological part, fundamental analysis can be focused on three levels. In this case analysis provides closer look on global level (respectively country) then on a concrete company.

The main idea of fundamental analysis is that the price of every agricultural commodity, so wheat as well, is driven by supply and demand. On this principal is working every market in the world and can be graphed as follows. Whole process of setting the prices is driven by the interaction between demanders, people who are willing to buy some product for acceptable price[49] and suppliers who are trying to maximize their profits. At the equilibrium point where the supply curve meets the demand curve, the deal is done for some certain price (i.e. USD per bushel) and quantity (amount of bushels). In the following part are analysed the factors which drive the movement of supply and demand curve in wheat commodity market.
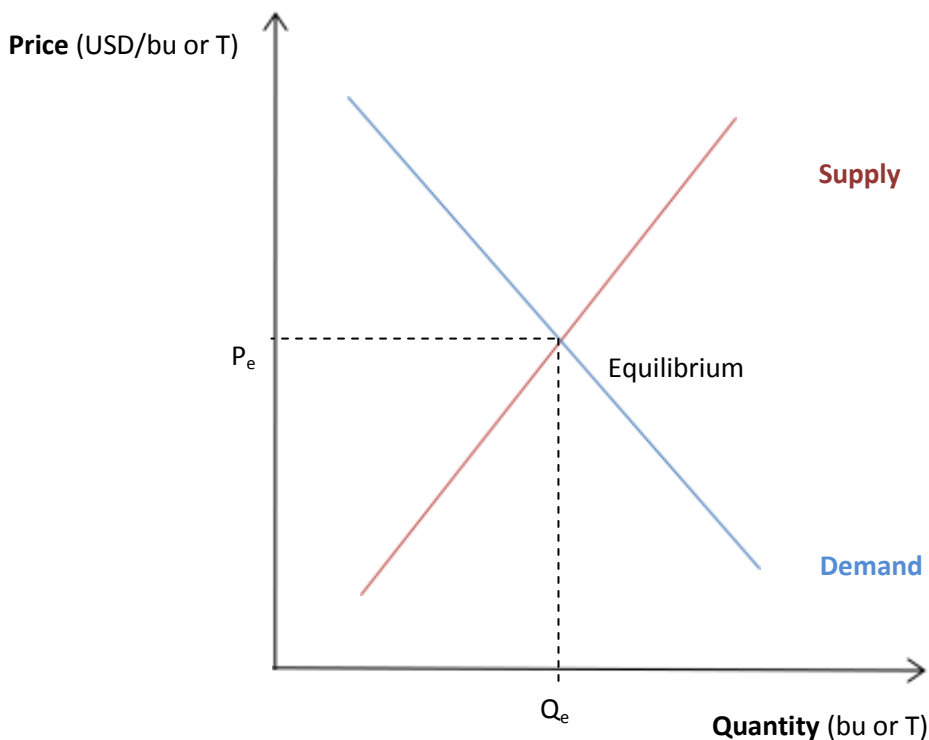

Figure 4: Supply and Demand Curve *(Source:own input based on the knowledge)*

4.1.1. Introduction

Firstly as any other commodity which is grown wheat and its price is affected by the seasonality. The price is changing over time depending on what situation wheat is right in

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[49] TradingCharts: Law of Demand and Fundamental Analysis, (online)

the calendar. As you can see in the Figure 7, the price is changing regularly during the year so we may see the seasonality occurrence.

The price usually goes down through harvest and peaks between March and July depending on the class (spring or winter wheat). In this case we may see that in 2012 the price of Hard Red Winter Wheat peaks up between June and July and at the end of the year the price is starting to decline.
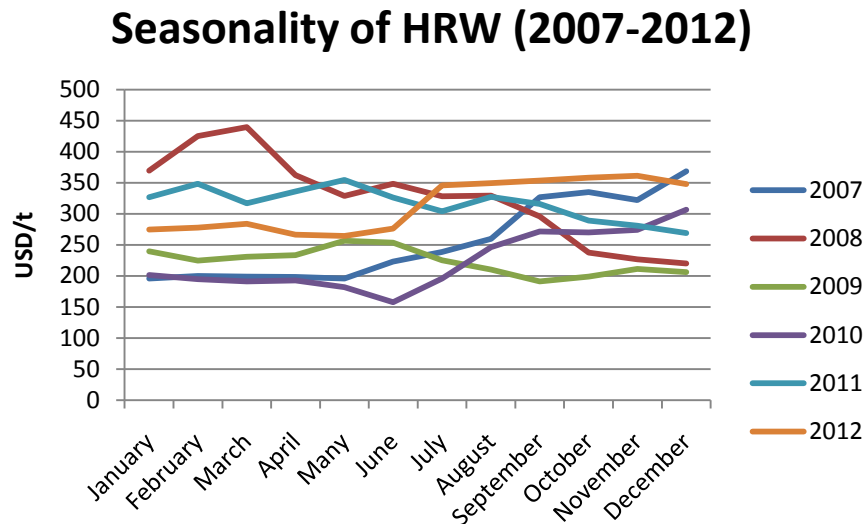
Seasonality of HRW (2007-2012)

