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State Aid for the Coal Sector in the European Union: Pre- and post-crisis perspective

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Abstract

This article presents the evolution of the conditions of state aid admissibility to the coal industry, starting with legal regulations within the European Coal and Steel Community, the European Community, and now the European Union. The thesis was formulated that, in connection with the expiry on 31 December 2010 of Council regulation No. 1407/2002, on the basis of which the European Commission allowed aid for the national mining industry in different member states in the period before the onset of the financial and economic crisis, the immediate cause of introduction of the next regulation for mining state aid in the form of Council Decision 2010/787/EU on state aid to facilitate the closure of uncompetitive coal mines was the increasing intensity of the aid for the mining industry in recent years.

Keywords: financial and economic crisis, state aid, coal mining sector, legal regulations, the European Union

1 Introduction

Considering the essential context of granting state aid by the member states of the European Union, we can distinguish three main categories of aid permitted under article 107 paragraph 3 of the Treaty on the Functioning of the European Union (TFEU - OJ 2010 C 83/1). The qualification of the aid measure to one of three categories—regional aid, horizontal aid, or sectoral aid—is determined based on the purpose for which state aid was intended; in the case of the coexistence of multiple purposes, the main purpose determines the result (Evans, 1997, p. 25). Regional aid is distinguished by its territorial reference; this aid is granted to enterprises operating in an area characterized by a relatively low level of economic development. Horizontal aid admissibility is not dependent on the area covered by this type of aid, but on the purposes to be achieved as a result of granting. These include, for example, the development of small and medium-sized enterprises, research and development, environmental protection, employment, and training. Sectoral aid is strictly aimed at enterprises operating in a particular sector of the economy. The basis for recognizing it as compatible with the internal market and admissible is primarily article 107 paragraph 3 points c and d TFEU. In this case, the criterion for granting aid is the affiliation of the beneficiary to the given sector. A special place among these sectors is occupied by so-called sensitive sectors, which include synthetic fibers, automotive, shipbuilding, and the steel and coal mining sectors. In addition, such sectors as agriculture, fishing and fisheries, and transport can benefit from this aid.

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State aid for sensitive sectors is connected with the restructuring processes of respective sectors of the economy and individual enterprises. This aid is permitted in cases where the granting accelerates the necessary changes or the development of these sectors, restores their long-term operations, and has a soothing effect on the social and economic costs of changes in these sectors. Sectoral aid is subject to particularly thorough and careful control due to the nature of specific sectors (Romariz, 2014). At the very least, the low capacity utilization, overproduction, or fierce competition in the internal market and beyond should be indicated. State aid for the coal industry is justified by the competitive imbalance of coal mines in the member states of the European Union, with coal being imported from outside the EU. Since the 1950s, some European coal production could no longer compete on the market, mainly due to a reduction in the cost of transporting coal from third countries, the depletion of coalfields with attractive geological conditions, and increased labor costs. Hence, the European Coal and Steel Community, later the European Community, and now the European Union authorized member states to grant subsidies to the coal industry in order to allow for an organized process of restructuring and closing unprofitable mines.

The aim of this article is to present the conditions for admissibility of state aid to the coal mining sector, including regulations made before the financial and economic crisis and the new regulation in the form of Council Decision 2010/787/EU, which since 1 January 2011 has allowed the European Commission to assess the potential requests for aid in the mining industry. With particular regard for the financial aspects of the application of Council Regulation No 1407/2002, the analysis is carried out to verify the claim that the introduction of another regulation of state aid for mining resulted from member states' increasing expenditures on aid to the mining industry.

The foundation of the European Union policy in the field of state aid is a provision specified in article 107 paragraph 1 TFEU, which constitutes that state aid is incompatible with the internal market (Böhmelt, 2013; Hille & Knill, 2006; König & Mäder, 2013; Toshkov, 2008). It is thus not the definition of whether the aid is incompatible or compatible with the internal market, but defining state aid as prohibited unless excluded from this prohibition under article 107 paragraphs 2 and 3 or article 106 paragraph 2 TFEU. Thus, based on the treaty provisions that speak directly of aid being compatible with the internal market, such provisions allow the adoption of a broad and flexible interpretation of the term "state aid" (D'Sa, 1998; Schina, 1987). In the concept of "state aid" as defined in article 107 paragraph 1 TFEU, which is of a broad and general nature, the open texture of law is clearly evidenced (Hart, 1997). As a result, there is no way to determine the semantic scope of that concept and legal norm defining the prohibition of state aid solely by reference to its semantic dictionary meaning and formal inference rules. Determining the semantic concept of state aid and the meaning of a legal norm defining the prohibition of state aid is specified during legal discourse, which in this case is proceeding before the Court of Justice of the European Union. The Court of Justice of the EU may be referred to as a "precedent court" because the general rules formulated in its case law determine the interpretation and application of both treaties as well as all EU secondary law (Scheuring, 2010). Therefore, this article analyzes state aid granted to the coal mining sector based on the concept of state aid with the meaning given and constantly being given by the case law of the EU courts.

2 Literature Review

State aid for the coal sector has been of considerable interest to the community sectoral policy since the 1951 signing of the European Coal and Steel Community (ECSC) Treaty of Rome (1957). Although article 4 of the ECSC treaty clearly prohibited state aid for the mining sector (ECJ, 30/59, para 20), in 1964 the European Commission sanctioned the granting of state aid to the coal industry (CFI, T-239/94, paras 61–64). This would justify the worsening economic situation in this sector, which was affected by the rising costs of mining in the member states, the competition of cheaper imported coal, and price pressure from alternative energy sources, such as crude oil and natural gas (CFI, T-106/96, para 62). Following the premise of improving the situation in the mining industry, the commission issued five decisions that allowed for state aid in connection with covering the costs of restructuring processes: Decision 3/65/ECSC (OJ 1965 L 31), Decision No 3/71/ECSC (OJ 1971 L 3), Decision 528/76/ECSC (OJ 1976 L 63), Decision No 2064/86/ECSC (OJ 1986 L 177/1), and Decision No 3632/93/ECSC (OJ 1993 L 329/12). Commission Decision No. 3632, which was released as the last one in the framework of the ECSC, introduced a radical approach to generating a significant loss in the mining industry and allowed for state aid upon fulfillment of the specified purposes. It then indicated improvement of the economic situation of mining, taking into account global prices of coal (with a target of lowering the size of granted aid), preventing the threats to the economic and social situation in regions that have been particularly affected by the total or partial restriction of the operation of mining sector enterprises, and supporting the mining industry to adapt to environmental protection requirements. These objectives were to be achieved through the use of five possible types of aid specified in this decision—namely, operating aid, aid to limit the scope of activity, aid to cover the additional costs, aid for research and development, and aid for environmental

protection. It should be highlighted that the member states had an obligation to provide each of the mentioned aids directly from the budget, which was intended to improve transparency and allow verification of the amounts spent. Failure to meet this condition was explicit with the lack of acceptance of the commission for the given aid measure (ECJ, 214/83, para 30; ECJ, C-441/97 P, para 53).

After the expiration of the ECSC treaty in July 2002, the legal basis for granting state aid to the coal industry came from the provisions of the treaty establishing the European Community (now the Treaty on the Functioning of the European Union [TFEU]). Article 107 paragraph 3 point e and article 109 TFEU Council Regulation EC No 1407/2002 of 23 July 2002 issued state aid to the coal industry (OJ 2002 L 205/1). This regulation was meant to enable restructuring and reduce the capacity of the coal sector enterprises on the one hand and ensure access to coal in order to improve the energy security of the European Union on the other hand (Heidenhain, 2010, pp. 395–398). This document sanctioned the admissibility of state aid for the coal industry to cover only the costs associated with the extraction of coal to produce electricity, combined production of heat and electricity, production of coke, and the fueling of blast furnaces. This aid could be given to the reduction of activity in this sector (liquidation of certain coal mines) or to the access to coal resources. Coal regulation provided for additional aid to cover exceptional costs not related to the current operations of the coal mining sector enterprises, which are so-called inherited liabilities, including liabilities for social benefits. In all three exemptions from the general prohibition on granting state aid, the foundation to benefit from state aid was the plans notified by the European Commission. Member states granting state aid to the coal sector enterprises were obliged to provide the commission with all necessary information relating to the current situation in the national power industry in order to justify the estimated production capacity forming part of the plan for protecting access to coal reserves (Holscher, Nulsch, & Stephan, 2014).

In connection with the expiry of the term of regulation 1407/2002 from 20 July 2010 at the end of 2010, the European Commission presented a new document setting out the conditions of admissibility of state aid to the coal industry sector (European Commission, 2010). A new legal instrument regulating aid to the coal industry on procedural grounds could be developed only in the form of a council regulation, based on article 107 paragraph 3 point e of TFEU. On December 10, 2010, the council passed decision 2010/787/EU on state aid, facilitating the closure of uncompetitive coal mines (OJ 2010 L 336/24), which is valid from 1 January 2011 to 31 December 2027. The aid may cover only the costs connected with coal for electricity production, combined production of heat and electricity, production of coke, and the fueling of blast furnaces in the steel industry, where such use takes place in the union.

The council's decision provides for two types of aid. The first is the aid for closure (article 3). Mines that incur losses during their current activity may benefit from such aid provided that they present a plan of liquidation whose deadline does not extend beyond 31 December 2018. All entities authorized to receive such aid have to have been in operation on 31 December 2009, while the total amount of the aid for closure granted by a member state must be characterized by a downward trend. The reduction has to be no less than 25% by the end of 2013, no less than 40% by the end of 2015, no less than 60% by the end of 2016, and no less than 75% by the end of 2017 compared to aid granted in 2011. Furthermore, the total amount of closure aid to the coal industry of a given member state may not exceed, for any year after 2010, the amount of aid granted by a member state and approved by the commission in accordance with articles 4 and 5 of regulation 1407/2002 for 2010. The notified aid may not exceed the difference between the foreseeable production costs and foreseeable revenue for a given coal production year. The aid actually paid is subject to annual adjustment based on actual costs and revenues—at the latest by the end of the coal production year following the year for which the aid was granted. It should also be emphasized that the amount of aid per one ton of coal equivalent may not cause a reduction in the prices along with the coal delivery from the union (the so-called prices for union coal at utilization point) to be lower than the prices of similar calorific value of coal from third countries.

The second type of aid is aid to cover exceptional costs, such as costs arising from or resulting from the closure of coal production units; these costs are not related to current production (article 4). Such aid may be used to cover the costs incurred or provisions made by the enterprises that are closing or have closed coal production units, including enterprises benefiting from closure aid. Such aid may also be used to cover the costs incurred by several enterprises. An exhaustive list of cost categories that can be covered by state aid was included in the annex to the council's decision.

It should be highlighted that the council's decision contains procedural provisions that are very similar to the provisions of Council Regulation No 1407/2002. They mainly explain how the commission should be notified of such aid to enable complete assessment before considering approval of the aid. In order to increase transparency and efficiency of the aid provided by the member states to the coal mining sector, the total aid received by the enterprises is shown in the profit and loss account as a separate item of revenue, as opposed to sales revenue. The maximum amount of aid approved by the council's decision shall apply regardless of whether the

aid is financed entirely by member states or partly financed by the European Union (Clayton & Segura Catalan, 2015). These rules are designed to allow for the isolation of aid measures from the funds obtained from normal business activity in order to ensure better control over state aid.

3 Data and Methodology

According to EU competition law, state aid for enterprises in the coal mining sector should be provided by member states in accordance with the principles of proportionality and degressivity (ECJ, 31/59, para 88). Thus, the amount of granted aid shall be appropriate to the results achieved while it is also necessary to aim for the gradual reduction of state aid for mines. In relation to the scoreboards prepared by the commission in the field of state aid (i.e., state aid scoreboard), the resources allocated to state aid for the mining industry in the period covered by Council Regulation EC No 1407/2002 amounted to EUR 16.6 billion in 2003, EUR 8.1 billion in 2004, EUR 6.0 billion in 2005, approximately EUR 3.8 billion in 2006, and approximately EUR 2.9 billion in 2007 for the period of 2008–2010 (see Table 1). The decreasing intensity of the aid in the mining sector was associated with closing of the least profitable mines and—indirectly—with a reduction in sectoral aid for horizontal aid granted to enterprises irrespective of the regions and sectors in which they operate and, thus, are more preferred by the commission.

In the course of regulation 1407/2002, the commission's decisions related to 11 member states: Bulgaria, the Czech Republic, France, Spain, Germany, Poland, Romania, Slovakia, Slovenia, Hungary, and the United Kingdom. In 2005–2007, the average value of the aid for the mining industry amounted to EUR 4.84 billion, while in the comparable period of 2008–2010 it was already EUR 3 billion. State aid reduction reflected the situation on the coal market. First, coal consumption in the EU decreased by 4.7% in 2005 compared to 2004, and in 2006 it fell a further 5.4%. Moreover, the production of coal in the member states underwent systematic limitation due to increasing imports of cheaper raw materials from third countries. Countries such as Bulgaria, the Czech Republic, and France completely abandoned the granting of aid based on the provisions in regulation 1407/2002. However, this did not preclude the possibility of granting aid to enterprises operating in the mining sector based on the general state aid rules that applied to all sectors. It is necessary to point out the definition of aid determined in article 107 paragraph 1 TFEU, which refers to the types of aid, such as regional aid, environmental aid, training aid, or aid for research and development.

By analyzing the intensity of aid directed to the coal industry, four groups of member states can be distinguished. The first group includes countries that have ceased coal subsidies for operating coal mines (the Czech Republic, Bulgaria, France, Italy). The second group includes countries that provide operational aid (Romania). The third group includes the countries that have decided that, as part of their overall energy strategy, they want to keep the coal mines likely to be profitable without operating aid in the market, thus providing only investment aid (Poland, Slovenia, the United Kingdom). The fourth group comprises those countries that provide both operating aid and investment aid (Germany, Hungary, Slovakia, Spain). This trend is presented in Table 2.

Table 1 State Aid Granted to the Mining Sector by Member States based on Council Regulation EC No 1407/2002 (in millions of euros)

	2003	2004	2005	2006	2007	2008	2009	2010	Total
Bulgaria	2.5	11	9.4	6.6	:	:	:	:	**29.5**
Czech Republic	0.2	19.4	0.4	0	0	0	0	0	**20**
France	1076.7	1029.5	0	:	:	:	:	:	**2106.2**
Germany	7150.6	3374.3	3010.7	2586.5	2532.6	1913.6	1847.4	1845.3	**24261**
Greece	18.2	:	:	:	:	:	:	:	**18.2**
Hungary	12	110.3	42	34	41	36.9	30.7	29.1	**336**
Poland	5470.9	664.4	256.5	170.9	110.2	157.2	98.3	197	**7125.4**
Romania	194.6	265.4	82.1	111.4	121.4	95.2	76.8	63.7	**1010.6**
Slovakia	6.6	1.5	4	5.9	4.2	4	5.5	5	**36.7**
Slovenia	19.1	16.6	16.3	16.8	18.4	18.3	16.7	11.9	**134.1**
Spain	2567.6	2520.9	2462	868.1	836.7	813.3	774.4	821.8	**11664.8**
United Kingdom	36.8	53.6	66.9	13.1	0.5	2.2	:	:	**173.1**
EU 28	16555.9	8066.8	5950.4	3813.2	3665.1	3040.6	2849.9	2973.8	**46915.7**

Source: EUROSTAT (2015).

