

HEDGING – POSSIBILITIES OF RISK MANAGEMENT IN AGRICULTURE¹

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Abstract

The scope of agricultural production is to a great extent affected by volatile risks. This paper presents possibilities that financial markets provide to manage such risks. It minutely describes basic derivatives, futures and options, with a special focus on their use on agricultural commodities. The paper further describes probably the most popular futures – weather futures. Furthermore, the authors deal with complex and cross-hedging strategies. The last section brings the analysis of possibilities of establishing a derivatives market in Serbia. The first step towards this goal is to set up a commodity market and adopt related legislation, but also to meet other preconditions, such as to establish a licensing system, simplify trade with foreign entities, establish a system of clearing, develop a framework for extra-judicial settlement and to work on internationalisation of trade. Once these preconditions are met, it would be possible to establish an agricultural commodity derivatives trading system.

Key words: *futures, options, business risk, agriculture, hedging strategies, Serbia.*

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Introduction

Modern business entities operate in a quite dynamic and increasingly uncertain business environment, which has been particularly evident over the past few decades. Business results and cash flows are affected by numerous factors, such as: changes in price for inputs, end-products and services, and changes in interest rates, tax rates and exchange rates. In regard to agriculture, one should also take into account an adverse impact of environmental factors. Such environment requires a proper risk management mechanism, one of which is the use of derivatives.

On developed financial markets, derivative markets have been operative since 1970s. Futures emerged first, followed by options. Farmers immediately recognised and started to use the benefits these financial instruments provided in terms of risk management. Weather futures, however, appeared much later. The first weather futures trade took place in 1997 in an OTC (over-the-counter) market. Only two years later, the Chicago Mercantile Exchange introduced these instruments.

In this paper, the authors present derivatives and the main principles these financial instruments are based on. Moreover, the authors also minutely explain futures and options, and introduce the reader with tendencies present on basic derivatives markets, focusing on agricultural commodity derivatives. The central part of the paper is dedicated to risk management on derivative markets, namely hedging strategies. The paper presents weather futures and agricultural commodity futures and options, as well as complex hedging strategies. The final section of the paper puts a focus on perspectives and preconditions for establishing an agricultural derivatives market in Serbia.

Derivatives – commodity and financial market instruments

Derivatives i.e. derived securities are financial instruments that are dependent upon underlying assets or occurrence of an event, being based upon commodities, stocks, bonds, interest rates, indices or weather data. The reason for investing in these instruments lies in benefits that one would have if they successfully forecast the price of the underlying asset or the occurrence. The value of such securities is derived from the price of other assets, such as commodities or interest rates. Hence, a change in the price of the underlying asset affects the price of the derivative.

Derivatives exchange is also known as derivatives trading. Unlike spot trading, where transactions are carried out immediately (T+0) or within five days (T+5), derivatives trading implies a delayed delivery. These instruments are also known as derivatives contracts. At the time of contracting, e.g. a commodity, the parties define the price, quantity, quality, date and time of the delivery, and the delivery and payment are made later in the future. Moreover, there is a difference between these two types of trade in terms of physical delivery of the underlying asset – spot transactions end with delivery, whereas derivatives transactions do not necessarily end with delivery but with an offset.

Derivatives, by their nature, enable hedgers⁴ to transfer a volatility risk (caused by change in the price of the underlying asset) to speculators⁵, who accept the risk hoping to gain profits. A possibility to manage the risk and gain a speculative profit at the same time has led to strong development of derivatives markets, enabling business entities in developed market economies to use diverse hedging strategies.

Derivatives comprised financial derivatives and commodity derivatives. Financial derivatives are based on currency rates, interest rates, other securities and market indices, whereas commodity derivatives are based on the price for metal, agricultural commodities, electrical power, industrial inputs, oil and natural gas, ore, rubber, commodity indices, etc.

The main idea behind derivatives trading is to forecast price trends. Contracted parties have opposite expectations. If not, they would not have any interest in contracting such trade. On the one hand, sellers expect prices to fall, and on the other, buyers rely on forecasts on price rise.

The main derivatives contracts are forwards. Forwards are considered to be the only contract of this kind that has all the characteristics of derivatives contracts, comprising all the necessary elements. However, these financial instruments cannot be traded on a centralised market, since they are concluded individually, having a high flexibility and thus being difficult to standardise. Hence, futures and options contracts are basic derivative contracts traded on derivatives markets.