Figure 5: Seasonality effect on the price of HRW (Wheat Price (Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, US Dollars per Metric Ton) (2007-2012) *(Index Mundi, 2013, online)*

Furthermore the sellers and buyers as well should observe global events – such as natural disasters, international politics but also events occurring within his or her country.

There is only one factor which is influencing both supply and demand side: reports and predictions which are released by organizations and institutions. In the U.S. these information are provided by United States Department of Agriculture (USDA) or Board of Trade of each exchange. These reports bring continuous information about wheat acreage, yields, production, export demands or some policy and process changes and many more. This information may actually affect both sides to act somehow.

4.1.2. Supply Side

Supply side is mainly affected by the level of production, the amount of wheat produced in the world and its changing may influence the price a lot. Wheat commodity is highly dependent on harvesting area or so to say the number of hectares where wheat is being grown. If the quantity is not being satisfactory and the harvesting area is great, it may be because the yields are not sufficient enough (bushels obtained from one hectare) and

farmers are not doing their job well. Generally the harvesting area is affected by processes in farming, where so called crop rotation and right management of crop production gives the rule of changing the crop planted on field to harvest the commodity with required quality and condition and to provide needful nutrients to the plants obtained from the soil. Competition crops which represent substitutes of wheat are another cause of reduction in harvesting area of wheat such as corn or soybeans in the U.S. and the trends in ethanol production or other purposes may change. Nevertheless, the main source of harvesting area and yield reduction is weather. Adverse effects of weather like droughts, floods or even bad winter conditions for winter wheat may change the harvesting area, yields and total production which formulate the supply.

Globally there is a high risk in wheat production because the supply covers the demand with just small surplus so the reserves are not huge.[50] On the other hand if the reserves would be higher, they might influence the price of wheat to goes down. The reason of this movement is mainly a durability of this commodity even if in comparison with other commodities wheat is much more durable. But lower amount of reserves would move with the price of wheat as well and so they would move it in the opposite way - up. These reserves or so called carryover stocks are measured in stock to use ratio which is expressed in percentage of total use (demand) of certain commodity in one year (in the case of wheat a year is counted July/June) and in the past was moving between 20 and 30% in wheat commodity.[51]

Government programs in wheat producing countries such as special loans for farmers, donations or even special taxes on biodiesel etc. also affect the supply curve because they represent the motivation for farmers to grow some certain crop or to start their businesses of farming. Cost of carry also plays a significant role in the price determination and these costs cover financing, storage, shrink and insurance and may affect final price of futures contract.

Finally imports are influencing the supply as well and some countries are more and some less dependent on them. The imports (which are mainly from Canada as a trading partner) represents less than 10% in the United States and the list of main dependent countries is in the Top traders section.

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[50] US Wheat: Supply & Demand, (online)
[51] TradingCharts: Stocks to Use Ratio, (online)
    FoodOutlook: June 2009, (online)

4.1.3. Demand Side

Demand side is mainly driven by domestic demand created by processing companies which creates different food products from wheat, or companies which need to feed the animals and also firms which are using wheat for more industrial purposes (production of bio fuels, beverages, starch products, cosmetics...etc.). Last but not least is also utilization of wheat for next season in form of seeds which are set to the ground. Generally speaking, important role here plays the division of the country's economy in sectors and the focus its production and dependence on this commodity. Besides the domestic demand there is also export demand which is created by insufficient supply of foreign countries. Export demand is influenced not only by foreign countries which are not successful in satisfying their needs in their domestic markets but by country's policy as well. Lot of countries have quotas for exporting of commodities and goods to avoid the dependency on foreign countries which might take power over these countries simply by ruining their markets and quotas represent a kind of protection. Furthermore the attraction of foreign countries is not caused just by satisfying supply (amount, the quality, the class of wheat) but the credit of exchange and trading country as well.

Currencies are other important factor affecting the acting of demanders. When one currency is weak in comparison with different one (USD/EUR), it causes that products in the U.S. market are relatively cheap for European countries. In wheat example might for example bio fuels producing companies from the EU start to buy wheat in the U.S. market which actually moves the prices of wheat on CBOT or other exchange to go up because the shortage in supply is created.

