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Measuring On-shelf Availability of FMCG Products

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Abstract: *Technological development and the process of globalization influence the increase of customers' awareness. In these circumstances they are becoming more demanding, expecting retailers to offer them the right product at the right time and at the right place. The result is one of the basic tasks of retailers, which reflects in providing an adequate level of product availability in retail stores. In order to prevent the stock-out situation, special attention should be dedicated to its identification and measurement. These operations are very important for establishing and implementing other various measures for increasing product availability and thus sales and competitiveness of retail companies. In this regard, besides theoretical considerations of product availability, we presented the basic methods for its measurement. Also, by using the sample of six Fast Moving Consumer goods categories, we applied the method based on the analysis of POS data. In addition to identifying the out-of-stock rates, we confirmed the results of other studies that product availability varies among different categories and retail stores.*

Key words: *product availability, measuring, product category, retail store*

Merenje dostupnosti proizvoda svakodnevne potrošnje

Apstrakt: *Sa tehnološkim razvojem i procesom globalizacije, povećava se i informisanost kupaca. U takvim uslovima, kupci postaju sve zahtevniji, očekujući od maloprodavaca da im ponude pravi proizvod, u pravo vreme i na pravom mestu. Iz toga proizilazi i jedan od osnovnih zadataka maloprodavaca koji se ogleda u obezbeđivanju adekvatnog nivoa dostupnosti proizvoda u*

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maloprodajnim objektima. U cilju sprečavanja nedostatka zaliha, posebnu pažnju treba posvetiti njegovom identifikovanju i merenju. Na taj način, stvara se osnova za preduzimanje različitih mera povećanja dostupnosti proizvoda, što se pozitivno odražava na prodaju i konkurentnost maloprodajnog preduzeća. S tim u vezi, u radu smo, pored teorijskog razmatranja dostupnosti proizvoda u maloprodaji, predstavili i osnovne metode njenog merenja. Takođe, na uzorku od 6 kategorija proizvoda svakodnevne potrošnje primenili smo metodu zasnovanu na analizi POS podataka. Pored identifikovanja stopa nedostatka zaliha, potvrdili smo i rezultate drugih studija da se dostupnost proizvoda razlikuje među različitim kategorijama i maloprodajnim objektima.

***Ključne reči**: dostupnost proizvoda, merenje, kategorija proizvoda, maloprodajni objekat*

1. Introduction

In terms of expressed competitiveness, retail companies adjust their offer to the needs and requirements of their customers by assuring the right product, at the right time in the right place. However, according to Kotler & Keller (2012) this objective provides little practical guidance. These authors (2012) see the problem in the absence of a system that can simultaneously maximize customer service and minimize distribution cost.

In retail sector with the increase of inventory levels, better customer service can be achieved (Wild, 2002). Higher number of products in stock in retail stores increases the possibility that the customer will find and buy the desired product (Ton & Raman, 2010). Positive impact of higher inventory levels on sale has been confirmed by the results of several studies (Dubelaar, Chow & Larson, 2001; Cachon & Terwiesch, 2006; Koschat 2008, Balakrishnan, Pangburn & Stavrulaki, 2008). In relation to this, the out-of-stock situation (OOS) can cause significant negative consequences, not only for retailers, but also for other entities in the supply chain. Besides lost sales, which according to Hausruckinger & Rackebrandt (2003) amount to 14% of total sales, the stock-out problem can decrease the store and brand loyalty (Musalem, Olivares, Bradlow, Terwiesch & Corsten, 2010) and cause operational issues of purchase and marketing efforts in the supply chain (Ehrenthal, Gruen & Hofstetter, 2014).

However, holding inventories has its price too. With the increase of inventory level, the inventory carrying costs (which include storage charges, cost of capital, taxes, insurance, depreciation and obsolescence) increase as well. According to 25th annual state of Logistics Report of CSCMP organization (Council of Supply Chain Management Professionals), the total value of business inventories in 2013, in the United States amounted $ 2.459 trillion, while the cost of their holding had a value of $ 469 billion (Schulz, 2014). In the Republic of Serbia in the same year, business inventories accounted for 9.71% of the total business assets with the value of $ 14.6 billion (The Serbian Business Registers Agency, 2014). This percentage is even higher in the trade sector (18.9%), where the value of business inventories in 2013 totalled $ 5 billion. If we assume that holding costs range from 20-30% of the value of the inventories (Stancic, 2006), they amounted to $ 1-1.5 billion in the trade sector of the Republic of Serbia in 2013. In addition to these costs, we should not neglect the setup (ordering) costs, which include all the costs associated with preparing, sending and receiving orders. These are mainly the costs of administrative nature which does not depend on the ordered quantity.