⁴ The term “hedger“ refers to a person who manages some risk, i.e. a person who sells or buys securities to reduce financial risks.

⁵ The term “speculator“ refers to a person who takes a risk in order to make a profit.

Futures

Futures are highly standardised contracts for purchasing/selling of a certain asset at a future point in time. In other words, futures are obligations to purchase or sell a certain commodity or a financial instrument on a predetermined date and at a predetermined price. In the broadest sense, futures are focused on a future price estimated at the present moment (e.g. livestock price in October, or next year's US dollar to Euro exchange rate). This instrument is a subject of trade only on regulated exchange markets.

The most traded are futures contracts on precious metals, energy, agricultural commodities, metals, and weather conditions (data on amounts of precipitation, temperatures, etc.).

The central part in futures trading has clearing houses, granting to both parties that clauses from the futures contract will be respected. Clearing houses act as a buyer to every futures seller and a seller to every futures buyer. Practically, clearing houses grant the fulfilment of the obligations from futures contracts. Thereby, there is no need for direct communication between sellers and buyers, and personal trust cedes its place to institutional trust.

One of the basic functions of futures contracts is to enable participants either to use hedging strategies or to speculate on the future price of a product [Belozertsev et al., 2012].

Options

Options give the buyer the right but not the obligation to buy (*call*) or sell (*put*) a certain basic instrument (asset, commodity, security, etc.) at a pre-determined price (*strike – exercise price*), before a pre-determined date. Options can be defined as derived securities, with a certain right for the buyer (*holder*). Obligations between the parties are regulated with *option contracts*. From a legal aspect, option contracts are incomplete contracts, giving one party the right to call or put a certain asset at a set price but not obliging them to do so. The reason why the option seller (*writer*) has a responsibility towards the buyer (*holder*) is because the option seller at the moment of contacting is paid the *premium*, which is the price of the option.

Option contracts generally expire on a certain date in the month prior to the expiration of futures contracts. Option holders are obligated to use the options by that time. Hence, option holders can use the option right (*in the money*), sell the option right to a third party or leave the option to expire (*out the money*).

Option writers also have several alternatives to the moment they are called to exercise the option. One of the most important alternatives for option writers is to close their position by buying the same type of option. This can be exercised at any moment until the clearing house informs option writers to fulfil the obligation from the contract.

The beginnings of modern options trading, as we know it today, dated back to 1973, when the first options exchange was founded in Chicago. Despite some theorists perceive options trading as “gambling”, the volume of these derivatives is increasing year-on-year.

The key elements of an option contract are:

1. *Pre-determined price of an asset (strike price)*, based on which option holders can exercise the right to call or put the underlying asset.
2. *Premium – the price of the option*. A premium price is formed on the market by the interaction of the forces of demand and supply

One should differentiate a strike price from a premium. The strike price is pre-determined by the option contract, whereas the premium is a price of the option contract and it is subjected to daily changes. Option writers keep the premium, no matter the option right has been exercised or not.

When options are out of the money or in the money⁶, the premium paid is just a reflection of the time value of money. On the option's due date, the premium equals the actual value of the option, which is normal, since the time component has been expired.

There are two basic types of option contracts:

- *call options* and
- *put options*.

⁶ Term “in-the-money-option“ refers to a situation where the value of an option equals the sum of the strike price plus premium paid. In such case, the option holder covers the cost of the premium and does not make any profit.

Calls and puts are separate options, since there are the holder and the writer for each of them. Call options are contracts that allow the holder to call a certain asset at a pre-determined price before a pre-determined date. The holder can exercise this right but is not obligated to do so. On the other hand, the writer has to fulfil the obligation from the option contract [Kolb and Overdahl, 2007].

Options can also be categorised by the underlying asset. According to this criterion, options can be based on:

- currency,
- shares,
- financial and other indices,
- commodity (including agricultural commodity) and
- weather data (precipitation amount, temperature sums, etc.).

Regarding the way of functioning, options can be categorised as American and European-style options. European-style options may be exercised only on a due date, unlike American-style options that may be exercised at any time before the due date.

The authors recommend European-style options to be included into the Serbian legislation, since American-type options are more complex and require a developed institutional framework [Allgood et al., 2010]. The names of these two types of options do not imply that those options are strictly a subject of trade in the USA or Europe. Both types are subjects of trade at a global level.