According to the currency and the opening of the market to the global area there also play significant role transportation and its fees. When going over the sea or ocean the grain commodities are usually sold with FOB (Free on Board) agreement where the buyer pays almost whole costs in the process of shipping. For the U.S. wheat are used ports in Gulf of Mexico, in Portland and in the Great Lakes and every port charges different prices. These costs may also influence the buyer where (country or port) he will buy this commodity and whether it is profitable to send overseas or not.[52]

One of the possible factors which actually will affect the price of wheat to go up is the rising price of crude oil. This movement may cause the buyers start buying wheat for

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[52] US Wheat: How to Buy, (online)

bio ethanol production. Author believed that this is caused by rising concern about crude oil and future and the production of bio ethanol decently helps to reduce consumption of crude oil by dilution of its products with it. Apart from this the bio ethanol is more environmental friendly and the fumes are much healthier.[53]

In the end the investors should not forget how close relationship is between commodity markets and equity markets. Lot of companies are bounded with this certain commodity because their businesses are running and using wheat as a major source for their products. Any shortages in wheat production may entail these companies many problems and the value of the stocks of these companies traded in the equity markets may decrease and move with the whole market. And not only one company but a complex impact on the economy of a country through the value of indices (Dow Jones Industrial Average in the U.S.).[54]

4.1.4. Past and the Future

All the factors mentioned in the previous chapters are affecting supply or demand of wheat and the USDA is reporting real data during the year about these factors. In the Table 2 is shown Grain Market Outlook in the U.S. It contains information about planted and harvested area, yield per harvested acre in the U.S., beginning stocks, production, imports, exports, ending stocks and many more from year 2007 till now. It contains also prediction for 2012/2013 because this marketing year has not ended yet.

In the following part are applied theories of influence on supply and demand on the real data obtained from the USDA. Some of these data were chosen to analyze graphically because of their relatively countable influence on one of acting sides. Data about food, feed and residual use are influenced by news and trends around the world which are very hard to predict or to count.

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[53] HowStuffWorks: 10 Top Biofuel Crops, (online)
[54] Investopedia: Commodities That Move the Markets, (online)

Item	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Planted Area (million acres)	60.5	63.2	59.2	53.6	54.4	55.7
Harvested Area (million acres)	51.0	55.7	49.9	47.6	45.7	49.0
Yield per harvested acre (bu./acre)	40.2	44.9	44.5	46.3	43.7	46.3
			Million bushels			
Beginning Stocks	456	306	657	976	862	743
Production	2,051	2,499	2,218	2,207	1,999	2,269
Imports	113	127	119	97	112	130
Total Supply	2,62	2,932	2,993	3,279	2,974	3,142
Food Use	948	927	919	926	941	950
Seed Use	88	78	69	71	76	75
Exports	1,263	1,015	879	1,289	1,05	1,05
Feed & Residual	16	255	150	132	164	375
Total Use	2,314	2,275	2,018	2,417	2,231	2,45
Ending Stocks	306	657	976	862	743	691
% Ending Stocks-to-Total Use	13.2%	28.9%	48.4%	35.7%	33.3%	28.2%
U.S. Average Farm Price – Wheat ($/bushel) June 1st to May 31st Marketing Year	$6.48	$6.78	$4.87	$5.70	$7.24	$7.70-$8.10 ($7.90)
Adj. U.S. Average Farm Price – Corn ($/bushel) Monthly Avg: June 1st to May 31st	$3.96	$4.47	$3.56	$4.76	$6.40	≈$7.20
Ratio of U.S. Wheat-to-Corn Prices Monthly Avg: June 1st to May 31st	164%	152%	137%	120%	113%	≈110%

Table 2: U.S. Grain Market Outlook (2007-2013) *(Source: AgManager: Grain Outlook, online)*

From the data collected by USDA and released by AgManager has been created following graph (see Figure 7). As it is seen there are always losses in planted area and final harvested area is always smaller. In percentage expression these losses are moving between 10% and 16% of planted area. This information may signal that the price of wheat will go down when the losses are low because the final production will be much higher and