In the circumstances where both stock-outs and too large inventories impose additional costs, retail managers should pay special attention to their analysis. In fact, one of the key steps in optimizing inventory levels refers to measuring on-shelf product availability in retail stores. Therefore, besides basic indicators, in this paper we have presented the most commonly used availability measuring methods. Bearing in mind that this issue is especially important in Fast Moving Consumer Goods (FMCG) industry (Gruen & Corsten, 2002), we applied the POS estimation method and calculated OOS rates for several FMCG categories. In addition we investigated the existence of differences in out-of-stock rates between different stores and product categories.

2. Retail Product Availability

Along with customer relations, product availability represents one of the main aspects of customer service (Wild, 2002). According to Grant, Lambert, Stock & Ellram (2006) it can also be defined as the customer service output of a successful supply chain system. By increasing its level, service quality level in retail stores rises, which has positive impact on customer satisfaction and thus, retailer business performance.

Product availability is usually connected with firm's ability to satisfy customer demand. In this regard, Wild (2002) calculates availability as:

$$\text{Availability} = \frac{\text{Demand satisfied}}{\text{Total demand}}, \qquad (1)$$

Bearing in mind the type of demand, product availability can be measured in two different ways (Wild, 2002). If the order consists of a single product, availability can be defined as the quotient between total number of items supplied and total number of items ordered. However, in the case of a multiple product order, it represents the percent of the total number of complete orders supplied in the total number of orders.

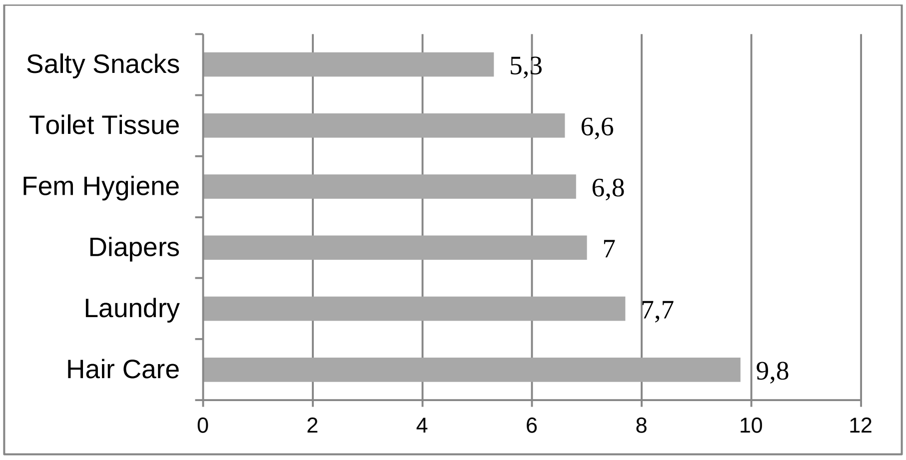
Following the same approach, Chopra & Meindl (2004) distinguish product and order fill rates, as availability indicators. While order fill rate represents the fraction of orders that are filled from available inventory, product fill rate is equivalent to the probability that product demand is supplied from available inventory. Because all products must be in stock for an order to be filled, the order fill rate tends to be lower than product fill rate. Besides these two indicators, Chopra & Meindl (2004) enhance the importance of the cycle service level (CSL) as the third availability measure. This indicator represents the fraction of replenishment cycle (the interval between two successive replenishment deliveries) that ends with satisfied customer demand. The CSL value of 80% means that in 8 out of 10 replenishment cycles, all customer demands have been met (there was no stock-out situations).

In many studies (Roland Berger Consultants, 2003; Fernie & Grant, 2008; Ettouzani, Yates & Mena, 2012), product availability in retail stores was analyzed and described through out-of-stock (OOS) problem. According to Gruen & Corsten (2007) the OOS event occurs when, for some contiguous time, an item is not available for sale as intended. From spatial aspect, these authors (2007) differentiate two kinds of OOS events: shelf and store OOS. While in the case of shelf OOS event, product can be physically present in the store, but not in the right position on the shelf, store out-of-stock event implies the situation where the item is physically absent from the retail store. For measuring OOS events (both store and shelf), Gruen & Corsten (2007, p. 3) suggested the use of following OOS attributes (i.e. measures that can be calculated and reported as OOS rates):

- Item OOS Event Rate (the number of OOS events for an item over a given unit of time);
- Category OOS Event Rate (The number of items in the category that are OOS at the time the measurement expressed as a percentage of the total number of items intended for sale);
- OOS Duration Rate (During a given measurement period, the total time that the item is OOS / the total selling time available);
- Shelf Availability Rate (100 percent - OOS Duration Rate);
- OOS Lost Unit Sales Rate (The total sales unit losses due to OOS / (the total number of sales units sold + the total sales unit losses));
- OOS Sales Loss Rate (The total monetary sales volume losses due to OOS / (the total sales + the estimated dollar sales losses));
- OOS Customer Impact Rate (1 – [(the number of estimated baskets the item would have appeared - the actual number of baskets the item appeared) / the number of estimated baskets the item would have appeared]).