Table 1. *Global futures and options volume*

Type of derivatives	2012	2013	2014
Futures	11,072,105,368	12,217,755,153	12,165,484,775
Options	10,118,012,082	10,425,664,621	10,707,129,486

Source: *FIA (2013, 2014), Annual Volume Survey*

The global futures and options volume is large and comprises billions of contracts. Table 1 shows the number of contracts traded worldwide in the last three years. As one can see, the volume of these derivatives has been increasing year-on-year.

Table 2 shows global futures and options volume given by categories. The largest portion of contracts is based on equities, whereas the volume of agricultural derivatives has increased by a rather high rate of 15.7% over the past two years.

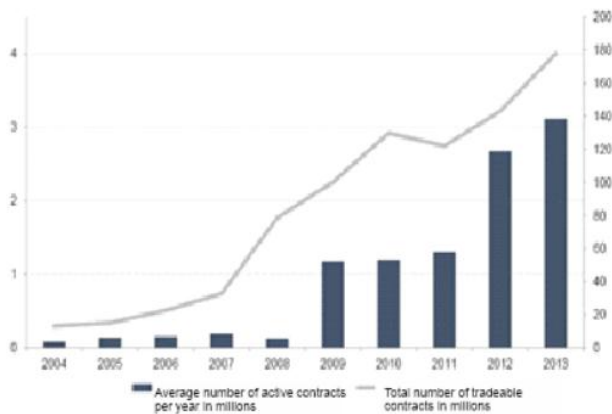
Table 2. *Global futures and options volume by category*

Category	2013	2014	Change
Individual equity	6,390,404,778	6,439,177,097	1.6%
Equity index	5,381,657,190	5,827,913,937	8.3%
Interest	3,330,904,991	3,268,154,625	-1.9%
Currency	2,496,423,691	2,119,023,131	-15.1%
Agriculture	1,209,776,849	1,400,153,550	15.7%
Energy	1,315,276,356	1,160,317,682	-11.8%
Non-precious metals	646,349,077	872,601,162	35.0%
Precious metals	433,546,140	370,872,772	-14.5%
Other	347,412,764	355,224,591	2.2%
Total	21,551,751,836	21,867,438,547	1.5%

Source: *FIA (2014), Annual Volume Survey*

Graph 1 illustrates how popular these financial instruments are, giving an overview of global commodity derivatives volume in the period 2004-2013.

Graph 1. *Global commodity derivatives volume in the period 2004-2013*



Source: *World Federation of Exchanges*

This paper puts a focus on agriculture, since farmers in Serbia have a lot of potential to use financial derivatives and thereby manage possible risks. Hence, the authors present global futures and options volume for ten agricultural commodities that had the highest volume rate in the period 2008-2013.

Table 3. *Global agricultural commodity futures and options volume in the period 2008-2013*

	Contract	2008	2013	Change
1	Palm Oil Ft	6,302,478	82,495,230	1,208.9%
2	Soy Mean Ft	81,265,439	265,357,592	226.5%
3	Soy Oil Ft	44,695,993	96,334,673	115.5%
4	Rubber Ft	46,461,103	72,438,058	55.9%
5	Soybean Meal Ft	13,354,174	20,237,181	51.5%
6	Soybean Opt	9,806,935	14,760,704	50.5%
7	Soybean Oil Ft	16,928,361	23,805,912	40.6%
8	Lean Hogs Ft	8,505,138	11,277,038	32.6%
9	Wheat Ft	19,011,928	24,993,158	31.5%
10	Soybean Ft	36,373,096	46,721,081	28.4%

Source: *FIA (2013), Annual Volume Survey*

The data imply that this market is very liquid and growing.

Risk management on derivatives markets (hedging strategies)

As it was previously mentioned, the main motive of futures trading is to manage the risk of change in the price of an underlying asset. To illustrate this mechanism the further text gives an example of hedging strategies by using a financial future and a commodity future.

Weather derivatives

Weather derivatives are novel securities emerged in the mid-1990s. The most traded weather derivatives are those based on precipitation amount and temperature sums. Climate change and an increased risk of lower yields due to drought or high temperatures have led to a larger volume of weather derivatives. Hedging strategies that use weather derivatives comprise the trading of forwards, swaps, futures and options.

These hedging strategies are used by business entities that have temperature-related costs in winter (cost of heating) or in summer (cost of air conditioning, impact of temperatures on agricultural production, etc.).