farmers have to sustain the quality and durability of wheat. But the main information which signals that price will go down is the amount of harvested area and the responsible investors should keep in touch with the numbers from the past to compare the results.
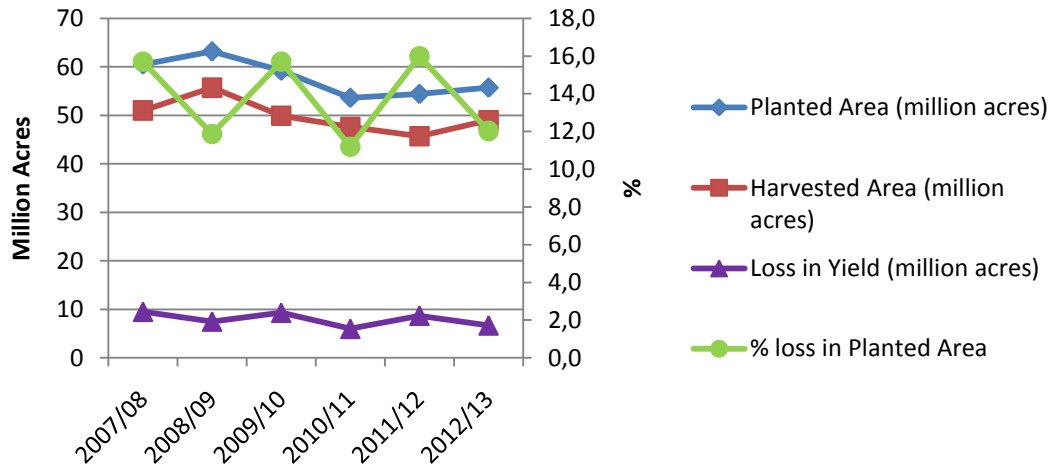
Planted and Harvested Area in the U.S. (2007-2013)

Figure 6: Planted and Harvested Area in the U.S. (*Source: own input, data source: AgManager: Grain Outlook, online*)

In the next section is used a knowledge about the statistics methods which are important part of empirical research. In this analysis was used calculation of correlation coefficient which determines the correlation between two variables. In this case the first variable as stock-to-use ratio and second variable – average price of HRW in the U.S. This analysis focused on relationship between the annual average prices and stock-to-use ratio to reveal the significant role in price formulation of this item. The calculation gives the result of $R^2 =$ -0.076602599 which represents negative 7.66% strong relationship between these two variables. This result signalizes that the price is influenced by stock-to-use ratio only by 7.66% (negatively – stock-to-use ratio goes up, annual average price of HRW goes down) which is very weak factor affecting the price. Nevertheless the investors should not forget even this small influence factor in their decisions. In the Figure 8 are shown runs of these two variables to gain idea about their curves. On the left side is axis for average price in USD per metric ton and on the right side is axis for stock-to-use ratio in %. On the horizontal line are years studied in this analysis.

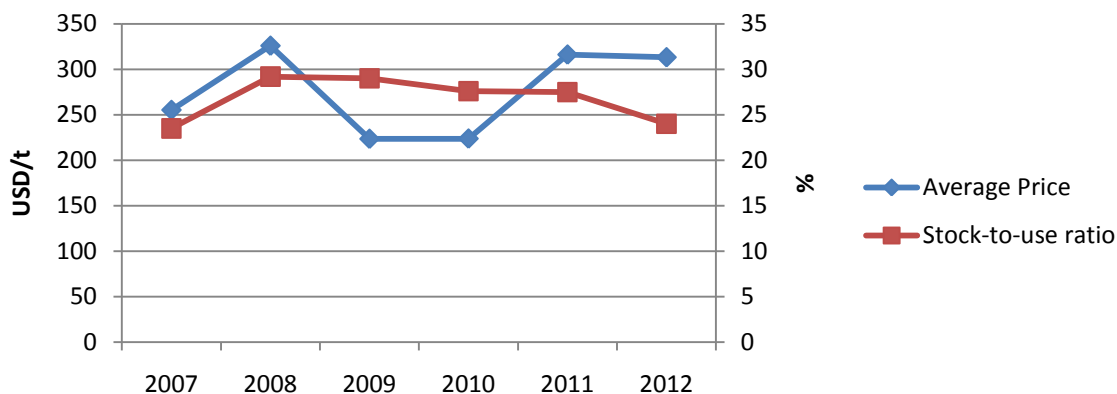# Annual Average Price of HRW v. Stock-To-Use Ratio in the U.S.

Figure 7: Average Price of HRW Wheat (Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, US Dollars per Metric Ton) v. Stock-To-Use Ratio in the U.S. *(Source: own input, data source: AgManager: Grain Outlook, online and Index Mundi, 2013, online)*

The last part of fundamental analysis is focused on wheat main substitute in the U.S. market – maize (corn). Firstly the production of corn was compared with the feed use of wheat and again the correlation coefficient helped to reveal the strength in this relationship. First step was the conversion of the units in metric tonnes. Data for feed use of wheat was listed in U.S. bushels so as it was mentioned in the section Wheat and Measurement, the basic transferring relationship was applied as 1 ton = 36.73 U.S. bushels. The hypothesis was that if the production of corn will go down then the feed use of wheat will go up. In the final calculation the correlation coefficient (R^2) was equal to 0.6603171724 and the hypothesis was rejected. The result was very surprising and the production of corn in the U.S. has with the feed use of wheat positive and relatively strong relationship (approximately 66%). This result actually signalizes that there is certainly another factor which is influencing both variables and it is not recommended to decide upon this knowledge of this relationship. Another hypothesis is that with higher sample size the result might be different if the data includes more past years. But in this thesis the research was focused on years starting from the economic crisis 2007/2008. In the Figure 9 is shown a graph of these two variables. There were used two levels of the same units (metric tonnes) because of the clarity of the graph. On the left side is corn production in mega tonnes and on the right side is feed and residual use of wheat in tonnes. They are again compared from year 2007 till 2013.