In addition to these attributes, the most commonly used availability measure is the OOS rate which according to IGD (2004) represents "the percentage of Stock Keeping Units being unavailable on the retail store shelf at a particular moment in time" (as cited in Ettouzani et al. 2012, p. 215). This indicator is complementary to on-shelf availability rate (OSA), with their total sum of 100%. According to Gruen, Corsten & Bharadwaj (2002) the average OOS European level is estimated at 8,6%. Among countries, the OOS rate varies from 4% in UK, 5% in Netherlands, 7% in France and 12% in Italy (Roland Berger Consultants, 2002; Sloot, Verhoef & Franses, 2005; ECR AP, 2012). On the other hand, results of the field study conducted by Ehrenthal & Stolzle (2013), which included several European retail stores, pointed to much lower OOS rates (2,15%). Besides these differences, OOS rates vary among product categories and stores as well.

Figure 1. OOS Averages by Category



Source: Gruen et al. 2002

Among 18 FMCG categories in 40 studies, the lowest average out-of-stock rate was identified at salty snacks category (5,3%). On the other hand, hair care product category had the highest OOS rate of 9,8%. Ehrenthal & Stolzle (2013) have also confirmed that the OOS rates differ among product categories. According to their research, the stock-out levels varied between four categories: fresh food (2.9%), food (1.1%), near-food (0.5%) and non-food (4.4%).

In addition, following Roland Berger Consultants (2003), out-of-stock levels vary among different and same types of store formats. Following their study, some stores perform 6 to almost 7 times better than others in this respect.

3. Product availability Measuring Methods

Bearing in mind that in the case of out-of-stock of FMCG products more than 50% of buyers wouldn't make any purchase at the moment (Corsten & Gruen, 2004), retailers should strive to satisfy their demand immediately by adjusting assortment to their needs. Thus, care must be taken to measure availability at the time of "receiving the order", without the opportunity to fill the demand later (Wild, 2002). Because of this out-of-stock on retail shelf is much more difficult to measure than store out-of-stock (Dimitrios & Papakiriakopoulos, 2006), which can be confirmed by simple analysis of inventory records. According to Roland Berger Consultants (2003), there are two main methods for measuring out-of-stocks: manual and POS estimation method. In both cases, retailers can engage either their own employees and in-house systems, or specialized third-party service providers. Afterwards, Gruen & Corsten (2007) proposed the third "PI" measurement method.

Manual method. The first, traditional method is based on periodic checks of displayed product categories. The main task of engaged personnel is to identify shelf gaps usually with the help of hand-held scanners (Grünblatt, Werke & Schwartau, 2006). Gruen & Corsten (2007) define this gap as hole or "item that has a shelf tag or otherwise should have inventory on the shelf according to the planogram for that category, but there is no inventory for that item on the shelf visible to the shopper" (p.14). By using manual method the OOS rate is calculated as the percentage of "holes" at the particular moment in time.

Angerer (2005) used this approach in his study. Five students were engaged to count OOS incidents in 10 stores during two weeks period. Shelf availability of 100 different FMCG products was checked twice a day, once in the morning and once in the evening. Weekly OOS rate for each product was calculated as quotient of number of times when an item was absent from the shelves and total number of checks during that week, i.e. for example if an item wasn't present on the shelf two times in the first week, the out-of-stock rate is 16,6% (2 stock-outs divided by 12 checks, as during six days two daily measures were conducted).

Gruen & Corsten (2007) segregated four primary advantages of this measurement method: reliable benchmarks for comparison, believing results, approximation of lost sales and cost-effectiveness. In addition, these authors (2007) pointed to some limitations of this approach, such as:

- inability in measuring either the lost revenue or consumer impact of each OOS;
- unbalanced selection of product categories under supplier influence;

- problems with frequency and timing of the audits, where peak business hours and weekends are often missed;
- short duration of the audit (determined by the budget);
- labour intensive audits where accuracy can be diminished by unavoidable counting and other human errors;
- prohibitive overall costs for sustained measurement (depending on frequency and duration of the audit);
- the method is unfeasibly scalable to a large number of categories or a large number of stores.