Table 2 State Aid to Coal Industry Sector due to the Target of Destination (in millions of euros)

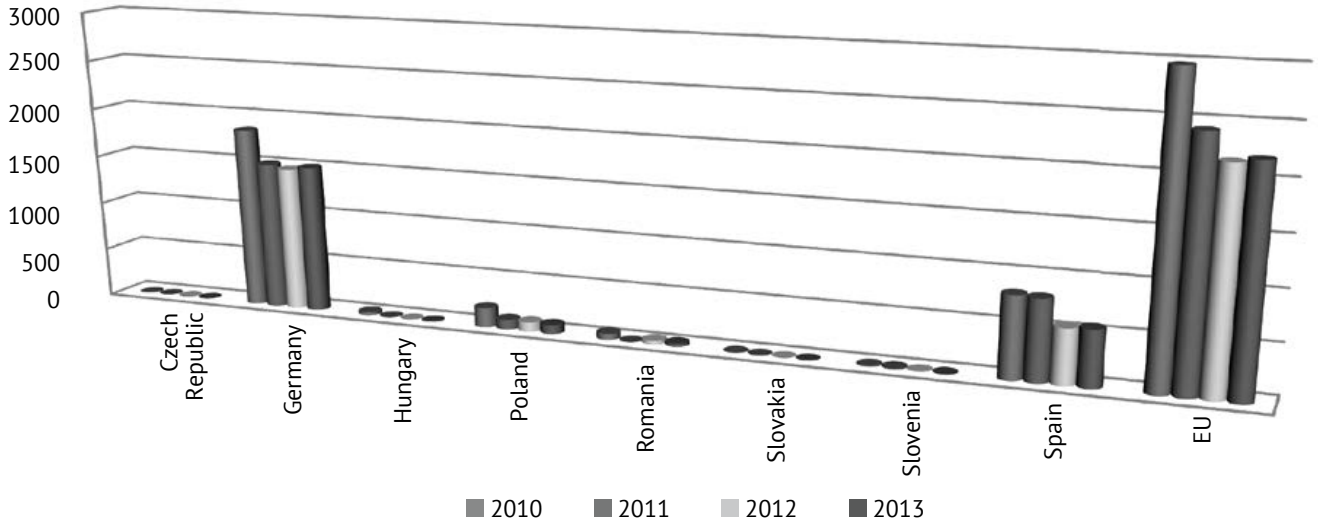
	Average annual value of aid for current production		Average annual value of aid for purposes other than current production		Average annual value of total aid for the coal industry sector	
	2005–2007	**2008–2010**	**2005–2007**	**2008–2010**	**2005–2007**	**2008–2010**
Bulgaria	2866.24	1845.32	1961.69	1179.50	4827.93	3024.82
Czech Republic	3.80	0	4.48	0	8.28	0
France	0	0	6.46	0	6.46	0
Germany	2138.62	1289.13	723.53	698.56	2862.15	1987.69
Hungary	42.59	31.22	20.95	3.41	63.54	34.63
Poland	0	0	325.67	109.21	325.67	109.21
Romania	73.75	84.69	0	0	73.75	84.69
Slovakia	1.33	4.11	2.34	0.27	3.67	4.38
Slovenia	0	0	16.10	11.44	16.10	11.44
Spain	562.14	436.17	556.33	367.27	1118.47	803.44
United Kingdom	0	0	38.92	0.78	38.92	0.78
EU 28	2866.24	1845.32	1961.69	1179.50	4827.93	3024.82

Source: author's calculations based on DG Competition.

Taking into account two periods concerning the years 2005–2007 and 2008–2010, it should be noted that the vast majority of countries that support the domestic mining industry limited the aid to this sector. The exceptions are only Romania and Slovakia, for which we can observe an increase in operating aid granted. It should be noted that the four countries have finished granting the aid. France closed its last coal mine in 2004, although in 2006 it authorized a private enterprise, which by definition was not to receive any subsidies, to start mining activity in a new open-cast mine in the area of *L'arc* (Gardanne). The Czech Republic privatized previously state-owned coal mines and ceased granting subsidies, which led to a significant reduction in both mining and employment. Italy had one active coal mine in Sardinia, for which no state aid was identified to the commission. In these three countries, the restructuring process was completed.

In terms of permissible investment aid, the United Kingdom, Poland and Slovakia have limited their subsidies for mines, whereas the United Kingdom and Slovakia have completely privatized their mines, which were previously owned by the state. In Poland, the privatization process is underway.

Figure 1 State aid for the mining sector granted by member states based on Council Decision 2010/787/EU in 2010–2013 (in millions of euros)



Source: EUROSTAT (2015).

The restructuring process of the coal mining industry in these countries ended to such an extent that all mines far from reaching a break-even point ceased their operations. In contrast, Germany, Hungary, Romania, and Spain continued operating aid schemes based on article 5 paragraph 3 of the coal regulation. In these countries, there was very little probability that their domestic mining industry would survive without operating aid.

The coal regulation provided for two different instruments for facilitating the closure of mines that are no longer competitive on the world market: closure aid, which was the aid covering the operating losses of mines until the date of closure, and aid for inherited liabilities, which covers certain categories of social and environmental obligations resulting from the coal industry. The process of closing unprofitable mines was carried out in all member states that produce coal, with the exception of Italy. Germany, Spain, and France have granted closure aid to alleviate the social consequences of closing the mines. Without the payment of closure aid, closing the mines took place in three countries (Hungary, Slovakia, Poland). Activities of the second instrument have been adopted by the Czech Republic and France, whose governments continued paying subsidies for acquired social and environmental commitments. Other member states, with the exception of Hungary and Italy, have to a certain extent taken over acquired social and environmental costs not only for closed mines, but also for still active mines.

Figure 1 shows the amount of aid for the mining sector in 2010–2013, which includes the first three years of the Council Decision 2010/787/EU. According to the current provisions, the value of granted aid did not exceed the reference value from 2010 in relation to all member states providing aid for this purpose and for each of the countries separately. It should be noted that three countries, the Czech Republic, Hungary, and Slovakia, have already ceased granting the aid. Thus, the aid for mining industry is provided by only five member states: Germany (EUR 1504 million in 2013), Poland (EUR 93.3 million in 2013), Romania (EUR 33.4 million in 2013), Slovenia (EUR 4.7 million in 2013), and Spain (EUR 568.1 million in 2013). In 2011–2013, state aid for the mining industry showed a downward trend, whereas the value of aid began to grow in 2013.

4 Results and Discussion

Council Decision 2010/787/EU considered that the production and consumption of coal in Europe in the future will continue to decline and that, despite the development of new mining technologies, coal mines are and will be more expensive to maintain than in the countries exporting coal, such as Indonesia, Australia, and South Africa. In addition, it was pointed out that, compared to the world's crude oil or natural gas reserves, Europe has the most substantial reserves of coal, which gave direction to the mining industry in many member states. Thus, even watching the slow process of restructuring the mining industry in some member states in the first decade of the 21st century, it was not difficult to conclude that the mining sector deprived of access to state aid will not meet the rules of competition and will fall, causing severe consequences in the regions already affected by high structural unemployment and destroyed environment. The possibility of granting state aid—although on more restrictive conditions—was thus justified by the "too big to fail" principle known from its application to the banking sector, which meant that mining in some regions and even in member states is an too important employer and, despite regular losses, is unlikely to be liquidated (compare Hallerberg, 2011). This factor is thus closely linked to the effects for the energy sector of the financial crisis, which in Europe began with the collapse of the Lehman Brothers Bank in 2008. The transmission mechanism in this case was very simple: The deteriorating economic situation due to limited opportunities for investment by enterprises of the real economy—along with the limited access to bank loans—led to decreased energy consumption and demand for coal.

Thus, the implementation of Council Decision 2010/787/EU of 10 December 2010 occurred during the financial crisis that emerged in 2008, confirming that even countries characterized by low-cost mining depend on global coal prices. The financial crisis has caused a sharp deterioration in the economic situation of many countries, including the fastest-growing, but most carbon-intensive, countries of China and India. This in turn led to a decrease in demand for energy and as a result changed the trend of energy prices from upward to downward. Coal prices fell from USD 220 per ton in July 2008 to just USD 70 per ton in January 2009. Since mid-2011, the price of coal has declined; at the end of 2014, coal prices stood at USD 75–76 per ton according to index-ARA (Amsterdam-Rotterdam-Antwerp).

In light of such considerations, the question emerges as to whether in the current macroeconomic situation coal can gain and maintain a competitive position in the market of energy carriers without state aid? Even before the financial crisis, a number of "traditionally mining" member states decided to end coal mining. Other countries such as the Czech Republic, Poland, the United Kingdom, and Spain continued production, which at that time of high energy prices on world markets was profitable. However, considering the effects of the crisis on the mining sector in the form of low coal prices, it is expected that projects profitable even a few years ago may again require significant support from the state. Only member states can decide whether to grant mining support. Such a situation can be seen in Poland, where—under pressure from the trade

unions—the authorities have currently abandoned the unconditional closing of unprofitable mines. The agreement implies that some of these mines will indeed be a part of Mine Restructuring Company, with an allocated PLN 2.3 billion (approximately EUR 545 million), but not in order to extinguish their activity. Mines are to be restructured and then sold to potential investors. The agreement between unions and the government indicates that everything will follow Council Decision 2010/787/EU, according to which state aid for mines may be granted only for their closing and only until the end of 2018. The interpretation of this plan is that, when the Mine Restructuring Company sells mines, it will simply ask the government for aid, which will be included in the price of the mines. In addition, the Polish government believes that at least one or two years of peace were gained to find an investor, all for a cost of PLN 2.3 billion. However, the European Commission interprets decision 787 totally differently than the Polish government—namely, one of the key conditions for granting aid for mining is the irreversible closure of mines. Therefore, the commission cannot give permission for state aid, which is not intended to facilitate the closure of the mines, and investment and restructuring in these mines are not allowed. According to the commission's interpretation, operating losses in the mines may be covered in the mines "irrevocably destined for closure by the end of 2018"; only extraordinary costs incurred after the closing (e.g., water pumping) can be covered longer (i.e., until 2027). In addition, Poland notified Brussels of its aid plan for mines and must at the same time present a plan for their closure. Discrepancies in interpretations also appear in terms of the amount of aid possible to grant. In accordance with article 3 point g of Council Decision 2010/787/EU, aid for mining granted annually cannot be more in the given country than in 2010, which means that the amount of support may not exceed PLN 400 million per year. Meanwhile, Poland already intends to spend PLN 1 billion on aid for mines in 2015 and another PLN 900 million in 2016. Why is the commission able to exceed the aid limit? In 2010, Poland for the first and the last time provided support for investments in mines, which was indicated in the EU laws at the time. It allocated exactly PLN 400 million from the budget for this purpose. Moreover, according to article 108 TFEU, until the commission does not approve state aid plan, member states may not grant such aid, which means that theoretically the Polish government has no right to pay out money to the Mine Restructuring Company for the mines. Waiting for the Brussels agreement would mean that the miners will not get a salary during this time because, after all, the Mine Restructuring Company does not have the money.

As such, what is the case for the planned 2015 aid for Polish mines? First, the lack of specific regulations in the current Council Decision 2010/787/EU does not block the opportunity to grant aid, and it does not make this aid automatically illegal. Second, the ability to provide aid for mining will really depend on the will and creativity of the member states. However, in each case of aid for the mining sector, the starting point for assessing the admissibility of providing aid is the definition of aid incompatible with the internal market defined in article 107 TFEU and conditions for notification of such aid to the European Commission, as stated in article 108 TFEU.

5 Conclusion

The Green Paper on the European Union's energy security published in 2000 formulated a critical (from the point of view of the problem addressed in the article) methodological approach of the European Commission relating to the admissibility of state aid for the mining sector and its compatibility with the internal market (European Commission, 2000). Namely, the commission made decisions about the future of the coal industry, given the lack of any possibility of achieving competitiveness in this industry on the world market. A competitive imbalance between the production of coal within the European Union and imported coal from outside the area forced the coal industry to take decisive restructuring measures, including a significant reduction in production capacity. As a result, Europe has become largely dependent on external supplies of primary energy sources, which violated the European strategy for the security of energy supply, taking into account the development of national sources of primary energy used in particular for the production of electricity. Therefore, on 16 October 2001, the European Parliament adopted a resolution on a European strategy for the security of energy supply, which recognized the importance of coal as a national source of energy. Strengthening the EU's energy security justified maintaining the possibility of coal production while taking into account the financial aid of the country in the sector, increasing its efficiency and reducing the size of the subsidy.

The green paper's records were reflected in Regulation 1407/2002, adopted on 23 July 2002, which was rather an act of acceptance of the fact that the coal industry in the European Union is not and will not be able to operate under market conditions. Therefore, the primary purpose of this document was to continue the restructuring process of the mining industry in the member states and to improve the security of the energy supply to the EU market through the use of coal for this purpose, provided that reasonable and acceptable costs of its acquisition can be achieved. Therefore, in line with the strategy of the EU's energy security, coal has gained a reputation as a strategic fuel whose production could be subsidized in order to mitigate the potential energy crises. However, the thesis stated at the outset of this article must be rejected because, taking into account the figures presented by the General Directorate on Competition, it should be

noted that the intensity of aid to the coal industry decreased each year, showing the same downward trend. From 2004 to 2009, the value of the granted aid amounted respectively to EUR 16.6 billion, EUR 8.1 billion, EUR 6.0 billion, approximately EUR 3.8 billion, EUR 3.7 billion, EUR 3 billion, EUR 2.8 billion, and EUR 3 billion. In comparable 3-year periods, 2005–2007 and 2008–2010, public aid for the mining industry averaged EUR 4.84 billion and EUR 3.03 billion for all 27 member states. Such data confirm the view contained in Council Decision 2010/787/EU that a small proportion of subsidized coal in the overall energy mix does not justify the further maintenance of such subsidies in order to secure the energy supply in the European Union. In addition, the indefinite support for uncompetitive coal mines is not justified by EU policies promoting renewable energy sources and sustainable and secure low carbon economy. In 2011–2013, state aid for the mining sector did not exceed the level of 2010, which indicates members states' compliance with expenditure rules introduced by Council Decision 2010/787/EU. The council's decision of 10 December 2010 expresses the sectoral state aid system proposed by the commission, which should be regarded as a transitional system, leading to the full application of the general rules on state aid to the coal sector. Yet this raises a question as to whether, when informed by financial and economic crisis macroeconomic realities, there will be a need for a new form of regulation of admissibility of state aid for mining. Nevertheless, it would be rather a very specific regulation resulting from the fact that certain issues are not in any existing state aid framework compatible with the provisions of the Treaty on the Functioning of the European Union.