The most commonly used strategies are the use of the heat index (*heating degree days*) in winter and the cool index (*cooling degree days*) in summer. When it comes to risk management in agriculture, people mostly use *growing degree days*, with temperature ranges for optimal crop growth (maximum and minimum value). Weather derivatives can be created on all measurable weather conditions, i.e. values in a stable time series.

The amount of precipitation can considerably affect crop yields, so precipitation derivatives are very important for farmers' hedging strategies. It is necessary to define a *strike level* for a weather parameter, the amount upwards of which the option can be exercised if the parameter performs differently than the strike level.

Unlike commodity derivatives, weather derivatives are not based on the asset whose price changes on markets. Hence, the price of this underlying asset (one weather parameters or more) has to be determined beforehand.

The second difference between weather derivatives and the other types of derivatives is that the latter have a quite clear monetary value of the underlying asset. In case of weather derivatives, the change in the value of the asset (weather parameter) is in fact the change in precipitation amount (millimetres) or temperature (degrees Centigrade), so such value should be converted in a monetary value, by using the minimum value of a weather parameter (*tick size*).

A tick size in standardised weather derivatives contracts is often 1 mm = 20 US dollars. Accordingly, to calculate the value of a weather derivative it is necessary to multiply the *tick size* with the real differentiation from the *strike level*.

Temperature derivatives are commonly traded in the winter period (November – March) and in the summer period (April – October).

As in some other types of derivatives, it is also important for weather derivatives to define the methodology for calculating the value of the underlying asset, in this case – temperature sums or precipitation

amounts. People mostly use data from the respective weather station or the average value of the same weather parameter recorded by several weather stations.

Weather derivatives allow limiting of the maximum amount of the payout. For instance, if the maximum amount per option is €1,500 further deviations from a strike level cannot increase that amount.

Agricultural commodity futures

Agricultural commodity futures are standardised derivatives, based on a certain commodity. In 2013 the volume of commodity futures ranked second after the volume of shares futures. The most traded futures are energy futures, followed by futures on agricultural commodities, metals, chemical and industrial commodities.

Over the last couple of decades, commodity derivatives markets have developed due to markedly volatile commodity prices and an increased need for future price-risk management.

Futures hedging strategies are based on buying (a long hedging position) or selling (a short hedging position) futures. Thereby farmers or other commodity holders can ensure the price of their commodity.

If spot market prices at the due date are lower than futures prices, they will be compensated by pre-determined prices and vice versa – if spot market prices are higher, they will be decreased by the loss on the futures. Hence, in both cases, pre-determined prices are exercised.

Experience has shown that hedgers often decide not to pursue expected prices due to change in the underlying asset, resulting in a discrepancy between spot prices at which hedgers actually sell their commodities and prices at which futures values are calculated.

It is especially characteristic for commodity futures, where the exchange can calculate the futures value on one spot market that can be thousands of kilometres away from the market hedgers actually sell their commodity on.

Example 1: A maize farmer sells a future in May for November, at a price of 15,000 RSD/t. Table 4 shows possible scenarios:

Table 4. *Short hedging position (no change in the underlying asset)*

Expected price for maize in November, at the option's due date (in RSD per tonne)	Actual maize price at a spot market in November (in RSD per tonne)	Total price achieved Spot price +/- profit/loss on a futures market (in RSD per tonne)
12,000	12,000	12,000 + 3,000 = 15,000
14,000	14,000	14,000 + 1,000 = 15,000
15,000	15,000	15,000
16,000	16,000	16,000 – 1,000 = 15,000
17,000	17,000	17,000 – 2,000 = 15,000

Source: *Authors' calculation*

A farmer expects that maize price in November will be 15,000 RSD/t and therefore sells a maize futures contract at that price. If the price at the end of the future period is below 15,000 RSD/t the farmer will gain profits on the futures contract, but at the same time the profits will be annulated by the loss in the same amount, since the farmer actually sells the maize at the price of the futures contract. Contrariwise, if the futures price is above 15,000 RSD/t farmer's loss will be completely annulated by a higher spot price at which maize is sold. Hence, in both cases by having a futures contract the farmer ensures the price of 15,000 RSD/t.

To simplify the above mentioned – as much as the farmer loses from falling prices on a spot market from April to November, he will gain from falling prices on a derivatives market.