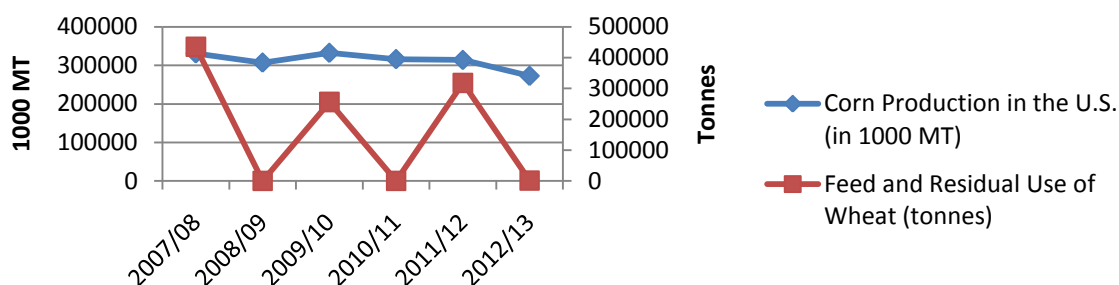# Corn Production and Feed Wheat Use in the U.S. (2007-2013)

Figure 8: Corn Production and Feed Wheat Use in the U.S. (2007-2012) *(Source: own input, data source: AgManager: Grain Outlook, online and Index Mundi, 2013, online)*

Finally the attention is paid to the relationship between prices of wheat and corn as a main substitute. Again the coefficient of correlation was used as the explanation of the relationship between these two variables. R^2 was equal to 0.697908 presents almost 70% strong relationship between wheat price and the corn price. The investors should pay attention to the corn prices because when they go up usually wheat prices will go up as well.
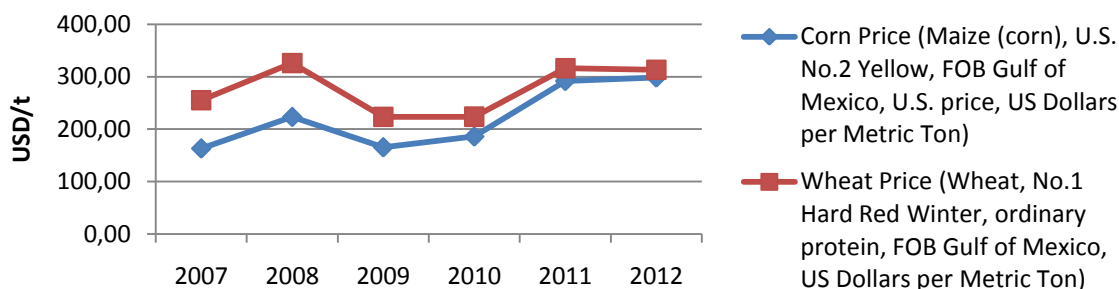
Annual Average Corn and Wheat Prices

Figure 9: Annual Average Corn and Wheat Prices *(Source: own input, data source: Index Mundi, 2013, online)*

4.2.   Technical Analysis

In the methodological part are introduced both analyses used in this thesis. As was mentioned in the previous chapter, fundamental analysis focuses on economic forces of supply and demand which are affecting the price of wheat to move. Technical analysis is different and focuses only on the price movement. They are trying to see patterns and trends in the price movement using charts and with right timing effectively invest. So the fundamentalists study the cause of market movement while the technicians study the

effect. In this analysis hundreds of tools are included but this thesis is providing only some of them to get the basic knowledge of this broad area.[55]

Next chapters are introducing simple moving average, exponential moving average, moving average convergence, Bollinger bands, relative strength index and stochastic oscillator and are applied on price of U.S. wheat. The whole computations of technical analysis are made in Advinion Professional Chart™ which is available on Investing.com web page.

4.2.1.   Introduction

Firstly, as good investors you should know that the basic philosophy of this analysis is the assumption of price moving in trends. These trends are called uptrend, downtrend and sideways trend depending on the direction where they are moving. These trends can be seen in charts – bar charts or candlestick charts which with a little different method show the open, high, low and closing price. The closing price as chartists believe is the most critical price of the trading day.