Given current considerations within the structure and conditions of admissibility of state aid, it should be noted that changes in EU policy regarding the providing of aid have been introduced in response to the severe consequences of the financial crisis affecting the restriction of access to sources of finance and the crisis in the real economy shifting primarily into a decline in production, which together contributed to a crisis of public finances—namely, a crisis of excessive public debt and budget deficit resulting from the slowdown in different sectors of the economy. Member states reported a decline in GDP and trade as well as significant limitations of production and expenditures on crucial investments; they also experienced a rise in unemployment, thereby increasing social unrest. In such conditions, a significant decrease in demand and orders for raw materials and finished goods as well as the increasing problems of buyers' solvency have become commonplace, which in turn contributed to the deterioration of enterprises' financial situation, leading to the inhibition of initiated or the omission of new investments, changes in the structure of employment, and even the bankruptcy of certain business entities. At the same time, tightening banks' lending policies significantly reduced enterprises' access to external sources of financing, thereby impeding the ability to stay on the market, implement new investment, and ensure further development. In this situation, the state's actions to support the economy have become one of the tools for opposing the increasing economic and social difficulties.

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Državna pomoč za premogovni sektor v Evropski uniji – pred- in pokrizna perspektiva

Izvleček

V prispevku predstavljamo razvoj pogojev za dopustnost državne pomoči premogovni industriji, začenši s pravnimi predpisi Evropske skupnosti za premog in jeklo, potem predpisi Evropske skupnosti in danes Evropske unije. Oblikovali smo tezo, da se je v povezavi s potekom Regulative Sveta EU št. 1407/2002 dne 31. decembra 2010, na osnovi katere je Evropska komisija dovolila pomoč rudarski industriji v različnih državah članicah EU v obdobju pred začetkom finančne in ekonomske krize in ki je postala vzrok za uvedbo novega predpisa o državni pomoči rudarstvu v obliki Odločitve Sveta EU 2010/787/EU o olajševanju zaprtja nekonkurenčnih rudnikov premoga, intenzivnost pomoči rudarski industriji v zadnjih letih povečala.

Ključne besede: finančna in ekonomska kriza, državna pomoč, premogovni sektor, pravni predpisi, Evropska unija.

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Model for Determining the Stability of Retail Deposits with Higher Outflow Rates

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Abstract

Retail deposits are treated as one of the cheapest and most stable funding sources for banks, especially for those with high volumes of retail deposits. A bank defines three main categories of retail deposits that are subject to different outflow rates for the purpose of liquidity coverage requirements in reporting and compliance. The outflow rates for the first two main groups are 5% and 10% respectively, but for the third main group the bank calculates its own outflow rates. We analyzed the latter in this paper. Each bank should assign retail deposits to one of the three categories based on the number and type of predetermined risk factors. Risk factors are divided into two groups according to the degree of risk. The paper first describes the legislative framework, followed by the method of calculating higher outflow rates for retail deposits according to the historical movements and the expected volatility assessment in the situation of stress conditions. At the end of the paper, we briefly provide the future treatment of retail deposits with higher outflow rates.

Keywords: retail deposits, stability, transactional account, LCR, deposit guarantee scheme, depositors, higher outflow rates, Basel III

1 Introduction

On 6 December 2013, the European Banking Authority (EBA) published "Guidelines on retail deposits subject to higher outflows for the purposes of liquidity reporting under the Regulation (EU) no. 575/2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (*CRR 2013*)." For the purpose of the liquidity coverage ratio (LCR) of CRR Part 6, the guidelines (EBA/GL/2013/01) defined detailed rules on retail deposits with higher outflows in accordance with the third paragraph of Article 421 of CRR (*Guidelines*).

For the purposes of the LCR calculation, institutions report the amount of retail deposits covered by a deposit guarantee scheme (DGS), which are either part of an established relationship making withdrawal highly unlikely or held in a transactional account. In principle, these retail deposits are considered the most stable and will be subject to the lowest outflow rates of 5%. All other retail deposits not included in the previous items and that do not fulfill the conditions of retail deposits with a higher outflow rate are subject to the 10% outflow rates. A retail deposit should be considered part of an established relationship when the depositor meets at least one of the following criteria: (a) has an active contractual relationship with the institution of a minimum duration of 24 months,

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(b) has a borrowing relationship with the institution for mortgage loans or other long-term loans, or (c) has a minimum of two active products, other than loans, with the institution. A retail deposit should be considered as being held in a transactional account when salaries, income, or transactions are regularly credited and debited against that account.

Guidelines cover the methodology for the identification of retail deposits that are subject to higher outflows. Retail deposits are grouped in three main categories. Each category is formed based on the number and riskiness of the risk factors they meet. The guidelines do not prescribe the outflow rates for the three categories, but stipulate that institutions are to report retail deposit amounts allocated to each of the three categories together with their own estimates of expected outflows under stress conditions. This paper demonstrates how a commercial bank can develop a simple internal model for calculating the stability of the retail deposits with higher outflow rates that are subject to LCR reporting. The bank's own econometric model is based on the historical data and expected stability/volatility for the specific retail deposits. Thus, we have developed our model based on two main hypotheses: how the historical data impact the stability of considered retail deposits and what level of stability we can expect in the subsequent 22 working days.

This paper is divided into three main parts. The first part considers the regulatory issues that are the basis for the empirical part, which is the second part, including the interpretation of the results of the internal model. The last part describes the future challenges in the field of measuring the stability of the retail deposits with higher outflow rates according to the Delegated Act.

2 Results of the EBA Discussion Paper and the Basis for the Guidelines

In February 2013, the EBA published its discussion paper (DP) on retail deposits subject to higher outflows for the purposes of LCR reporting. The scope of the DP covered all retail deposits as per Article 409 of CRR, but emphasis was put on the process of identifying retail deposits that carry a higher outflow risk. The result of the DP was presented in the form of 18 questions that should be answered by any potential respondent. EBA received 25 responses, of which 21 were published on the EBA website (EBA, 2013b). Before presenting a summary of the key points arising from the consultation, here are the most significant, from a technical point of view, questions (EBA, 2013a):

- Availability of data: the introduction of liquidity requirements to some extent is based on actual behavior observed during a stressed situation that may be considered realistic. Thus, the institutions should use local historical data and a forward-looking approach (the latter within the circumstances of a combined idiosyncratic and market-wide stress scenarios).
- Factors affecting the stability of retail deposits: the value of deposits, products that are rate-driven or have preferential conditions, maturing fixed term or notice period deposits, high risk distribution channels including Internet-only access and brokered deposits, the currency and location of deposits, non-resident deposits, depositors who are sophisticated or high net worth individuals, product-linked deposits and any other characteristics that might indicate a retail deposit with a higher outflow rate.
- Factors divided into two groups: high risk and very high risk.
- Mix of characteristics according to their riskiness and three categories: category 1 with an outflow rate of 15%, category 2 with an outflow rate of 20%, and category 3 with an outflow rate of 25%.

A summary of the key points arising from the DP is provided below (EBA, 2013b):

- Most respondents considered that the proposed risk factors concerned the characteristics of the deposits rather those of the depositors.
- Some respondents proposed additional risk factors; these were basically the financial position of the bank, the financial stability of the country, the customer as a single product user, and concentration risk.
- Some respondents considered that some risk factors may be closely correlated; such a situation was mentioned regarding sophisticated and rate-driven deposits, which are by default deemed to be associated.
- Some respondents did not agree that deposits with virtual (Internet only) banks must be subjected to a more stringent regime than those linked to Internet accounts with traditional banks, which have a network of physical branches.
- Many respondents considered that the non-resident condition itself could be potentially discriminative.
- Some respondents rejected the idea that rate-driven deposits must be subjected to higher outflow rates.
- Some respondents saw the imposition of higher outflows on maturing term deposits or fixed-notice accounts as counterintuitive and should be seen as providing stable funding.
- Some respondents argued that the imposition of specific higher outflow rate places EU banks at a disadvantage compared to non-EU banks.
- Many respondents stated that the DGS amount in each relevant jurisdiction should be the threshold for determining whether a retail deposit should be subjected to a higher outflow rate. For a split between high and very

high-risk retail deposits, a threshold of 1 million € was proposed instead of 500,000 €.
- Some respondents raised concerns about the technical difficulties inherent in the data collection process.
- Some respondents stated that significant investment in IT infrastructure would be necessary to implement the identified process and new staff would be needed to analyze databases.

In August 2013, the EBA published its Consultation Paper (CP) considering the draft guidelines as a further step of the previously published DP. As a change to the approach proposed in the DP, the draft guidelines will not prescribe the associated outflow rates for the three categories. Instead, the draft stipulates that credit institutions shall report retail deposit amounts allocated to each of the three categories together with their own estimates of expected outflows under stress conditions.

3 Data Preparation, Collection, and Analysis

The bank is in the process of data preparation, collection, and analysis, which includes detailed examination of the criteria and methodology for the definition of retail deposits with higher outflow rate, fully taking into account the guidelines. The latter continue to include a three-tiered "bucket" approach to allocate retail deposits subject to higher outflows for the purposes of liquidity reporting. At the aggregated level of reporting liquidity outflows within CRR, three main groups of retail deposits are considered (CRR, 2013 and ZBS, 2013):
- retail deposits covered by a DGS and which are either part of an established relationship making withdrawal highly unlikely or held in a transactional account, including accounts to which salaries are regularly credited. Such retail deposits are subject to an outflow rate of 5%.
- retail deposits that do not meet criteria from the previous point or are not identified as deposits with a higher outflow rate. These are subject to an outflow rate of 10%.
- retail deposits based on the number and risk level of the risk factors are grouped into three categories set out in the guidelines. Such retail deposits have three different outflow rates depending on the credit institution's own estimates of expected outflows under stress conditions.

Our paper emphasizes the retail deposits that are subject to a higher outflow rates. First, the criteria for their definition need to be clarified. Second, the methodology for the identification of three categories needs to be determined. Third, the time series that represent the core for the econometric modeling needs to be identified in order to calculate the outflow rates for all three categories.

Above all, we need to emphasize what represents the starting point for the development of the model presented in this paper. The respective bank has developed a number of simple econometric models that have been inspired primarily by the following papers: Stesevic (2008), Perusko and Zenzerovic (2011), Takemura and Kozu (2009), OENB (2008), and von Feilitzen (2011). The latest has also been a fundamental issue within the development process of the internal model, which has been described in the article.

3.1 Criteria for Definition of Retail Deposits with Higher Outflow Rates

Criteria are presented as a list of factors that form the basis for the bank's calculations of retail deposits with higher outflow rates. High value deposits are particularly sensitive in a combined idiosyncratic and market-wide stress scenario and may therefore be subject to higher and faster outflows. In addition, high value deposits contribute to the concentration of the deposit base, and over-reliance on such deposits can compromise the stability of the deposit base.

Depositors influenced by higher yield, preferential conditions, or negotiated rates can be more responsive to competitors and other attractive offers. Consequently, these deposits may prove to be less stable. Maturing fixed-term retail deposits or deposits with fixed-notice periods may be less stable during stress periods because they are more likely to be funds that depositors do not need for day-to-day transactions.

The clients of Internet-only banks have access to their bank only through the Internet, and the absence of direct contact with staff can have a negative effect on confidence and stability under stress conditions. Moreover, exchange rate volatility can also affect the stability of both foreign and local currency denominated deposits. The ability of retail non-resident depositors to transfer deposits may impact the stability of such deposits.

The following summarized list of risk factors or harmonized criteria will be used for our empirical analysis (EBA, 2013c):
1.) High value deposits: over 100,000 € to 500,000 € (C1)
2.) Very high value deposits: over 500,000 € (C2)
3.) Deposits that are rate-driven or have preferential conditions: exceeding the average rate for similar retail products offered by peers, return is derived from the return on a market index or set of indices, or return is derived from any market variable other than a floating interest rate (C3)

4.) Maturing fixed-term or notice period deposits: fixed-term deposit with an expiry date maturing within the 30-day period or deposit with fixed notice period shorter than 30 days (C4)
5.) High-risk distribution channels: including Internet-only access and brokered deposits (C5)
6.) The currency of deposits: deposits denominated in foreign currencies (C6)
7.) Non-resident deposits: the statistical or tax definition at the depositor level (C7)
8.) Product-linked deposits: banking product to which the deposit is linked terminates during the 30-day period and the client can then disburse the savings (C8)

3.2 Method for Determining the Retail Deposits with Higher Outflow Rates

Risk factors or criteria described in the previous chapter are classified into two groups according to the level of risk, which impacts the stability of retail deposits (EBA, 2013c):

a) Group 1 (high risk – VR), which includes the following risk factors:
   - VR_C1: deposits over 100,000 € to 500,000 €
   - VR_C3: interest-rate sensitivity
   - VR_C5: Internet bank
   - VR_C6: deposits in foreign currency
   - VR_C8: product-linked deposits

b) Group 2 (very high risk – ZR), which includes following risk factors:
   - ZR_C2: deposits over 500,000 €
   - ZR_C4: fixed-term deposits with residual maturity up to 30 days or notice period deposits shorter than 30 days
   - ZR_C7: non-resident deposits

Using the scoring system, the bank assessed the retail deposits from points (a) and (b) and assigned retail deposits to one of the three following tiered buckets defined based on the number of risk factors attributed to the underlying deposit (Nova KBM d.d., 2014):

- CATEGORY 1 (KAT01): retail deposits with two factors from Group 1 *or* written for the econometric modeling use →

  a = VR_C1 + VR_C3 + VR_C5 + VR_C6 +VR_C8 = **2**

  and

  b = ZR_C2 + ZR_C4 + ZR_C7 = **0**

- CATEGORY 2 (KAT02): retail deposits with three factors from Group 1 or with one factor from Group 1 and one factor from Group 2 →

  a = **3** and **b** = **0** or **a** = **1** and **b** = **1**

- CATEGORY 3 (KAT03): retail deposits with two factors from Group 2 or two factors from Group 1 and one factor from Group 2 or with any other mix of factors →

  a = **2** and **b** = **0** or **a** = **2** and **b** = **1** or **a** > **2** and **b** > **1**

3.3 Time Series

Time series are data that are collected over a certain period of time (e.g., unemployment rate, salaries, rents, inflation, Euribor). These data can be collected daily, weekly, monthly, quarterly, or annually. The main purpose of the time series is to observe the evolution of economic phenomena over time and to establish the general findings of this movement. The latter enables the prediction of further development and the acceptance of appropriate measures. Included are daily data from 1 September 2013 to 31 March 2014. A longer time series, from a historical point of view, was not possible due to the complexity of defining individual categories and transactional systems.

4 Empirical Analysis

4.1 Starting Point for Model Estimation and Implementation of Regression Analysis

We used ordinary least squares (OLS), which is considered the most commonly used method of determining the regression coefficients. OLS is often called the “queen” of the assessment methods of regression coefficients and is considered the “best linear unbiased estimator” (BLUE). Regression analysis must meet certain assumptions that the estimator of regression coefficients will be BLUE. In our regression analysis, we considered the assumptions unconditionally (Greene 2003, Gujarati 1988, Pfajfar 1998 and Schwert 2011).

In our analysis, we used two types of data: quantitative and qualitative data. Quantitative data were determined by time series of daily data from September 2013 to March 2014 (DPRS 2013 and 2014, EURIBOR 2013 and 2014, SURS 2013 and 2014). Qualitative data were included through a dummy variable, with which we indicated the presence or absence of certain properties. Using regression analysis,

we studied the movement of retail deposits separately for KAT01, KAT02, and KAT03 and evaluated models that incorporate the selected parameters. Based on the results, we conducted a 30-day forecast (or 22 working days) and calculated the stability of retail deposits for each category in the form of higher outflow rates. Regression analysis was performed using the Econometric Views 7 (EViews 7, 2010a and 2010b) software package.