Agricultural commodity options

This kind of options is based on agricultural commodities. Option hedging lies on *put* or *call* options trading. *Put* options give commodity holders the right to sell their commodities at a certain price in the future. With *call* options, holders hedge the risk of changes in input prices and have the right to buy a certain commodity at a certain price in the future.

The advantage of hedging strategies is flexibility – the option holder choses whether to use the option or to let it expire. Having paid the premium, the option holder cannot have an extra loss, unlike in futures hedging. The downfall of this option and other options hedging lies in a high premium price that needs to be paid when buying the option right. Example 2: A livestock farmer buys a call option on maize for May at a strike price of 16,000 RSD/t and pays the premium of 1,000 RSD/t.

Depending on change in maize price, several scenarios are possible, as shown in Table 5.

Table 5. *Buying a call options strategies – possible outcomes*

Maize price on a spot market (in RSD per tonne)	Actual option price (in RSD per tonne)	Profit/loss (in RSD per tonne)
12,000	0	-1,000
14,000	0	-1,000
16,000	0	-1,000
18,000	2,000	1,000
20,000	4,000	3,000

Source: *Authors' calculation*

Table 5 shows that the farmer will suffer a loss in the amount of the premium paid (1,000 RSD/t) if the maize price is lower than 16,000 RSD/t. If the price is higher than 16,000 RSD/t, the option will be “*in the money*”, namely the farmer will exercise the option since its strike price is 16,000 RSD/t, being below the market price.

Complex hedging strategies

Complex hedging strategies implies buying and selling several different derivatives. Complex strategies are used in speculative purposes to make profits but they are also used as hedging strategies to secure the price/asset in the future period. There are a number of combinations of hedging strategies that can be used, depending on one’s expectations in terms of prices movements and intensity in a certain period of time.

Cross hedging strategies

Cross hedging implies hedging strategies on assets on which no derivatives are based. For this purpose, one can use futures and options contracts (options give more flexibility but require paying a premium). Such strategies can be important on derivatives markets due to a small number of assets on which derivatives are formed.

Perspectives and preconditions for establishing an agricultural derivatives market in Serbia

To be successful, a derivatives market should meet two sets of preconditions: preconditions needed for establishing a derivatives market

and preconditions for improving the business environment of such market. Hence, most important is to:

- Establish a system of licencing and control of derivatives markets and their participants;
- Establish a system of clearing and balancing;
- Establish a system of arbitrage;
- Establish hedge funds;
- Develop a reporting system on all the factors that affect pricing of commodity-exchange instruments, etc.

Some of the preconditions for the establishment of a derivatives market refer to the improvement of the overall business environment [Acharya et al., 2013], such as:

- A secure system of commodity storing and delivery in commodity derivatives trading;
- A clearly defined fiscal policy that regulates taxing of exchange transactions. Inappropriate taxing policies on security deposits and margins can negatively affect commodity-exchange trading;
- The environment in which the price of an asset is formed by market forces. Quite often the government sells and buys agricultural commodity abruptly and insufficiently transparent, which pose an obstacle to growth of a standardised derivatives market. Ensuring the minimum selling prices, the European Union intervenes in the market and negatively affects agricultural commodities trading volume. Doing so, it decreases the volatility of prices for agricultural commodities, and consequently decreases the interest of agricultural commodity sellers to use derivatives exchange and hedge the potential risk [Kovačević, 2002].

The existence of clearing houses is as one of the main preconditions for establishing of derivatives markets and their successful operation. The task of clearing houses is to ensure the exercising of financial part of transactions. In commodity derivatives markets, clearing houses act as a third party that ensures fulfilling all contracts. For that reason, both buyers and sellers can make valid contracts only through clearing houses [National Futures Association, 2010].

Agriculture is one of the key branches of Serbian industry. The introduction of risk management mechanisms can reduce potential losses of farmers significantly. In that respect, it is important to compile all the necessary elements that can affect the establishment and growth of

derivatives markets. In the first place, a country should have a developed commodity market. In Serbia, there is the Commodity Exchange in Novi Sad, but it is not organised according to the Law on capital markets [“Sl. glasnik“ RS, br. 31/2011]. There are two sets of preconditions that need to be fulfilled before a commodity market could develop enough to become a derivatives market:

- 1) Setting the legislation and other preconditions for establishing a commodity market with all the characteristics of commodity-exchange systems. If the development of such system is measured by “services” offered to business subjects and other participants, then the current system lacks the following:
 - a. Standardised mechanisms of exchange arbitrage,
 - b. Hedge funds that enable extra-judicial compensation of loss made on a commodity market and
 - c. A system of clearing and balancing, etc.
- 2) Institutional preconditions, in terms of overall business environment. A commodity market is not an isolated system. Besides its internal organisation, it also depends on the business environment. This set of preconditions comprises:
 - a. A fair share of warehouse receipts offered by a commodity market,
 - b. An adequate policy of central banks when it comes to foreign currency payments,
 - c. An adequate tax policy,
 - d. An established and regulated system of commodity storage,
 - e. Complete liberalisation of commodity markets,
 - f. More efficient legal procedures,
 - g. A developed system of market information provided by state authorities, etc.