The most futures technicians use only the total volume and open interest figures. Futures contracts are shown in the different chart with so called open interest. Open interest is the total number of outstanding futures contracts that are held by market participants at the end of the day, only in longs or shorts, not both. Under this chart is usually another with total volume and these two play important role in futures trading decisions.

On the exchange you have the option to buy wheat in spot trade or in form of contracts which are always fixed with certain months – March, May, July, September and December. Investing.com offers also overview price of U.S. Wheat which is in this thesis studied as an example and was chosen as the most traded commodity.[56]

4.2.2.   Simple Moving Average

"A simple, or arithmetic, moving average is calculated by adding the closing price of the security for a number of time periods and then dividing this total by the number of time

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[55] MURPHY, John J. *Technical analysis of the financial markets: a comprehensive guide to trading methods and applications, p.43*
[56] MURPHY, John J. *Technical analysis of the financial markets: a comprehensive guide to trading methods and applications, p. 44*

periods. Short-term averages respond quickly to changes in the price of the underlying, while long-term averages are slow to react."[57]

For the investors the line of simple moving average (SMA) is important because they decide whether to buy or sell based on the movement and contact of price chart and SMA. When the price line touches and goes above the SMA then it signalizes for BUY and when it acts the same but goes below the SMA then it signalizes for SELL. The biggest issue of this technique is delay of the information of crossing and movement of the line and when this event does not occur for significant period of time the investor may lose money. This technique is not very flexible.

Another utilization of SMA is based in combination with another SMA for different time period. Every security traded in the exchange requires different periods for research but usually are compared short-term SMA (hour, 1-day, 10 days) with long-term SMA (50 days, 100 days, and 200 days). The investors are comparing these two lines and again are focused on the contact between these two lines. This contact signalizes the command for BUY or SELL based on the short-term SMA located above or below the long-term SMA. This method is called double crossover and provides more reliable information that the timing for action is right.

In the graph below (Figure 12) are shown signals based on the movement and contact of SMA (10 days) with price line of U.S. Wheat and also the combination with another SMA (50 days) last 6 months. When the blue line (SMA (10)) crosses the orange line (SMA (50)) there is seen the trend of selling in the drop of price following to the March. There are also two false signals in this double crossover method which are caused by price line contact with SMA (10) and investors who are deciding upon this method. The price which is Y-axis is explained in USD. Both methods are signalizing to SELL on the last spot.

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[57] Investopedia: Simple Moving Average (SMA) Definition. (online)

Figure 10: Simple Moving Average of US Wheat *(Source: Advinion Professional Chart, Investing.com, 2013, online)*

4.2.3.   Exponential Moving Average

This tool is very similar to simple moving average with difference that it is more sensitive to the latest data. It reacts faster to recent price changes than SMA. For short-term averages are used 12- and 26-day EMA and 50- or 200- for long-term trends.[58]

In the world of investors it indicates the same signals as SMA and following graph is showing higher sensibility to the price changes than previous method. EMA also signalizes to the investor to SELL in the last spot.

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[58] Investopedia, 2013, (online)

4.2.4.　　Moving Average Convergence Divergence

"A trend-following momentum indicator that shows the relationship between two moving averages of prices. The MACD is calculated by subtracting the 26-day exponential moving average (EMA) from the 12-day EMA. A nine-day EMA of the MACD, called the "signal line", is then plotted on top of the MACD, functioning as a trigger for buy and sell signals."[59]

When the MACD falls below the signal line, it is a bearish signal, which indicates that it is time to sell. Conversely, when the MACD rises above the signal line, the indicator gives a bullish signal, which suggests that the price is likely to go upward. Generally traders are waiting for a confirmed cross above the signal line before they take any actions. From the moves of these lines can be also known the end of current trend and when the MACD raises dramatically it gives the signal that security is overbought and will soon return to normal levels. For faster analysis it better to focus on histogram because it graphically describes the same actions which are actually happening between MACD and signal line. As you can see in the graph (Figure 14) below, the histogram is shown in the

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[59] Investopedia, 2013, (online)

bottom side of the graph with black bars. These bars represent difference between the two moving averages that day. The investors are paying attention to how close the bars are to the zero line or which direction they are moving – whether they are closing or diverging from this line.

In the graph MACD of US Wheat are seen two BUY signals – at the end of November 2012 and at the beginning of January 2013. On the other hand there are also seen two SELL signals – at the beginning of December 2012 and the beginning of February 2013. At the beginning of March the SELL signal is still confirmed but the change may be expected in few days because of the closing bars to the zero line.