4.2 Regression Model for Category 1 (KAT01)

The mathematical form of the model for KAT01 is as follows:

$$KAT01_t = \beta_1 + \beta_2 KAT01(t\text{-}1)_t + \beta_3 EURIBOR_t + \\ + \beta_4 NETO\_PLACA_t + \\ + \beta_5 ST\_REG\_BREZPOS_t + \\ + \beta_6 DUMMY\_INFOR_t + u_t ,$$

where:

$KAT01_t$	retail deposits for Category 1 for *t* day (dependent variable)
$KAT01(t\text{-}1)_t$	retail deposits for Category 1 for *t*-1 day, hereafter referred to as KAT01(-1), (explanatory variable)
$EURIBOR_t$	reference interest rate 6M Euribor for *t* day (explanatory variable)
$NETO\_PLACA_t$	net salary in Slovenia for *t* day (explanatory variable)
$ST\_REG\_BREZPOS_t$	unemployment rate in Slovenia for *t* day (explanatory variable)
$DUMMY\_INFOR_t$	dummy variable due to negative information about the bank in media for *t* day (explanatory variable)
u_t	stochastic disturbance (or stochastic error term) for *t* day
β_1	regression coefficient of the constant (or an intercept)
β_2 do β_5	regression coefficients of the explanatory variables
β_6	regression coefficient of the dummy variable
t	time series from 1 September 2013 until 31 March 2014

We expect the following signs of regressions' coefficient estimators:

- for *KAT01(-1)* a positive sign. As this is a lagged dependent variable, the only reasonably outcome is a positive sign.
- for *EURIBOR* a positive sign. Higher interest rates should attract deponents to put their funds into the bank.;
- for *NETO_PLACA (net salary)* a positive sign. Higher salaries should lead to higher savings/deposits.
- for *ST_REG_BREZPOS (registered unemployment rate) a* negative sign. Increased unemployment usually means that people receive just an unemployment compensation for the certain period of time and afterwards social support. Both amounts are lower than the salary.
- for *DUMMY_INFOR* a negative sign.
- for *CONSTANT* a positive sign because of an increase in or the preservation of KAT01 retail deposits' balance.

4.3 Regression Model for Category 2 (KAT02)

The mathematical form of the model for the medium risky category, KAT02, is as follows:

$$KAT02_t = \beta_1 + \beta_2 KAT02(t\text{-}1)_t + \beta_3 EURIBOR_t + \\ + \beta_4 NETO\_PLACA_t + \\ + \beta_5 ST\_REG\_BREZPOS_t + \\ + \beta_6 DUMMY\_INFOR_t + u_t ,$$

where:

$KAT02_t$	retail deposits for Category 2 for *t* day (dependent variable)
$KAT02(t\text{-}1)_t$	retail deposits for Category 2 for *t*-1 day, hereafter referred to as KAT02(-1) (explanatory variable)
$EURIBOR_t$	reference interest rate 6M Euribor for *t* day (explanatory variable)
$NETO\_PLACA_t$	net salary in Slovenia for *t* day (explanatory variable)
$ST\_REG\_BREZPOS_t$	unemployment rate in Slovenia for *t* day (explanatory variable)
$DUMMY\_INFOR_t$	dummy variable due to negative information about the bank in media for *t* day (explanatory variable)
u_t	stochastic disturbance (or stochastic error term) for *t* day
β_1	regression coefficient of the constant (or an intercept)
β_2 do β_5	regression coefficients of the explanatory variables
β_6	regression coefficient of the dummy variable
t	time series from 1 September 2013 until 31 March 2014

We expect the same signs of regressions coefficient estimators for KAT02 retail deposits as we described for KAT01 retail deposits.

4.4 Regression Model for Category 3 (KAT03)

The mathematical form of the model for the riskiest category, KAT03, is as follows:

$$KAT03_t = \beta_1 + \beta_2 KAT03(t\text{-}1)_t + \beta_3 EURIBOR_t + \beta_4 NETO\_PLACA_t + \beta_5 ST\_REG\_BREZPOS_t + \beta_6 DUMMY\_INFOR_t + u_t ,$$

where:

$KAT03_t$	retail deposits for Category 3 for *t* day (dependent variable)
$KAT03(t\text{-}1)_t$	retail deposits for Category 3 for *t*-1 day, hereafter referred to as KAT03(-1) (explanatory variable)
$EURIBOR_t$	reference interest rate 6M Euribor for *t* day (explanatory variable)
$NETO\_PLACA_t$	net salary in Slovenia for *t* day (explanatory variable)
$ST\_REG\_BREZPOS_t$	unemployment rate in Slovenia for *t* day (explanatory variable)
$DUMMY\_INFOR_t$	dummy variable due to negative information about the bank in media for *t* day (explanatory variable)
u_t	stochastic disturbance (or stochastic error term) for *t* day
β_1	regression coefficient of the constant (or an intercept)
β_2 do β_5	regression coefficients of the explanatory variables
β_6	regression coefficient of the dummy variable
t	time series from 1 September 2013 until 31 March 2014

We also expect the same signs of regressions' coefficient estimators for KAT03 retail deposits as described for KAT01.

4.5 Testing Stationary Time Series

The series used in the model for the estimation of outflow rates for the three categories of retail deposits are KAT01, KAT01(-1), KAT02, KAT02(-1), KAT03, KAT03(-1), Euribor, net salary, and registered unemployment rate. Using augmented Dickey-Fuller (ADF) testing, we can conclude that series KAT01, KAT01(-1), KAT02, and KAT02(-1) are non-stationary in their absolute form. Series KAT03, KAT03(-1), Euribor, net salary, and registered unemployment rate are stationary on the first difference. Therefore, we used the logarithm transformation.

4.6 Economic and Statistical Interpretation of the Results

Econometric model for Category 1

Table 1 Results of Econometric Model for Retail Deposits Category 1 (KAT01), 1 September 2013 to 31 March 2014

Dependent Variable:	LOG(KAT01)
N:	150
Constant	1.77
t-stats	*(2.72)*
LOG(KAT01(-1))	0.91
t-stats	*(27.03)*
LOG(EURIBOR)	0.15
t-stats	*(1.89)*
LOG(ST_REG_BREZPOS)	-0.28
t-stats	*(-1.98)*
R^2:	0.877
Adjusted R^2:	0.874

Note: Statistically insignificant variables are omitted from the table.

The estimated regression coefficients are statistically significant and their signs are in accordance with our expectations after the elimination of statistically insignificant regression coefficients. Regression constant *C* in our model represents an increase or preservation of the retail deposits balance for KAT01.

As evident in Table 1, we eliminated two explanatory variables: the net salary and the dummy variable. They were defined as statistically insignificant. The other three explanatory variables have an impact on the KAT01 retail deposits, as shown in Table 1. The estimated equation suggests that the increase of KAT01 retail deposits by one percentage point during the previous day will lead to an increase of KAT01 by 0.91 percentage points the next day.

The results of diagnostic tests in Table 2 show that the regression model is very good and suitable for predicting the movement of Category 1 retail deposits.

The results of the econometric model for retail deposits of Category 1 were used to estimate the volatility and expected movements of these deposits within the next 22 working days under stress conditions. The estimated stability of retail deposits (KAT01, KAT02, and KAT03) were calculated as the ratio between the lowest predictive value of the deposits in the next 22 working days minus two standard errors and the maximum predictive value of

Table 2 Diagnostic Test Results of Regression Model for Retail Deposits Category 1 (KAT01) (number of observations = 150)

Test	Critical value (c)*	Calculated value *	Fulfillment Yes/No & Results description
t-statistics	1.655	t_i > 1.894	Yes. We can reject the null hypothesis that individual regression coefficients are zero at significance level α = 0.10.
F-statistics	2.667	347.889	Yes. The regression model is overall statistically significant (F > F_c).
R^2/Adjusted R^2	0<R^2<1	0.877 / 0.874	Yes. 87% of changes in the dependent variable is explained by our regression model.
Autocorrelation (h-test)	-1.96<h<+1.96	-0.75	Yes. There is no autocorrelation.
Heteroskedasticity (White test)	11.0705	4.391	Yes. In our regression model we do not have heteroskedasticity ($\chi^2 < \chi^2_c$).
Multicollinearity (VIF test)	VIF < 10	VIF_i < 6	Yes. No multicollinearity is present.
Model specification (Ramsey-Reset test)	2.667	0.134	Yes. As F < Fc we cannot reject the null hypothesis; therefore, we conclude that our model is correctly specified.

Note: * at the α = 0.05 significance level (confidence interval 95%).
** i = regression coefficients/variables. *** VIF = Variance Inflation Factor.

deposits in the next 22 working days (at the 95% confidence interval). The commercial bank adopted a very conservative approach by calculating the stability of deposits. Thus, it takes into account the lowest possible forecasted value of deposits in the next 22 working days.

Retail deposits within Category 1 are treated as the least risky category, taking into account a predetermined number and type of risk factors. For the purpose of the LCR reporting, the outflow rate for retail deposits that fall into Category 1 was calculated at 15.21% using the historical and expected volatility assessment.

Econometric model for Category 2

Table 3 Results of Econometric Model for Retail Deposits Category 2 (KAT02), 1 September 2013 to 31 March 2014

Dependent Variable:	LOG(KAT02)
N:	150
Constant	1.71
t-stats	*(2.97)*
LOG(KAT02(-1))	0.89
t-stats	*(24.72)*
LOG(ST_REG_BREZPOS)	-0.24
t-stats	*(2.24)*
D_INFOR	-0.01
t-stats	*(-1.35)*
R^2:	0.870
Adjusted R^2:	0.868

Note: Statistically insignificant variables are omitted from the table.

Table 3 shows that the estimated regression coefficients are statistically significant and their signs are in accordance with our expectations after the elimination of statistically insignificant regression coefficients. The calculated *t* statistic for the regression coefficient estimator of the dummy variable *d_infor* was 1.349; therefore, we can reject the null hypothesis about its statistical significance only at 80% probability (t_c = 1.287). Yet we need to emphasize that, due to data complexity, only a short time series has been included. The bank considered in this paper is one of the three largest banks in Slovenia and is treated as a systematically important bank in Europe; thus, we decided to keep the impact of media on the bank's retail deposits within Category 2.

Similarly, two explanatory variables were eliminated here—namely, the Euribor and net salary—as these were defined as statistically insignificant. Although the other three explanatory variables have an impact on the KAT02 retail deposits, as clearly seen in Table 3, the regression analysis of KAT02 retail deposits showed that an increase of the registered unemployment rate by one percentage point would lead to a decrease of KAT02 retail deposits by 0.24 percentage points.

The results of the diagnostic tests are presented in Table 4. They indicate that the regression model is good and suitable for predicting the movement of Category 2 retail deposits.

The results of the econometric model for retail deposits of Category 2 were used to estimate the volatility and expected movements of these deposits within the next 22 working days under stress conditions. Retail deposits within Category 2 are treated as the medium risky category,

Table 4 Diagnostic Test Results of Regression Model for Retail Deposits Category 2 (KAT02) (number of observations = 150)

Test	Critical value (c)*	Calculated value *	Fulfillment Yes/No & Results description
t-statistics	1.976	t_i > 2.240	Yes. We can reject the null hypothesis that individual regression coefficients are zero, except for *d_infor*.
F-statistics	2.667	326.992	Yes. The regression model is overall statistically significant (F > F_c).
R^2/Adjusted R^2	0<R^2<1	0.870 / 0.868	Yes. 87% of changes in the dependent variable is explained by our regression model.
Autocorrelation (h-test)	-1.96<h<+1.96	-0.04	Yes. There is no autocorrelation.
Heteroskedasticity (White test)	11.0705	28.725	No. Because ($\chi^2 > \chi^2_c$), we reject the null hypothesis of no heteroscedasticity, and it is corrected with White test.
Multicollinearity (VIF test)	VIF < 10	VIF_i < 3	Yes. No multicollinearity present.
Model specification (Ramsey-Reset test)	2.667	0.376	Yes. As F < Fc we cannot reject the null hypothesis; therefore, we conclude that our model is correctly specified.

Note: * at the α = 0.05 significance level (confidence interval 95%).

** i = regression coefficients/variables. *** VIF = Variance Inflation Factor.

taking into account the predetermined number and type of risk factors (retail deposits that meet three criteria from high-risk Group 1 factors or one criterion from Group 1 and one criterion from Group 2 risk factors). For the LCR reporting, the outflow rate for retail deposits that fall into Category 2 was calculated at 22.57% using historical and expected volatility assessment.

Econometric model for Category 3

Table 5 Results of Econometric Model for Retail Deposits Category 3 (KAT03), 1 September 2013 to 31 March 2014

Dependent Variable:	LOG(KAT03)
N:	150
Constant	1.94
t-stats	*(2.92)*
LOG(KAT03(-1))	0.89
t-stats	*(22.96)*
LOG(EURIBOR)	0.10
t-stats	*(1.33)*
LOG(ST_REG_BREZPOS)	-0.26
t-stats	*(-1.82)*
R^2:	0.800
Adjusted R^2:	0.797

Note: Statistically insignificant variables are omitted from the table.

Table 5 shows that the estimated regression coefficients are statistically significant and their signs are in accordance with our expectations after the elimination of statistically insignificant regression coefficients. The calculated *t* statistic for the regression coefficient estimator of 6M Euribor is 1.332; therefore, we can reject the null hypothesis about its statistical significance only at 80% probability (t_c = 1.287). Yet we need to emphasize that due to data complexity only a short time series was included. We decided to keep the impact of 6M Euribor on the bank's retail deposits within Category 3 because some contracts included in this category are based on the reference rate movement.

As shown in Table 5, we again eliminated two explanatory variables: net salary and the dummy variable. The other three explanatory variables have an impact on the KAT03 retail deposits. An increase in 6M Euribor by one percentage point will lead to an increase in KAT03 retail deposits by 0.10 percentage points (taking into account the 80% probability).

The results of diagnostic tests are presented in Table 6. They show that the regression model is good and suitable for predicting the movement of Category 3 retail deposits.

The results of the econometric model for retail deposits of Category 3 were used to estimate the volatility and expected movements of these deposits within the next 22 working days under the assumption of a combined idiosyncratic and market-wide stress scenario. Retail deposits within *Category 3* are treated as the riskiest category, taking into account the predetermined number and type of risk factors (retail deposits who meet two criteria from very high-risk Group 2 factors or two criteria from Group 1 and one criterion from Group 2 risk factors or any other risk factor combination). For the LCR reporting, the outflow rate for retail deposits that fall into Category 3 was calculated at 34.40% using the historical and expected volatility assessment.

Table 6 Diagnostic Test Results of Regression Model for Retail Deposits Category 3 (KAT03) (number of observations = 150)

Test	Critical value (c)*	Calculated value *	Fulfillment Yes/No & Results description
t-statistics	1.655	t_i > 1.815	Yes. We can reject the null hypothesis that individual regression coefficients are zero, except for *Euribor*.
F-statistics	2.667	195.791	Yes. The regression model is overall statistically significant ($F > F_c$).
R^2/Adjusted R^2	$0<R^2<1$	0.800 / 0.797	Yes. 80% of changes in the dependent variable is explained by our regression model.
Autocorrelation (h-test)	-1.96<h<+1.96	-0.57	Yes. There is no autocorrelation.
Heteroskedasticity (White test)	15.086	13.105	No. Because ($\chi^2 > \chi^2_c$), we accept the null hypothesis of no heteroskedasticity.
Multicollinearity (VIF test)	VIF < 10	VIF_i < 5	Yes. No multicollinearity is present.
Model specification (Ramsey-Reset test)	2.667	0.196	Yes. As F < Fc we cannot reject the null hypothesis; therefore, we concluded that our model is correctly specified.