The commission is more important on commodity markets than on capital markets. On commodity markets, supply and demand “meet more easily” and if the commission is too high, commodity trading shifts to OTC markets. On the other hand, shares and bonds are difficult to trade with on OTC markets, so traders are in most cases forced to make transactions on exchange markets. Accordingly, trading on financial markets is less sensitive to commissions than trading on commodity markets.

Due to the entire above-mentioned, it is important for the established commodity-exchange system to be cost-effective, with minimum

obligations so that it could work with lower commissions. On the other hand, commodity markets themselves should organise to follow the principle of cost-efficiency and to have minimum administrative costs.

Institutional preconditions can further be categorised into two groups:

- 1) Preconditions related to establishing the institution of the commodity market and
- 2) Preconditions related to improvement of overall business environment necessary for work of commodity markets.

A developed derivatives trading does not exist in Serbia, mostly due to the lack of legislation [Zakić and Vasiljević, 2013]. The Law on capital markets [“Sl. glasnik“ RS, br. 31/2011] regulates issues of establishing standardised commodity derivatives, whereas spot trading is left to be regulated by the Law on commodity markets, currently in a draft. Albeit there is a legal framework for derivatives trading, as well as the need of legal entities to hedge the risk from changes in currency rates, interest rates, shares and other assets, such market has not been established yet. This is mainly due to the fact that the establishing of “in the house clearing” or independent clearing houses that the exchange engages for clearing and balancing has not been enabled.

Regarding commodity derivatives markets, the Draft law on commodity markets is expected to be adopted, to create environment for safe daily trading and establishment of an agricultural commodity derivatives market. Currently there is not a one element that enables derivative securities trading in Serbia, which primarily reflects in a lack of any authority that regulates and licenses commodity markets and their participants [Zakić and Kovačević, 2012].

Commodity markets are not isolated systems. Apart from an optimal legal regulation, it is also necessary to improve the overall business conditions through:

- Establishing a system of licensing and control of commodity markets. Considering the size of the agricultural commodity market, the draft law foresees that the system will rely on the existing institutions – Security Market Commission and financial markets that conduct such activities in other, more developed commodity exchange systems. This would simplify the whole commodity-exchange system and make it more cost-efficient (without establishing new institutions);

- Measures of the National Bank of Serbia and the Ministry of Finances, which would simplify the procedures of foreign trade on Serbian commodity exchange markets;
- Establishing an efficient “in-the-house” clearing or independent clearing houses;
- Mechanisms for extra-judicial settlement of disputes;
- Trading currency futures, interest rate futures, etc., besides commodity and financial derivatives. Not only would it help traders to make all transactions at one place, but it would also enable Serbian commodity markets to trade the same instruments as competitive markets in the region and worldwide;
- The procedure of asking for a positive opinion from the European Securities Market Commission (ESMA) on the Law on commodity markets that enables all traders from the EU to make transactions on non-EU exchange markets.

Conclusion

Hedging is one of the mostly used risk management measures in countries with developed derivatives markets. Positive experiences from developed countries show that improvement in this segment is a direct result of hedging strategies and an indirect result of the effect developed commodity derivatives markets have on macro-economic stability, primarily reflecting as a more stable demand/supply ratio, lower inflationary pressure, smaller oscillations in prices, a more favourable situation on markets, etc. Financial and commodity derivatives’ trading has not been operative in Serbia, albeit the need for such type of organised market. Establishing “in-the-house clearing” or independent clearing houses, which do the clearing and balancing on all developed derivatives markets worldwide, would favour development of derivatives markets. Adopting the law on commodity markets will regulate and improve spot trading in Serbia; whereas amendments on the Law on capital markets will help spot trading harmonise with EU regulations and introduce commodity and financial derivatives.

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