Figure 12: MACD of US Wheat *(Source: Advinion Professional Chart, Investing.com, 2013, online)*

4.2.5.   Bollinger Bands

"This technique was developed by John Bollinger. Two trading bands are placed around a moving average. Except these Bollinger's Bands are placed two standard deviations above and below the moving average which is usually 20 days. Standard deviation is a statistical concept that describes how prices are dispersed around an average value. Using two standard deviations ensures that 95% of the price data will fall between the two trading bands. As a rule, prices are considered to be overextended on the upside (overbought)

when they touch upper band. They are considered overextended on the downside (oversold) when they touch the lower band."[60]

    In the following graph (Figure 15) you can see the price development from March 2012 to March 2013 with applied 20 days Bollinger bands. During the June/July price shoot up because of the finished harvest and the seasonality occurs on the price determination. Few overextended prices on the downside appeared in May, September and November 2012 – were overbought. In contrast few oversold appeared at the end of March, August, October and December 2012 and few days before the 8th March. The trend of Bollinger bands signalizes that the price will continue to fall as it is predicted from the fundamental analysis that price of wheat follows the seasonality of this commodity.

Figure 13: Bollinger Bands of US Wheat *(Source: Advinion Professional Chart, Investing.com, 2013, online)*

4.2.6.   Relative Strength Index

"A technical momentum indicator that compares the magnitude of recent gains to recent losses in an attempt to determine overbought and oversold conditions of an asset. It is calculated using the following formula:

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[60] MURPHY, John J. *Technical analysis of the financial markets: a comprehensive guide to trading methods and applications, p. 209*

$$RSI = 100 - 100/ (1 + RS)$$

$$RS = Average\ of\ x\ days'\ up\ closes\ /\ Average\ of\ x\ days'\ down\ closes.$$

The RSI ranges from 0 to 100. An asset is deemed to be overbought once the RSI approaches the 70 level, meaning that it may be getting overvalued and is a good candidate for a pullback. Likewise, if the RSI approaches 30, it is an indication that the asset may be getting oversold and therefore likely to become undervalued."[61]
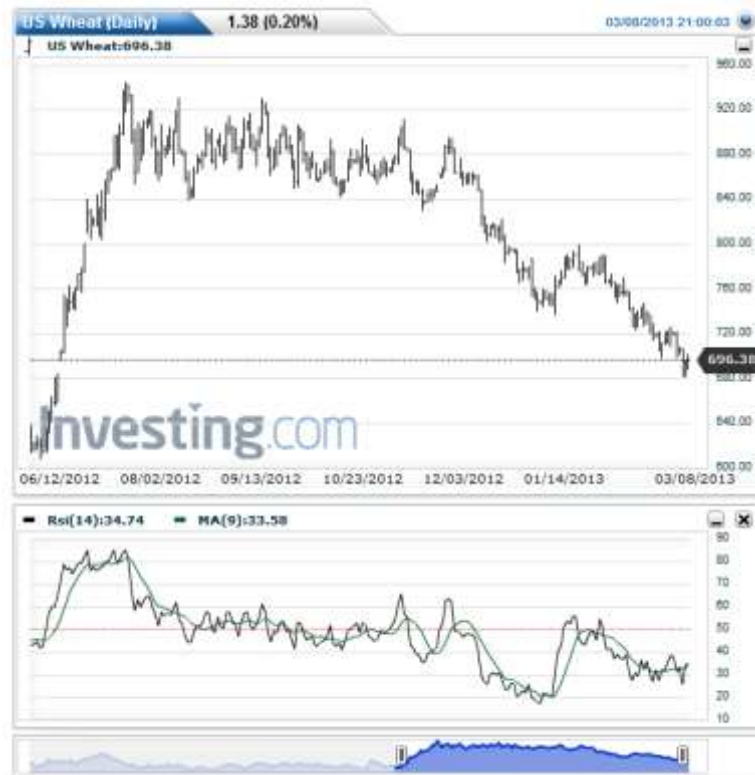

Figure 14: RSI of US Wheat *(Source: Advinion Professional Chart, Investing.com, 2013, online)*

As it is seen in the graph (Figure 16) in the bottom side, based upon the knowledge quoted from the source, US wheat has been overbought in June and July and during September it returned to the normal position. Between the year 2012 and 2013 wheat began to be oversold and in the middle of January is again returned to the normal position so that slowly fall back to the value of 30 and dance on the border of oversold.