Note: * at the α = 0.05 significance level (confidence interval 95 %).

** i = regression coefficients/variables. *** VIF = Variance Inflation Factor.

5 Future Treatment of Observed Retail Deposits under Delegated Regulation

The delegated regulation of 10 October 2014, supplementing Regulation (EU) 575/2013 with regard to LCR for credit institutions (known as the Delegated Act), established rules to specify in detail the LCR provided for in Article 412(1) of CRR (CRD IV, 2013 and CRR, 2013). The Delegated Act is divided into the following four main titles:

- Title 1: scope and application, definitions, calculation of LCR and stress scenarios
- Title 2: general and operational requirements, the valuation of liquid assets, the list of Level 1 and Level 2 assets specification, and alternative liquidity approaches
- Title 3: net liquidity outflows, liquidity outflows, and liquidity inflows
- Title 4: final provisions and application date (1 October 2015).

As our paper focuses on the retail deposits that are subject to higher outflow rates, let us summarize the requirements in the Delegated Act considering these types of retail deposits. As stated in Article 25, credit institutions shall apply a higher outflow rate where (EC, 2014a, 2014b and 2014c):

- the retail deposits fulfill point (a) below or two of the criteria in points (b) to (e), and the outflow rate shall be between 10% and 15%; and
- the retail deposits fulfill point (a) below and at least another criterion (b) to (e) or three or more criteria (a) to (e), and the outflow rate shall be between 15% and 20%.

Criteria for classification of the retail deposits subject to higher outflow into Category 1 or Category 2 are as follows (EC, 2014a, 2014b and 2014c):

a) the total deposit balance exceeds 500,000 €
b) the deposit is an Internet-only account
c) the deposit offers an interest rate that fulfills any of the following conditions: the rate significantly exceeds the average rate for similar retail products; its return is derived from the return on a market index or set of indices; and/or its return is derived from any market variable other than a floating interest rate
d) the deposit was originally placed as a fixed term with an expiry date maturing within the 30 calendar day period or the deposit presents a fixed notice period shorter than 30 calendar days
e) for credit institutions established in the EU, the depositor is resident in a third country or the deposit is denominated in a currency other than the Euro or the domestic currency of a member state

As we can see, the major difference compared to the current ECB/ITS reporting of LCR is in the number of categories and in the advanced defined outflow rates for these categories. Although today we have three categories and credit institutions must calculate outflow rates on an individual basis, only two categories are requested for future reporting, and for these categories the outflow rates should be prescribed in advance.

6 Summary

The main purpose of this paper was to show how a commercial bank can develop a simple internal model for calculating the stability of the retail deposits with higher outflow rates that are the subject of LCR reporting. First, we introduced the legal basis with its major documents. Then we

described the most important steps that are necessary within the business process of setting up the groundwork with its main elements to collect the data needed for econometric modelling. As the bank considered in this paper is the only Slovenian bank that has developed such a model, it represents a solid base to present the procedures and main results of a well-established internal model.

As indicated, the calculated outflow rates are very similar to those that EBA has suggested within the DP, especially for Category 1 and Category 2. Although the outflow rate under the stress conditions for Category 3, which comprises the riskiest factors, is even higher at the bank's level, the benchmark bank from this paper still uses the model today. The actual data on the retail deposits demonstrated that the model is very good at predicting the future movements of the considered deposits.

What we can expect in the future is more transparent output based on the detailed rules and harmonized input, with an aim to make the credit institutions less dependent on short-term financing and central bank liquidity provision by requiring them to hold sufficient liquid assets. The latest must withstand the excess of liquidity outflows over inflows that could be expected to accumulate over a 30-day stressed period.

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Model za izračun stabilnosti vlog na drobno z višjo stopnjo odliva

Izvleček

Vloge na drobno veljajo za enega najcenejših in tudi najstabilnejših virov financiranja za banke, ki razpolagajo z večjimi vrednostmi teh vlog. Za namen poročanja in izpolnjevanja zahteve glede likvidnostnega kritja definira banka tri glavne skupine vlog na drobno, ki jim pripadajo različne stopnje odlivov. Za prvi dve glavni skupini so značilne stopnje odlivov 5 % oziroma 10 %, za tretjo glavno skupino pa banka sama določi stopnje odlivov. Tretja glavna skupina je tudi predmet obravnave v tem članku. Banka na podlagi števila in dejavnikov tveganja razvrsti vloge na drobno v tri kategorije. Dejavniki tveganja so glede na stopnjo tveganja razdeljeni v dve skupini. V članku je najprej opisan zakonodajni okvir, nato pa način izračuna višjih stopenj odlivov za vloge na drobno v skladu s preteklimi nihanji in pričakovano oceno nestanovitnosti v situaciji stresnih razmer. Na koncu je na kratko podana prihodnja obravnava vlog na drobno z višjimi stopnjami odlivov.

Ključne besede: vloge na drobno, stabilnost, transakcijski račun, LCR, jamstvo za vloge, deponenti, višji odlivi, Basel III

Reduction of the Mean Hedging Transaction Costs

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Abstract

Transaction costs of derivative hedging appear in financial markets. This paper considers the problem of delta hedging and the reduction of expected proportional transaction costs. In the literature the expected approximate proportional transaction costs are customarily estimated by the gamma term, usually the largest term of the associated series expansion. However, when options are to expire in a month or few weeks, other terms may become even larger so that more precise estimates are needed. In this paper, different higher-order estimates of proportional transaction costs are analyzed. The problem of the reduction of expected transaction costs is considered. As a result, a suitably adjusted delta is given, for which the expected approximate proportional transaction costs can be reduced. The order of the mean and the variance of the hedging error can be preserved. Several examples are provided.

Keywords: derivatives, delta hedging, transaction costs, hedging error

Introduction

In order to reduce the risk of highly leveraged derivative contracts, different hedging strategies can be applied. As known, the discrete-time delta hedging is a dynamic hedging technique widely used in practice. Transaction costs due to discrete-time delta hedging are highly dependent on the frequency of hedging and thus on the time length Δt between successive adjustments of the portfolio. If the hedging is relatively frequent, then the time Δt is relatively small. More frequent hedging means more precise hedging (smaller hedging error) as well as higher total transaction costs (see, for example, Boyle & Emanuel, 1980; Toft, 1996). Less frequent hedging means lower total transaction costs, but also higher hedging error.

This paper considers the problem of the reduction of the expected transaction costs for the case when the frequency of hedging is not necessarily lowered. Specifically, let the option value $V = V(t,S)$ be a function of the time t and the underlying assets price S. Suppose that the price $S = S(t)$ has lognormal distribution. In the continuous-time Black-Scholes model, where the hedging is instantaneous and the replication is perfect, the number of shares at time is given exactly by the delta—the current value of the partial derivative $V_S(t,S)$, where $V(t,S)$ is the solution of the Black-Scholes-Merton (BSM) equation (Black & Scholes, 1973; Merton, 1973). When the hedging is in discrete time, then over the time interval $(t,t + \Delta t)$ the number of shares is kept constant while at the time point $t + \Delta t$ the number of shares is readjusted to the new value $V_S(t + \Delta t, S + \Delta S)$. For details, see (Boyle and Emanuel, 1980).

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The proportional transaction costs depend on the difference $|V_S(t + \Delta t,S + \Delta S) – V_S(t,S)|$, which is usually approximated by the gamma term—in most cases, the largest term of the associated Taylor series expansion (see, for example, Leland, 1985; Mastinsek, 2006; Toft, 1996). However, when options are near expiry, other terms of the series expansion are not necessarily small compared to the gamma term. Actually they can be even higher; thus, they cannot be ignored. This motivates further research. The following analysis will treat the problem more closely.

In order to deal with the subject, more precise estimates of proportional transaction costs will be considered**.** Consequently the problem of the reduction of the expected transaction costs will be analyzed. As a result, a suitably adjusted delta will be given for which the expected approximate proportional transaction costs can be reduced, while the order of the mean and the variance of the hedging error can simultaneously be preserved.

The paper is organized as follows: In the first section, the problem of proportional transaction costs and its reduction are considered. In the second section, the associated problem of the hedging error is studied. For illustration, an example of the European call option and several numerical results are given.

Transaction Costs

Let the number of shares N' at point $t + \Delta t$ be equal to the Black-Scholes delta: $N' = V_S(t + \Delta t,S + \Delta S)$, which is the hedge ratio customarily used in practice (compare Remark 1 below). If N is given by $N = V_S(t,S)$, then the proportional transaction costs C_{TR} at the rehedging moment $t + \Delta t$ are equal to:

$$C_{TR} = \frac{k}{2}\left|N'-N\right|(S+\Delta S) =$$

$$= \frac{k}{2}\left|V_S(t+\Delta t, S+\Delta S) - V_S(t,S)\right|(S+\Delta S) \qquad (1.1)$$

where k represents the round-trip transaction costs measured as a fraction of the volume of transactions. For details on the approximate transaction costs, see Leland (1985).

If $S = S(t)$ follows the geometric Brownian motion, then over the non-infinitesimal interval of the length Δt, its change can be approximated by:

$$\Delta S = S(t+\Delta t) - S(t) \approx \sigma SZ\sqrt{\Delta t} + \mu S\Delta t \qquad (1.2)$$

where σ is volatility, μ is the drift rate, and Z is the normally distributed variable with mean zero and variance one; in short $Z \sim N(0,1)$. For details, see Hull (2006). As noted, in this case, the first-order Taylor series approximation $|N'–N|$ of in (1.1) can be given by the partial derivative V_{SS} (the gamma), provided that other terms of the series are relatively small (Leland, 1985):

$$\Delta N = \left|N'-N\right| \approx \left|V_{SS}(t,S)\sigma SZ\sqrt{\Delta t}\right|, \qquad (1.3)$$

However, in many cases in practice, other partial derivatives of the series (like V_{St}) as well as the associated series terms may be too high to be neglected, as shown in example 1.

Example 1

Let V be the value of the European call option. Using the BSM formula (see (3.1) in the Appendix), the following ratio q between the partial derivatives can be obtained:

$$q := \frac{V_{St}}{V_{SS}} = \frac{S}{2T}\left[\ln S/S_0 - (\tfrac{1}{2}\sigma^2 + r)T\right]$$

where S_0 is the exercise price and T the time to expiry.

Suppose that S = 110\$, S_0 = 100\$, σ = 0.2, r = 0.05. Using the previous formula, very large ratios will be obtained:

if T = 0.1, *then* q = 48.6,
if T = 0.05, *then* q = 101.0,
if T = 0.02, *then* q = 258.3.

Moreover, if ΔS = 0.5 and Δt = 0.01, then the gamma term is not necessarily the largest term of the associated approximating series (1.4). Thus, other terms of the approximating series cannot be neglected. In order to deal with the problem, the following higher-order estimate can be considered:

$$\Delta N = \left|N'-N\right| =$$

$$= \left|V_{SS}(t,S)\Delta S + V_{St}(t,S)\Delta t + \tfrac{1}{2}V_{SSS}(t,S)\Delta S^2 + O(\Delta t^{3/2})\right|, \qquad (1.4)$$

where $O(.)$ *is the* order of the error. Consequently, the problem of the reduction of expected proportional transaction costs can be treated.

The objective of this paper is to obtain an appropriate choice of such that the expected transaction costs can be reduced while the order of the mean and the variance of the hedging error can be preserved. In particular, let us consider the adjusted hedge ratio of the form:

$$N = V_S(t + \alpha\Delta t, S) \qquad 0 \le \alpha \le 1, \tag{1.5}$$

where the parameter α is arbitrary and the number of shares N' is equal to the Black-Scholes delta: $N' = V_S(t+ \Delta t, S + \Delta S)$. For details, see Remark 1 below. In this case, we have:

$$\begin{aligned}\Delta N &= \left|N' - N\right| = \\ &= \left|V_{SS}(t,S)\Delta S + (1-\alpha)V_{St}(t,S)\Delta t + \right. \\ &\quad \left. + \tfrac{1}{2}V_{SSS}(t,S)\Delta S^2 + O(\Delta t^{3/2})\right|\end{aligned} \tag{1.6}$$

For simplicity of exposition, let us assume that $\mu = 0$ (as proposed by Leland (1985) the drift term in (1.2) may be neglected, when Δt is small). Then ΔN in (1.6) can be approximated to the order $O(\Delta t^{3/2})$ in the following way:

$$\begin{aligned}\Delta N \approx D = \left|V_{SS}(t,S)\sigma S\sqrt{\Delta t}Z + (1-\alpha)V_{St}(t,S)\Delta t + \right. \\ \left. + \tfrac{1}{2}V_{SSS}(t,S)(\sigma S Z\sqrt{\Delta t})^2\right|\end{aligned}$$

We rewrite D briefly:

$$D = b\left|aZ + (1-\alpha)c + Z^2\right|, \tag{1.7}$$

where

$$b = \tfrac{1}{2}V_{SSS}(t,S)(\sigma S\sqrt{\Delta t})^2,$$

$$a = \frac{V_{SS}(t,S)\sigma S\sqrt{\Delta t}}{\tfrac{1}{2}V_{SSS}(t,S)(\sigma S\sqrt{\Delta t})^2},$$

$$c = \frac{V_{St}(t,S)\Delta t}{\tfrac{1}{2}V_{SSS}(t,S)(\sigma S\sqrt{\Delta t})^2}. \tag{1.8}$$

The parameters a, b, c depend on S, σ, Δt and the time to expiry T.

Remark 1

At time $t + \Delta t$, when the option is near the expiration date and the stock price $S + \Delta S$ is known, the hedger may choose a different hedging frequency using, for instance, price-based or delta-based rebalancing. Then the adjusted delta $V_S(t + \Delta t + \beta\Delta t', S + \Delta S)$ $\beta \neq 0$ can be calculated with respect to the new stock price $S + \Delta S$. Alternatively, the two-period model can be considered. However, in this case, the terms of the form $|aZ + (1 + \beta - \alpha)c + Z^2|$ will appear; thus, the optimization problem with the two unknown parameters has to be treated.

Remark 2

In practical cases where Δt is relatively small, the V_{SS} term in (1.6) is usually larger than the V_{SSS} the term so that $|\alpha|$ given by (1.8) is larger than 1. In particular, for the European call option, specific values are given in the Appendix (formula (3.2) and Example 8); moreover, parameter c is in most practical cases negative. The explicit formula c for is given by (3.3) in the Appendix. Therefore, the following problem associated with the reduction of the expected proportional transaction costs C_{TR} given by (1.1) can be considered:

Proposition 1

If $a>1$ and $c<0$, then the minimal value

$$\min_{\alpha} E\left|aZ + (1-\alpha)c + Z^2\right| \tag{1.9}$$

is obtained for an α that satisfies the estimates:

$$1 - \omega_1 < \alpha < 1 - \omega_2 \tag{1.10}$$

where the constants ω_1, ω_2 depend on a, c and are given explicitly by the formulae (1.16) through (1.20), provided below.

Proof

If we introduce a new variable $Y = aZ + Z^2$, the minimization problem can be written as:

$$\min_{y} E\left|Y - y\right|. \tag{1.11}$$

As known from stochastic analysis, its solution is given by the *median* y_m of Y:

$$P(Y < y_m) = \frac{1}{2}. \tag{1.12}$$

The value $y_m>0$ can be obtained from the cumulative normal distribution function $\Phi(z)$ of Z. Using (1.12), the following relationship holds:

$$P(z_1 < Z < z_2) = \Phi(z_2) - \Phi(z_1) = \frac{1}{2}, \tag{1.13}$$

where z_1, z_2 are solutions of the quadratic equation: $z^2 + az - y_m = 0$ and thus are given by:

$$z_{1,2} = \frac{1}{2}\left(-a \mp a\sqrt{1+{}^{4y_m}\!/_{a^2}}\right).$$

Using the binomial (Taylor) series expansion, we have:

$$(1+x)^{\frac{1}{2}} = 1+\frac{1}{2}x-\frac{1}{8}x^2+... \qquad |x|<1\ . \tag{1.14}$$

Hence, for $x = {}^{4y_m}\!/_{a^2} < 1$, we get the estimates:

$$-a-{}^{y_m}\!/_{a} < z_1 < -a \text{ and } 0 < z_2 < {}^{y_m}\!/_{a}\ . \tag{1.15}$$

i) Using (1.13), (1.15), and the monotonicity of $\Phi(z)$, we find:

$$\Phi(z_1) < \Phi(-a) \text{ and } \Phi(z_2) = \frac{1}{2}+\Phi(z_1) < \frac{1}{2}+\Phi(-a)\ .$$

Hence,

$$z_2 < \Phi^{-1}(\frac{1}{2}+\Phi(-a)) =: z_a \tag{1.16}$$

and based on the quadratic equation, it follows:

$$y_m < z_a^2 + az_a =: y_a\ . \tag{1.17}$$

ii) Moreover, using (1.13) and (1.15), we also have:

$$-a-{}^{y_a}\!/_{a} < z_1$$

and

$$\frac{1}{2}+\Phi(-a-{}^{y_a}\!/_{a}) < \frac{1}{2}+\Phi(z_1) = \Phi(z_2)\ .$$

Based on the monotonicity of Φ, it follows:

$$z_b := \Phi^{-1}(\frac{1}{2}+\Phi(-a-{}^{y_a}\!/_{a})) < z_2 \tag{1.18}$$

and

$$y_b := z_b^2 + az_b < y_m\ . \tag{1.19}$$

Hence, using (1.17) and (1.19), it follows:

$$y_b < y_m = (1-\alpha)|c| < y_a$$

Thus, we get the estimates (1.10):

$$1-\omega_1 < \alpha < 1-\omega_2$$

where

$$\omega_1 := \frac{y_a}{|c|} \text{ and } \omega_2 := \frac{y_b}{|c|} \tag{1.20}$$

As mentioned, in many practical cases where the option is not near expiry and Δt is small, the V_{SS} term in (1.6) is usually much larger than the V_{SSS} term, so that $|\alpha|$ is relatively large. This means that the value of $\Phi(-|a|)$ is very small. If the constants ω_1, ω_2 are very small, the optimal delta is close to the standard Black-Scholes delta. For illustration, let us give some examples.

Example 2

Let us assume that $4 < a < 20$ and $-1 < c < -0.6$. (For specific values a and c in the case of the European call option, see the Appendix.) Based on the tables of the cumulative normal distribution function $\Phi(z)$ of Z, we find:

$$\Phi(-a) < \Phi(-4) < 0.0001$$

$$\Phi(z_a) < 0.5001$$

Hence, using (1.16), $z_a < 0.00026$. Based on the assumption of a and using (1.17) and (1.20), we have:

$$y_a < 0.0053$$

and

$$\omega_1 = \frac{y_a}{|c|} < 0.01$$

Thus, based on (1.10), the optimal α satisfies the estimates:

$$0.99 < \alpha < 1\ . \tag{1.21}$$

Example 3

Suppose that $a > 1$ is not very large (e.g., $a = 2$) and $-1 \le c \le -0.6$. Then we find:

$$\Phi(-2) = 0.0228$$

and

$$\Phi(z_a) = 0.5228$$

Moreover, from the tables for Φ we find: $z_a < 0.058$. Based on (1.17), it follows:

$y_a < 0.12$ (1.22)

Using (1.18) we also get:

$$0.04 < \Phi^{-1}(0.5197) = \Phi^{-1}(\frac{1}{2} + \Phi(-2 - 0.12/2)) < z_b$$

Hence, based on (1.19), we have:

$0.082 < y_b$ (1.23)

Therefore, (1.22) and (1.23) lead to: $0.08 < y_m < 0.12$.

Using (1.20), it follows:

$$1 - \frac{0.12}{|c|} < \alpha < 1 - \frac{0.08}{|c|}$$

Thus, when $-1 \le c \le -0.6$, then the optimal α satisfies the estimates:

$0.80 < \alpha < 0.92$. (1.24)

For particular values of c, sharper estimates can be obtained. For instance,

if $c = -0.6$, then $0.80 < \alpha < 0.87$

and

if $c = -1$, then $0.88 < \alpha < 0.92$

As shown in (1.1), (1.6), and (1.7), proportional transaction costs C_{TR} can be approximated using $\Delta N \approx D$, where $D = b|aZ + (1-\alpha)c + Z^2|$. Let us illustrate the conclusions with the following numerical results.

Example 4

Let $a = 1.2$, *and* $c = -1$. Then by direct calculations of the expected value, we get the following results for different values of α:

Table 1

$\alpha =$	0.	0.3	0.5	0.8	0.9	1.
$\Delta N \approx$	1.296b	1.208b	1.172b	1.160b	1.169b	1.188b

This shows that the expected approximate proportional transaction costs C_{TR} for the standard delta ($\alpha = 0$) are approximately 12% higher than those where the adjusted delta ($\alpha = 0.8$) is used. Thus, using the appropriate delta, they can be reduced by 10.5%.

Example 5

Let $a = 2$, *and* $c = -1$. In this case, we get the following results for different values of α:

Table 2

$\alpha =$	0.	0.3	0.5	0.8	0.9	1.
$\Delta N \approx$	1.786b	1.707b	1.670b	1.641b	1.639b	1.642b

In this case, the expected approximate proportional transaction costs C_{TR} for the standard delta ($\alpha = 0$) are approximately 9% higher than those where the adjusted delta ($\alpha = 0.9$) is used.

Remark 3

For $a < -1$, the proof and the estimates can be given in a similar way as for $a > 1$. In this case, the symmetry of the Gaussian (density) function and the symmetry between $(z^2 - az)$ and $(z^2 + az)$ can be used. Thus, using an analogous argument, we can give here explicit estimates as well. The following result can be obtained.

Proposition 2

If $a < -1$ and $c < 0$, then the minimal value $\min_{\alpha} E|aZ + (1-\alpha)c + Z^2|$ is obtained for an α that satisfies the estimates: $1 - \omega_1 < \alpha < 1 - \omega_2$, where constants ω_1, ω_2 depend on a and c and are given by formulae (1.26) through (1.30) below.

Proof:

In this case, using (1.14), we generate the following estimates:

$$-y_m/|a| < z_1 < 0 \text{ and } |a| < z_2 < |a| + y_m/|a| \quad (1.25)$$

i) First, based on the monotonicity of Φ, we have:

$\Phi(|a|) < \Phi(z_2)$,

$$w_a := \Phi^{-1}(\Phi(|a|) - \frac{1}{2}) < z_1 < 0 . \quad (1.26)$$

Hence, $|z_1| < |w_a|$, and given that $a < 0$, it follows:

$$y_m < w_a^2 - aw_a = w_a^2 + |aw_a| =: y_a \quad (1.27)$$

ii) Moreover, using (1.25), we get:

$$\Phi(z_2) < \Phi(|a| + y_a/|a|)$$

$$\Phi(z_1) < \Phi(|a| + y_a/|a|) - \frac{1}{2}$$

Thus,

$$z_1 < \Phi^{-1}\left[\Phi(|a| + y_a/|a|) - \frac{1}{2}\right] =: w_b \tag{1.28}$$

Using the quadratic equation and based on $|z_1| > |w_b|$, we also get:

$$y_m > w_b^2 + |a w_b| =: y_b \tag{1.29}$$

Hence, based on (1.27) and (1.29), we have $y_b < y_m < y_a$. Thus, it follows that $1 - \omega_1 < \alpha < 1 - \omega_2$ where

$$\omega_1 := \frac{y_a}{|c|} \text{ and } \omega_2 := \frac{y_b}{|c|}. \tag{1.30}$$

Example 6

Let us assume that $a = -2$ and $-1 \le c \le -0.6$.

i) Based on the tables of the cumulative normal distribution function $\Phi(z)$ of Z, we find:

$$\Phi(|a|) = \Phi(2) < 0.9772 < \Phi(z_2)$$

Hence, using (1.26), it follows:

$$\Phi(w_a) = 0.4772 < \Phi(z_1)$$

$$-0.058 < w_a < z_1 < 0a$$

and

$$|z_1| < |w_a| < 0.058$$

Using (1.27), we get:

$$y_m < w_a^2 + |a w_a| =: y_a < 0.12 \tag{1.31}$$

ii) Based on (1.28), we have:

$$\Phi(z_2) < \Phi(2.06) = 0.9803$$

$$z_1 < \Phi^{-1}[0.4803] =: w_b < -0.04$$

Using (1.29) we get $0.08 < y_b < y_m$.Thus, based on (1.31):

$$0.08 < y_m < 0.12$$

Hence, using (1.30), it follows:

$$1 - \frac{0.12}{|c|} < \alpha < 1 - \frac{0.08}{|c|} \tag{1.32}$$

Therefore, when $-1 \le c \le -0.6$, we have estimates for the optimal α : $0.8 < \alpha < 0.92$. In particular cases, (1.32) can be used to obtain the following sharper estimates:

if $c = -0.6$, then $0.80 < \alpha < 0.87$

and

if $c = -1$, then $0.88 < \alpha < 0.92$

Example 7

Let $a = -1.1$ *and* $c = -1$. Then using direct calculations of the expected value, we get the following results for different values of α:

Table 3

$\alpha =$	0.	0.3	0.5	0.8	0.9	1.
$\Delta N \approx$	1.246b	1.158b	1.123b	1.115b	1.127b	1.149b

This shows that the expected proportional transaction costs C_{TR} for the standard delta ($\alpha = 0$) are again approximately 12% higher than those where the adjusted delta ($\alpha = 0.8$) is taken.

Next, let us analyze the hedging error when—instead of the standard delta—the adjusted delta is used. We will show that, in this case, the order of the mean and the variance of the hedging error can be preserved.

Hedging Error

As above, let us assume that $S = S(t)$ following the geometric Brownian motion:

$$dS(t) = \mu S dt + \sigma S dW, \tag{2.1}$$

where μ is the expected annual drift rate, σ the volatility, and $W(.)$ the Brownian motion. Thus, over the interval of length Δt, the stock price change can be given by:

$$S(t+\Delta t) = S(t)\exp((\mu - \tfrac{1}{2}\sigma^2)\Delta t + \sigma Z\sqrt{\Delta t}), \tag{2.2}$$

where Z ~ N(0,1). For details, see Hull (2006). Then the change $\Delta S = S(t+\Delta t) - S(t)$ of $S = S(t)$ over the interval of length Δt can be approximated using the Taylor series (see Mastinsek, 2012):

$$\Delta S = $$
$$= S\left[\sigma Z\sqrt{\Delta t} + (\mu - \tfrac{1}{2}\sigma^2)\Delta t + \tfrac{1}{2}\sigma^2 Z^2\Delta t + \sigma(\mu - \tfrac{1}{2}\sigma^2)Z\Delta t^{3/2}\right] +$$
$$+ O(\Delta t^2) \tag{2.3}$$

With respect to (1.2), in this way, higher-order estimates of the hedging error ($O(\Delta t^2)$) can be given. As usual, let us assume that at time t a portfolio consists of a long position in the option and a short position in $N(t)$ units of stock S, so that the portfolio Π value at time t is equal to:

$$\Pi = V - N(t)S \tag{2.4}$$

The return of the portfolio value over the interval $[t, t + \Delta t]$ is then equal to

$$\Delta\Pi = \Delta V - N(t)\Delta S \tag{2.5}$$

as the number of shares $N(t)$ is held fixed during the time step Δt. The change ΔV of the option value $V(t,s)$ over the time interval of length Δt is, based on the Taylor series expansion, equal to:

$$\Delta V = V(t+\Delta t, S+\Delta S) - V(t,S) = V_t(t,S)\Delta t + V_S(t,S)\Delta S +$$
$$+ V_{St}(t,S)\Delta t\Delta S + \frac{1}{2}V_{SS}(t,S)(\Delta S)^2 + \frac{1}{6}V_{SSS}(t,S)(\Delta S)^3 + O(\Delta t^2). \tag{2.6}$$

Thus, based on (2.4), (2.5), and (2.6), the change of the portfolio value is equal to:

$$\Delta\Pi = V_t(t,S)\Delta t + (V_S(t,S) - N(t))\Delta S + V_{St}(t,S)\sigma SZ\Delta t^{\frac{3}{2}} +$$
$$+ \frac{1}{2}V_{SS}(t,S)S^2\left[\sigma^2 Z^2\Delta t + 2\sigma\left[(\mu - \tfrac{1}{2}\sigma^2) + \tfrac{1}{2}\sigma^2 Z^2\right]Z\Delta t^{3/2}\right] +$$
$$+ \frac{1}{6}V_{SSS}(t,S)\sigma^3 S^3 Z^3\Delta t^{\frac{3}{2}} + O(\Delta t^2). \tag{2.7}$$

If the amount Π is invested in a riskless asset (e.g., bonds) with an interest rate r, then over the interval of length Δt the return to the riskless investment is equal to:

$$\Delta B = \Pi\exp(r\Delta t) - \Pi = \Pi r\Delta t + O(\Delta t^2). \tag{2.8}$$

In this case, the hedging error ΔH, defined as the difference between the return $\Delta\Pi$ to the portfolio value and the return ΔB to the bond value, is equal to $\Delta H = \Delta\Pi - \Delta B$. Hence, based on (2.7) and (2.8), we get:

$$\Delta H = \Delta\Pi - \Delta B = V_t(t,S)\Delta t + (V_S(t,S) - N(t))\Delta S -$$
$$- (V - N(t)S)r\Delta t + V_{St}(t,S)\sigma SZ\Delta t^{\frac{3}{2}} +$$
$$+ \frac{1}{2}V_{SS}(t,S)S^2\left[\sigma^2 Z^2\Delta t + 2\sigma\left[(\mu - \tfrac{1}{2}\sigma^2) + \tfrac{1}{2}\sigma^2 Z^2\right]Z\Delta t^{3/2}\right] +$$
$$+ \frac{1}{6}V_{SSS}(t,S)\sigma^3 S^3 Z^3\Delta t^{\frac{3}{2}} + O(\Delta t^2). \tag{2.9}$$

Then the following result can be concluded.