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[61] Investopedia, 2013, online

4.2.7. Stochastic Oscillator

"The Stochastic oscillator, which was popularized by George Lane, is based on the observations that as prices increase; closing prices tend to be closer to the upper end of the price range. Conversely, in downtrends, the closing price tends to be near the lower end of the range. Two lines are used in the Stochastic Process – the %K line and the %D line. The %D line is the more important and is the one that provides the major signals. The intent is to determine where the most recent closing price is in relation to the price range for a chosen time period. Fourteen is the most common period used for this oscillator. To determine the K line, which is the more sensitive of the two, the formula is:

$$%K = 100 \, [(C\text{-}L14) \, / \, (H14 - L14)]$$

C – latest close, L14 – lowest low for the last 14 periods, H14 – highest high for the same 14 periods

This formula measures, on a percentage basis, where the closing price is in relation to the total price range for a selected time period. A very high reading (over 80) would put the closing price near the top of the range, while a low reading (under 20) near the bottom of the range. The second line (%D) is a 3 period moving average of the %K line. This is sometimes called fast stochastic. By taking another 3 period average of %D is computed slow stochastic, which is more used by traders because it provides more reliable signals."[62]

This method is applied in the following graph (Figure 17). In the upper part is seen bar chart with the price of US Wheat in USD last 4 months. Stochastic D line is seen in the bottom part with black colour. As we can see in the graph wheat has been oversold from February to the beginning of March 2013. And in contrast the overbought occurred in the second half of January 2013. This method is usually used with RSI which has been explained in the previous part and investors are waiting for the match of the decision to get more reliable command to BUY or SELL using these two methods.

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[62] MURPHY, John J. *Technical analysis of the financial markets: a comprehensive guide to trading methods and applications, p. 246-247*

Figure 15: Slow Stochastic of US Wheat (*Source: Advinion Professional Chart, Investing.com, 2013, online)*

5. RESULTS

The results are summed up in this chapter from previous analyses to generalize the outcomes of the research.

5.1. Fundamental Analysis

The supply and demand are the cornerstones of the market and fundamentalists are paying the attention to the forces which are causing these curves to move. Wheat prices movements are based upon the seasonality of this commodity and on the reports which are provided by institutions and organizations. The decisions of investment using fundamental analysis are based on these reports and so they are the crucial element. During the analysing itself the investors are focusing on the data about the production (harvested area, yields), domestic consumption, export demand of chosen wheat class and weather forecasts which are also included in reports. Right fundamentalist should also consider factors indirectly moving with the wheat price such as substitutes, the price of crude oil, and the power of currency in what the wheat commodity is traded etc. In the analytical part some chosen relationships have been counted and the only one relevant relationship appeared between two substitutes – the price of U.S. corn with the price of U.S. wheat. These two are considered as relatively closely related and so the investors might expect when price of U.S. corn will go up that then the price of U.S. wheat will go up as well. Generally investors should pay attention to the reports as well as the news because any global event might have greater or smaller impact on the wheat price change such as economic crisis in 2007/2008.

5.2.   Technical Analysis

This analysis gives us different look on the price change because this method is using just charts and hundreds of tools to predict the price movement. Main concept is based on the price moving in trends and investors using this method assume that this event will repeat in some patterns in short time. Crucial part of trading in exchange is timing and technical analysis should help to discover this right time using its special tools. This thesis reveals few most useful tools as a simple moving average and exponential moving average which both indicate to SELL for the day of study. MACD confirmed to SELL even if it indicates that changes might approach within few days. Bollinger bands then signalized that wheat has been oversold few days before the day of study. The RSI shows that wheat has been undervalued few days before the day of study and yet there is the trend of wheat to become normally valued again. Last tool used in this thesis - the stochastic oscillator indicates that in the day of study the wheat climbed from the zone oversold and probably the command the investor to BUY. Nevertheless it depends on the style of investor whether he or she is focused on short-run or wonders in long-run investment. These and other tools, which technicians are using, play an important role in the wheat price determination because upon the results of these tools the investors are deciding whether to buy or sell.

6. CONCLUSION

The aim of this thesis has been stated at the beginning of this bachelor thesis. Main goal was to define what factors are affecting the price which both fundamental and technical analysis offered through the different point of view. Closer description and explanation was provided in the analytical part and all the actions were described on the U.S. Wheat as a strong highly traded commodity which has been chosen during the research. Investors should keep in mind that the wheat commodity is certainly not a stable investment. With the applied knowledge of fundamental analysis wheat price acts very seasonally and the commodity is mainly sold in cycles based on the harvest times. Recommendations of the author suggest using both analyses for better understanding of price movement and reliable decisions. As a first step is recommended to closely study chosen commodity and its fundamentals not only within one country but over the world and compare the possibilities which the investor has. For the actions taken in the chosen exchange it is highly recommended to use technical analysis which offers broad opportunities and lot of material and studies exist in the both printed and electronic form. If the investor is not willing to invest in wheat futures and options, there is also a possibility to invest in companies processing wheat in the equity market but the assurance of good investment is never guaranteed and he or she will still need a knowledge and a little bit of luck.

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