Proposition 3

Let σ be the annualized volatility and r the annual interest rate of a riskless asset. Let $V(t,S)$ be the solution of the Black-Scholes-Merton equation:

$$V_t(t,S) + \frac{1}{2}\sigma^2 S^2 V_{SS}(t,S) + rSV_S(t,S) - rV(t,S) = 0. \tag{2.10}$$

If the number of shares $N(t)$ held short over the rebalancing interval of length, Δt is equal to:

$$N(t) = V_S(t + \alpha\Delta t, S)$$

where

$$0 \le \alpha \le 1, \tag{2.11}$$

then the mean and the variance of the hedging error are of order $O(\Delta t^2)$.

Proof

Let us sketch the proof (for details, see Mastinsek, 2012). Based on the assumption $N = V_S(t + \alpha\Delta t, S)$, it holds that $V_S(t + \alpha\Delta t, S) = V_S(t,S) + V_{St}(t,S)\alpha\Delta t + O(\Delta t^2)$. We put $N = V_S(t + \alpha\Delta t, S)$ into equation (2.9) and apply the BSM equation (2.10) to equation (2.9). Thus, the terms of equation (2.9) associated with the terms in (2.10) are cancelled, and it follows that:

$$\Delta H = (1-\alpha)V_{St}(t,S)\sigma SZ\Delta t^{\frac{3}{2}} + \\ + \frac{1}{2}V_{SS}(t,S)S^2\left[\sigma^2(Z^2-1)\Delta t + 2\sigma\left[(\mu-\tfrac{1}{2}\sigma^2)+\tfrac{1}{2}\sigma^2Z^2\right]Z\Delta t^{3/2}\right] + \\ + \frac{1}{6}V_{SSS}(t,S)\sigma^3S^3Z^3\Delta t^{\frac{3}{2}} + O(\Delta t^2).$$

Based on the assumption Z~N(0,1), $E(Z) = 0$, $E(Z^2) = 1$, and $E(Z^3) = 0$. Thus, it follows that the mean of the hedging error satisfies the equation $E(\Delta H) = 0 + O(\Delta t^2)$ for all α, $0 \le \alpha \le 1$. In light of this result and the fact that $E(Z^{2n}) = 1.3.5...(2n–1)$ and $E(Z^{2n-1}) = 0$, *for* $n = 1, 2, 3, ...$, then the variance of ΔH can be readily calculated.

Conclusion

In the preceding analysis, the problem of expected proportional transaction costs due to discrete-time delta hedging has been considered. A suitably adjusted delta associated with the frequency of hedging and the time sensitivity of the delta were given. In this way, expected approximate proportional transaction costs can be reduced while the order of the mean and the variance of the hedging error can be preserved.

Appendix

Let $V(t, S)$denote the value of a European call option. Using the BSM formula, we get:

$$V_{SS}(t,S) = N'(d_1)\frac{1}{\sigma S\sqrt{T}}, \\ V_{St}(t,S) = N'(d_1)\frac{\ln S/S_0 - (\frac{1}{2}\sigma^2 + r)T}{2\sigma T\sqrt{T}} \qquad (3.1)$$

with

$$d_1 = \frac{\ln S/S_0 + (\frac{1}{2}\sigma^2 + r)T}{\sigma\sqrt{T}} \qquad N'(x) = \frac{1}{\sqrt{2\pi}}e^{-\frac{x^2}{2}}$$

Here S_0 is the strike price, σ the annual volatility, r the interest rate, and T the time to expiry. Moreover, N(x) is the cumulative probability distribution function for a standardized normally distributed variable. For details, see Hull (2006). Based on the definition of a given in (1.8), we directly obtain:

$$a = \frac{-2\sqrt{T}}{\sqrt{\Delta t}(d_1 + \sigma\sqrt{T})}. \qquad (3.2)$$

This means, when Δt is relatively small and d_1 is not too large (the option price is not too far from the strike price), $|a|$ is larger than 1.

Example 8

Suppose that $\sigma = 0.2$, $\Delta t = 0.01$ *and* $r = 0$. Thus, we have:

when $T = 0.25$, *and* $0.85 < \left|S/S_0\right| < 1.2$ *then* $|a| > 5.0$

when $T = 0.1$, *and* $0.85 < \left|S/S_0\right| < 1.2$ *then* $|a| > 1.9$

when $T = 0.4$, *and* $0.9 < \left|S/S_0\right| < 1.1$ *then* $|a| > 1.4$

When the option is relatively deep in or out of the money (for instance, if $\left|S/S_0\right| > 1.2$), the gamma and delta options change very little over time. Thus, the needed readjustments of the portfolio are small and the proportional transaction costs low.

Next let us consider the parameter c for the European call option. Note that the terms associated with V_{St}, V_{SSS} in (1.6) are of the same order so that c is independent of Δt. In that case, using the BSM formula, we have:

$$c = \frac{V_{St}(t,S)\Delta t}{\frac{1}{2}V_{SSS}(t,S)(\sigma S\sqrt{\Delta t})^2} = \frac{-d_1 + \frac{(\sigma^2+2r)}{\sigma}\sqrt{T}}{d_1 + \sigma\sqrt{T}}. \qquad (3.3)$$

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Redukcija povprečnih transakcijskih stroškov hedging tehnike

Izvleček

Na finančnih trgih se pri uporabi hedging tehnike pojavijo transakcijski stroški. V tem članku se obravnava problem uporabe delta hedging tehnike ter redukcije proporcionalnih transakcijskih stroškov. V literaturi navedene metode običajno temeljijo le na uporabi tako imenovanega faktorja gama, ki ponavadi predstavlja največji člen v aproksimacijski vrsti. Toda pri opcijah s kratkim časom dospetja, mesec ali nekaj tednov, lahko drugi členi vrste postanejo celo večji. Tedaj so potrebne natančnejše aproksimacije. V tem članku so analizirane aproksimacije višjega reda in njihova uporaba pri zmanjšanju povprečnih proporcionalnih transakcijskih stroškov. Na podlagi analize je podan ustrezno prilagojen faktor delta, s katerim se povprečni aproksimativni proporcionalni transakcijski stroški lahko zmanjšajo. Pripadajoča napaka hedging tehnike se pri tem ne poveča. Za ilustracijo metode je dodanih nekaj primerov.

Ključne besede: finančni derivati, transakcijski stroški, delta hedging tehnika

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Conceptual Framework for the Definition and Regulation of Virtual Currencies: International and Russian practices

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Abstract

This paper analyzes possible definitions of virtual currencies in legislation and economics. Views of the European Central Bank, Financial Crimes Enforcement Network, and Financial Action Task Force regarding virtual currencies are studied. The analysis also covers the draft legislation to ban money surrogates in the Russian Federation. The author suggests two reasonable approaches to defining virtual currencies in law and economics. The Austrian School representatives' arguments on the existence of private money are reviewed. The author proposes the introduction of some changes in the legislation of the Russian Federation in order to give legal status to virtual currencies.

Keywords: virtual currency, Bitcoin, electronic money, private money, money surrogates

1 Introduction

Virtual currencies gained extraordinary popularity between 2011 and 2014 for a variety of reasons. One of the main factors was the distrust of market participants in the global financial system and so-called fiat currency; this distrust was heightened during the global financial crisis and the Cypriot financial crisis. In addition, the rapid development of an Internet-based economy generated inevitable interest among users in electronic money and currencies as well as new payment technology.

Bitcoin is the most widely recognized example among such virtual currencies. Bitcoin investors are mostly attracted by its high volatility. Although the original target audience of Bitcoin was young people drawn to computer technology, currently Bitcoin, along with securities and derivatives, is generating interest among speculative investors. Yet Bitcoin lost some of its popularity during the sharp fall of the exchange rate, Bitcoin thefts, and the collapse of the Mt. Gox exchange and regulators' continuing concerns about the role of virtual currency on the illegal market. Nevertheless, Bitcoin has always been and remains a newsmaker. For instance, at the end of 2014, Bitcoin became the ninth most popular payment method during sales on Black Friday and Cyber Monday; and at the end of January, the first regulated Bitcoin exchange licensed to operate in 24 states of the United States was opened.

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Currently, no country has created and adopted a legislative basis to regulate the issuance and circulation of virtual currencies and Bitcoins. Grinberg (2011, p. 207) stated that Bitcoin operates in a legal grey area. The problem still remains unsolved. In fact, there is an acute problem of providing licensing and oversight for activities of the so-called Bitcoin exchanges, their integration into the global financial system, as well as the protection of clients from hackers.

At present, no international consensus exists on virtual currencies either on the part of regulators or the leading representatives of economic and legal sciences. The approaches to defining virtual currency are rather diverse. They vary from considering the concept synonymous with a pyramid scheme to identifying virtual currency with a commodity or gold equivalent.

With this in mind, the objective of this paper is to differentiate approaches to defining virtual currencies in economics and law through the following tasks:

- conducting a comparative analysis of financial regulators' views on virtual currencies;
- detecting various approaches to defining virtual currencies and determining the most relevant ones;
- examining Russian legislation related to virtual currencies regulation and making recommendations for improvement; and
- determining prospects for the development of virtual currencies and areas for further investigation.

The first part of this paper considers financial regulators' viewpoints on virtual currencies, including the viewpoints of the European Central Bank, Financial Crimes Enforcement Network, and Financial Action Task Force. The second part introduces features of the Russian legislation concerning money surrogates, currencies, electronic money, existing problems, and possible ways to define virtual currencies. Finally, the third part discloses prospects of virtual currencies, identifying two relevant ways for defining virtual currencies and issuing a call for further discussion.

2 Financial Regulators on Virtual Currencies and Bitcoin

The stances of financial market regulators in relation to Bitcoin may be conditionally divided into three groups: loyal, neutral, and categorical. Logically, the group of loyal countries comprises those not limiting the circulation of Bitcoins or expressing concern over their speculative nature, anonymity, and other properties. A few of the countries in this group, such as Australia, Germany, and Norway, impose taxes on Bitcoin transactions.

Countries holding a neutral stance on Bitcoins warn their citizens against using them due to their risky and speculative nature; however, they do not prohibit direct transactions. The speculative nature and risks inherent to virtual currencies cause concern among regulators. According to Glaser, Zimmerman, Haferkorn, Weber, and Sterling (2014), new users tend to trade virtual currencies on a speculative investment intention basis and have a low intention to rely on the underlying network as means for paying goods or services. Böhme, Christin, Edelman, and Moore (2015, p. 226) concluded that the distinctive risks inherent to Bitcoin differ from other payment methods and stores of value, including market risk, the problem of a shallow market, counterparty risks, transaction risks, operational risks, privacy-related risks, and legal and regulatory risks.

Finally, countries exploiting the categorical stance directly prohibit Bitcoin transactions. Russia and China are among them. Interestingly, the People's Bank of China changed its stance on Bitcoin. At the beginning of December 2013, the People's Bank of China banned the country's financial institutions from conducting transactions with virtual currencies, although transactions with Bitcoins by individuals were permitted. However, at the end of March 2014, the People's Bank ordered that any Bitcoin transactions must cease by April 15. It is noteworthy that Chinese investors were particularly active in the Bitcoin market, resulting in 15 Bitcoin exchanges being established in the country.

2.1 The Stance of the European Central Bank (ECB)

The ECB expressed its viewpoint on virtual currency in general and Bitcoin in particular in 2012 in the guidance document entitled "Virtual Currency Schemes." The ECB defines virtual currency as "a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community" (European Central Bank, 2012, p. 13). In the same document, the ECB recognized that the definition may need adapting in the future if fundamental characteristics change.

With this in mind, the ECB significantly modified the definition of virtual currency in 2015. According to the modified version, virtual currency is now defined as a digital representation of value "not issued by a central bank, credit institution or e-money institution, which, in some circumstances, can be used as an alternative to money" (European Central Bank, 2015, p. 25). Changes made to the original ECB's definition of virtual currency included:

- the elimination of a virtual currency–money analogy as it has become clear that virtual currencies do not have the nature of a highly liquid asset and have not reached the level of acceptance commonly associated with money;

- the abandonment of the term "unregulated" due to the fact that, in some jurisdictions, legislation and regulation have caught up with this innovation and addresses some of its aspects; and
- the removal of the text fragment "used and accepted among the members of a specific virtual community" in order to avoid misunderstanding.

It is necessary to note that the current ECB definition of virtual currency comprises the term "digital representation of value," previously unknown to the economic science, whereas the original definition was based on the concept of "electronic money." This proves that the ECB changed its view on virtual currency.

In the relevant guidance document, the ECB also defined "virtual currency schemes" as a mechanism that covers both the virtual currencies and their own dedicated retail payment systems. The ECB simultaneously introduced the division of virtual currency schemes into three types: closed virtual currency schemes, virtual currency schemes with unidirectional flow, and virtual currency schemes with bidirectional flow.

Closed virtual currency schemes have almost no link to the real economy and are connected with computer games. Sometimes they are called "in-game only" schemes. The virtual currency in this case can only be spent by purchasing virtual goods and services offered within the virtual community and cannot be traded outside the virtual community. A well-known example of closed virtual currency schemes is World of Warcraft gold.

Virtual currencies with unidirectional flow can be purchased directly using real currency at a specific exchange rate, but they cannot be exchanged back to the original currency. The scheme owner establishes the conversion conditions. These schemes allow the currency to be used to purchase virtual goods and services. Sometimes the scheme owner might also allow the virtual currency to be used to purchase real goods and services. Examples of virtual currency schemes with unidirectional flow include Facebook credits, Nintendo points and airlines' frequent flyer miles.

Virtual currencies with bidirectional flow can be bought and sold according to the exchange rates to real currency. The virtual currency seems to be similar to any other convertible currency with regard to its interoperability with the real world. Virtual currency schemes with bidirectional flow allow for the purchase of both virtual and real goods and services. One of examples of these schemes is Linden dollars.

As for Bitcoin, the ECB considers it a virtual currency scheme with bidirectional flow, albeit with certain innovations that make its use more similar to conventional money.

2.2 The Stance of the Financial Crimes Enforcement Network (FinCEN)

When defining the concept of Bitcoin within the financial system, it is necessary to note the opinion of FinCEN in particular, which introduced the term "virtual currency" and has been making every effort to develop the legislative regulation of Bitcoin.

In its guidance dated March 18, 2013, FinCEN handled such concepts as currency ("real" currency) and virtual currency. FinCEN defined "real" currency as "the coin and paper money of the United States or of any other country that is designated as legal tender and that circulates and is customarily used and accepted as a medium of exchange in the country of issuance" (United States Department of the Treasury, FinCEN, 2013, p. 1). Virtual, as opposed to real, currency was defined as "a medium of exchange that operates like a currency in some environments, but does not have all the attributes of real currency" (United States Department of the Treasury, FinCEN, 2013, p. 1). FinCEN emphasized the fact that virtual currency does not have legal tender status in any jurisdiction. FinCEN's management addressed convertible virtual currency, which has an equivalent value in real currency or acts as a substitute for real currency.

FinCEN classified participants in the virtual currency exchange as users, exchangers, and administrators. The last two are money transmitters under FinCEN's regulations and the regulations implementing the BSA. Regarding the types of virtual currencies themselves, FinCEN identified both centralized and decentralized virtual currency. Bitcoin belongs to the latter group.

In January 2014, FinCEN issued a new guidance document regarding virtual currency exchange operations in general and transactions with Bitcoins in particular. The guidance focused in particular on defining the segments of bodies, including both citizens and organizations using Bitcoin for personal purposes. This category of Bitcoin investors (users) is not related to money services business under FinCEN's and BSA regulations (United States Department of the Treasury, FinCEN, 2014).

2.3 The Stance of the Financial Action Task Force (FATF)

In its June 2014 report entitled "Virtual Currencies, Key Definitions and Potential AML/CFT Risks," FATF introduced a glossary of terms related to virtual currency and their classifications. Virtual currency, according to the FATF, is "a digital representation of value that can be digitally traded and functions as a medium of exchange; and/or a unit of account; and/or a store of value, but does not have

legal tender status in any jurisdiction" (Financial Action Task Force, 2014, p. 4). Thus, FATF identified convertible (or open) and non-convertible (or closed) virtual currencies, as well as centralized and decentralized virtual currencies.

Convertible virtual currency has an equivalent value in real currency and can be exchanged for real currency. The examples of this type of currency include Bitcoin, e-Gold (defunct), Liberty Reserve (also defunct), Second Life Linden dollars, and WebMoney. Non-convertible virtual currency is intended to be specific to a particular virtual domain or world, such as a massively multiplayer online role-playing game or Amazon.com. According to the rules governing its use, it cannot be exchanged for fiat currency. Examples include Project Entropia dollars, Q coins, and World of Warcraft gold.

Centralized virtual currencies have a single administrating authority—namely, an administrator that controls the system. The administrator has several functions: issuing the currency, establishing the rules for its use, maintaining a central payment ledger, and redeeming the currency. FATF considers E-gold (defunct), Liberty Reserve dollars/euros (defunct), Second Life Linden dollars, WebMoney's WM units, and World of Warcraft gold to be the currency of this type. Decentralized virtual currencies are distributed, open-source, math-based, peer-to-peer virtual currencies that have no central administrating authority and no central monitoring or oversight. The most obvious examples are Bitcoin, LiteCoin, and Ripple.

FATF also listed known cases of criminal activities using virtual currency (Liberty Reserve, Silk Road, and Western Express International), expressing some concerns over this while clearly defining Bitcoin's prospects.

Thus, we can distinguish three different viewpoints on virtual currency. The ECB considers virtual currency as the concept of money, FinCEN refers to it as to a kind of currency, and FATF defines virtual currency as a digital representation of value. FATF's definition appears to be terminologically challenging. Nevertheless, it view on virtual currency is closer to that of FinCEN and is probably based on it, especially if we take into account the course of events. Ultimately, the views of financial market regulators regarding virtual currencies are based upon the concepts of virtual currency and electronic money.

3 Regulation of Virtual Currency and Bitcoin in the Russian Federation

In a letter dated January 27, 2014, the Bank of Russia warned citizens and businesses against using various virtual currencies, including Bitcoin. Yet Bitcoin transactions in Russia are not prohibited. Moreover, there has been no liability (either criminal or administrative) for transactional activities with Bitcoin. The letter identified five features of Bitcoins that should cause concern among regulators (Bank of Russia, 2014):

- Bitcoin is an unsecured instrument;
- No entity is responsible for Bitcoin (issuer);
- Operations with Bitcoins are of a speculative nature;
- Bitcoin domain and payments have an anonymous nature; and
- Bitcoin could possibly be used for illegal activities, even involuntarily.

The Ministry of Finance of the Russian Federation later pointed out the issues related to Bitcoin, such as the lack of a single issuance regulator and possible violations of the rights of the owners due to the lack of protection in judicial and administrative proceedings.

In our opinion, the biggest concerns for regulators are the lack of a responsible entity and the anonymous nature of Bitcoin domain and payments. Marian (2015, p. 67) expressed the same opinion and decoupled virtual currencies into two unique components: anonymity and decentralization. The other three points made by the Bank of Russia are inherent to many world currencies and financial instruments and were listed in the letter for purely notational reasons. Belomyttseva (2014, p. 27) considered the outlined issues in detail.

In its 2015 autumn session, the State Duma of the Russian Federation will consider a draft federal law "On Amendments being made to certain legislative acts of the Russian Federation" developed by the Ministry of Finance, introducing administrative liability for the issuance and circulation of Bitcoins. This document is designed to define the concept of money surrogates, to which Bitcoin has been relegated by legislators. The draft defined money surrogates as objects of property rights, including electronic ones, used as a means of payment and/or exchange and not prescribed by the federal law directly. From our standpoint, the definition of money surrogates in the draft is quite consistent, but it does not serve its purpose—namely, the prosecution of Bitcoin users. In this sense, the definition of money surrogates covers all kinds of bonuses and bonus points as well as gift certificates, fuel cards, frequent flyer programs, online game currencies, and other similar instruments. A more detailed review of the draft law was presented by Belomyttseva (2015, p. 55).

The draft also provided for the establishment of a mechanism for blocking information resources, which spread information conducive to the release of money surrogates and transactions involving them. The Russian Ministry of Communications is expected to block suspicious sites based on the decisions of the Bank of Russia.

The draft identified four categories of administrative violations in the Russian Federation related to the issuance and circulation of money surrogates: emission of money surrogates; creation and distribution of software to issue money surrogates; deliberate dissemination of information conducive to the release of money surrogates and transactions involving them; and the turnover of money surrogates. Penalties for these violations range from five to fifty thousand rubles for citizens, from twenty to one hundred thousand rubles for officials, and from ten thousand to one million rubles for legal entities. It should be noted that it would be rather difficult to evidentiate the offense of Bitcoins' issuance due to juridical uncertainty.

Russia's stance on Bitcoins is unique. In our opinion, it is too categorical and does not take into account the prospects for the development of virtual currency and payment systems. There is even the likelihood that the draft federal law on money surrogates will not be passed by the Duma in 2015, creating the need for an immediate solution to the problem related to the definition of virtual currencies in the Russian legislation.

However, some controversial changes related to the regulation and issuance of virtual currencies occurred in the Russian Federation in September 2015. First, in late September, the Russian payment system QIWI declared the intention to issue its own virtual currency called "BitRuble" (i.e., a Bitcoin analogue) in 2016. Second, the Bank of Russia announced that a special working team focused on studying the blockchain technology had been created. The Ministry of Finance of the Russian Federation then made it clear that it would be necessary to introduce criminal responsibility for the virtual currency–ruble exchange. The draft law is expected to be submitted to the State Duma of the Russian Federation before the end of the 2015 autumn session. Thus, in Russia we can observe a strong interest in virtual currencies demonstrated by market players. Nevertheless, the market regulators' actions can still characterized as inconsistent and uncoordinated. For countries with a loyal or neutral stance on virtual currencies, this issue has always been and remains on the agenda.

Thus, in our view, there are two reasonable approaches to defining Bitcoin in legislation. The first is based on the concept of currency and makes it possible to suggest the term "virtual currency" for Bitcoin. The other, which is based on the concept of electronic money, assumes the existence of non-fiat currencies and introduces the term "private electronic money." In this case, the first approach is certainly easier, has been approved worldwide, and is likely to cause less controversy, although the alternative is also interesting.

3.1 Bitcoin as Virtual Currency in Russia?

When discussing the opportunity for virtual currency to be defined in Russian legislation, we encounter some difficulties. Namely, we need a systemic interpretation of article 75 of the Constitution of the Russian Federation (1993), article 140 of the Civil Code of the Russian Federation (1994), article 27 of the federal law "On the Central Bank of the Russian Federation (Bank of Russia)" (2002), and article 1 of the federal law "On Currency Regulation and Currency Control" (2003). The Constitution of the Russian Federation (1993) and the federal law "On the Central Bank" (2002) define ruble as the currency of the Russian Federation while the Civil Code of the Russian Federation (1994) identifies currency with money, not giving a definition for either of them. Only the federal law "On Currency Regulation and Currency Control" (2003) specifically defines currency, acting as a basic legal act in the field of currency legislation. This document defines the types of currency (currency of the Russian Federation and foreign currency) and a limited list of instruments (currency in the form of banknotes, coins, and facilities on bank accounts and deposits), which are the currency of the Russian Federation and foreign currency, respectively. In this case, the legislation lacks an actual definition of currency that would determine which features should satisfy currency or its alternative in order to be considered as such.

Due to this conflict of laws, defining virtual currency within the existing currency legislation is impossible and requires specification of the concept of currency in the federal law "On Currency Regulation and Currency Control" (2003).

4 Bitcoin and Electronic Money

The first electronic money was issued in the 1990s, while the concept itself emerged in the 1980s. The EU first attempted to regulate electronic money in 2001. The European Commission provided a brief definition of electronic money: "a digital equivalent of cash, stored on an electronic device or remotely at a server" (European Commission, 2010). According to a more detailed definition from Directive 2009/110/EC of the European Parliament and of the Council (2009), electronic money is:

> electronically, including magnetically, stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions ..., and which is accepted by a natural or legal person other than the electronic money issuer.

The definition of electronic money in the Russian Federation is slightly different from that accepted in Europe. It appeared in the legislation of the Russian Federation quite recently—namely, in 2011—with the adoption of the federal law "On the National Payment System" (2011), while Yandex.Money, a popular system in Russia, was launched as early as 2002. According to the federal law from 2011, electronic money is transferred by one entity to another entity that keeps accounts of the information provided about the amount of money without opening a bank account in order to fulfill the monetary obligations of the entity that transferred the funds to third parties. Depositing a client's funds with an operator in a particular currency usually precedes the generation of electronic money. The involvement of a single emission and processing center is also possible. Payments in electronic money systems are carried out in well-known world currencies. Thus, electronic money is a digital means of expressing fiat currency. Only its form of existence, which is similar to that of Bitcoin, can be considered new. Consequently, electronic money cannot claim the status of an independent currency.

In the context of Bitcoin, the definition of electronic money can appear necessary if we concede that private money exists. Private money can be defined as non-state fiduciary money issued into circulation by private organizations and can be compared to Bitcoin based on its non-state status. The idea that private entities should issue and regulate currencies has been repeatedly expressed in economics, particularly by representatives of the Austrian School M. Rothbard, F. Hayek, and M. Friedman in separate proceedings. According to Rothbard (2010), money must be issued by private organizations on a competitive basis along with all other goods. Hayek (1990), in his work *Denationalisation of Money*, assumed that it was possible to denationalize money and keep the state from issuing money and taking control of the banking sector. Milton Friedman and Anna Schwartz (1986) claimed that "leaving monetary and banking arrangements to the market would have produced a more satisfactory outcome than was actually achieved through governmental involvement" (p. 59).

In our opinion, Bitcoin can be defined as a unique hybrid of private and electronic money, where both existed for a long time apart from each other. This interpretation implies that changes need to be made to the Russian federal law "On the National Payment System" (2011).

5 Prospects for Bitcoin

In February 2015, the research company Juniper Research released the study "The Future of Cryptocurrency: Bitcoin & Altcoin Impact & Opportunities, 2015–2019." The company estimated that the volume of transactions using virtual currency will decline by more than half—from $71 billion (in 2014) to $30 billion from (in 2015) (Juniper Research, 2015)—due to the problems related to virtual currency exchanges, Bitcoin theft, and regulators' concerns about the use of virtual currency in the illegal market. Moreover, according to Juniper Research, the growth in Altcoin (a virtual currency alternative to Bitcoin) transactions in 2014 emerged mainly due to a brief burst of activity in Dogecoin, Litecoin, and Auroracoin in the first quarter of 2014, which then came to nothing. By the end of the year, the volume of such transactions in dollars was less than 5% of the volume at the beginning of the year.

Juniper Research emphasized the role of the developments and progress related to virtual currency as well as the field of online payments on the whole. Ripple Labs (the developer of Ripple protocol for international financial transfers) has already focused on further work, and we will be able to see the evolution of other players in the virtual currency market over the medium term.

According to Vigna and Casey (2015, p. 295), decentralized virtual currencies do have a future and can solve some major problems. For instance, they dispel much of the enormous cost that a bank-centric model of payments imposes on the global economy. In addition, virtual currencies could bring millions of people excluded from that payment system into the global economy. Finally, they promise to hold whole classes of middlemen, centralized institutions, and government agencies accountable as never before.

Hileman (2015, p. 92) proposed the need to calculate and estimate the Bitcoin Market Potential Index as a new composite indicator that conceptualizes and ranks the potential utility of Bitcoin across 178 countries to show which countries have the greatest potential to see Bitcoin adoption. Today, only Argentina occupies the leading position within this ranking.

6 Conclusion and Discussion

This analysis of the major regulators' viewpoints on virtual currencies has shown no undivided opinion or clear-cut definition of virtual currencies and Bitcoin. The issue of whether Bitcoin can be considered money is still widely disputed. The author supports the viewpoint of Bal (2014, pp. 67–68), who stated that Bitcoin can be regarded as money in the economic sense but does not meet the definition of money in the legal sense. This approach is consistent and reflects the actual status of virtual currency.

It is possible to determine two well-founded approaches to defining Bitcoin in legislation. One is based on the concept of currency and enables us to associate Bitcoin with virtual currency. The other is based on the concept of electronic money and introduces the term "private electronic money," which is applied to Bitcoin.

Reviewing Russian legislation has revealed the absence of a definition of virtual currency and a conflict in the laws, making the definition of virtual currency as well as Bitcoin next to impossible. Solving this problem requires specifying the concept of currency in the federal law "On Currency Regulation and Currency Control."

Yet Bitcoin is likely to have significant potential for development in the next decade. The major problem now is precisely its legalization and lack of new legislation defining the concept of virtual currency or "private e-money," especially in Russia. In the short term, Bitcoin or its equivalent is unlikely to rival the ruble, but can be used, for instance, as a parallel currency. The legalization of virtual currencies should be followed by changes in the tax system. As virtual currencies bear some features of a tax haven (namely, there is no jurisdiction in which they operate and the accounts are anonymous; Marian, 2013, p. 42), it is essential to determine the basic principles of taxation on incomes derived from operations involving virtual currencies and integrate these principles into Russia's tax system. This requires further research.

The issue of fraud counteraction and protection of investors' rights still induces much discussion and is likely to become the focus area of interdisciplinary studies in the next few years.

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Konceptualni okvir za definicijo in regulacijo virtualnih valut: mednarodne in ruske prakse

Izvleček

V prispevku analiziramo možne definicije virtualnih valut v zakonodaji in ekonomiji. Proučujemo vidike Evropske centralne banke, urada Financial Crimes Enforcement Network in organizacije Financial Action Task Force o virtualnih valutah. Analizirali smo tudi osnutek zakonodaje o prepovedi denarnih surogatov v Ruski federaciji. Avtorica prispevka predlaga dva sprejemljiva pristopa za definiranje virtualnih valut v pravu in ekonomiji. Podajamo tudi pregled argumentov predstavnikov avstrijske šole o obstoju zasebnega denarja. Avtorica prispevka predlaga uvedbo nekaterih sprememb v zakonodaji Ruske federacije, da bi virtualnim valutam podelili legalni status.

Ključne besede: virtualna valuta, bitcoin, elektronski denar, zasebni denar, denarni surogati

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Primer 2a: Engle and Granger (1987) present critical values also for other cointegration tests.

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