According to Grünblatt et al. (2006), besides store checks OOS information can be collected with consumer surveys and household panels as well. At cash register zones consumers can be asked about items they wanted to buy, but are unavailable on the shelves. In this way retailers can record OOS items on the date of the survey. In addition, test households can be engaged in order to collect the information that is required for identifying and measuring out-of-stocks. However, long time and large costs occur as one of the main disadvantages of these approaches.

POS estimation method. The second measurement method is based on the use of POS sales and inventory data. By its implementation, the OOS rate is calculated as the number of times the consumer does not find the item on the shelf divided into the sum of the times the consumer find the item plus the number of times the consumer does not find it (Gruen & Corsten, 2007). This, as many other approaches established by retailers, consultants and academics has been set on the principles of estimating lost sales. Main advantages of these methods compared to manual reflect in automatic data collation, longer duration and frequency, higher accuracy and possibility to enable a much more detailed root causes and to focus on OOS items that are impacting shoppers the most (Hausruckinger, 2006; Gruen & Corsten, 2007).

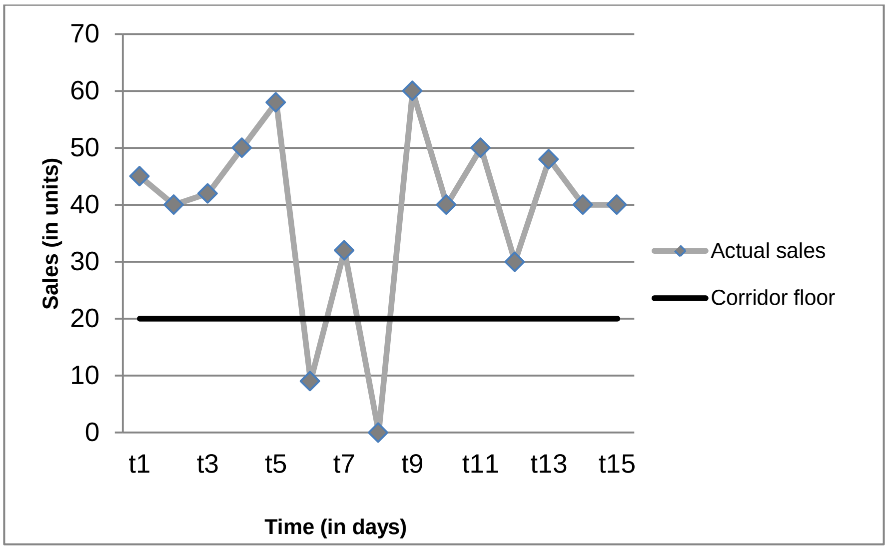
Within the “ECR Europe” organization, Hausruckinger (2006) developed a method of measuring OOS rates on the basis of the following POS data: product EAN, product name, international location number, product sales (in units) and date of sale. For successful implementation of this approach two main principles must be considered:

- data analysis and identification thresholds,
- sales pattern recognition.

According to Hausruckinger (2006), inventory turnover (measured in terms of units sold per period of time, per product or per store) and volatility (measured through variation coefficient) represent factors which supply specific thresholds. Products that are ideally suited to this model are one with high inventory turnover and low volatility.

For distinguishing expected and unexpected sales patterns, sales graphs can be used. Corridor floor for each product is calculated as average sales per product minus twice the standard deviation. Special attention should be dedicated to the quality of the underlying data, which retention period should be as long as possible. In some cases sales patterns should be analyzed for specific days of the week, or even times of day. If actual sales fall below corridors floor, it can be the signal of an OOS situation.

Figure 2. Corridor floor and OOS situations



Source: Hausruckinger, 2006

As presented in Figure 1, out-of-stock occurred two times (on days 6 and 8). Following Hausruckinger (2006), out-of-stock rate, i.e. OOS index, can be calculated by using the following formula:

$$\text{OOS index} = \frac{\text{Lost sales (in units)x 100}}{\text{Expected sales (in units)per period}} \quad (2)$$

In relation above, lost sales occur as a difference between average and actual sales. On the other hand average sales figure is used as expected sales figure.

The main disadvantage of this approach corresponds to the narrow range of its implementation. With POS measurement method on-shelf availability can be successfully measured only for a small number of FMCG products that have low sales volatility (Papakiriakopoulos, Pramatari & Doukidis, 2009).

Besides this, the major limitations of methods based on POS data include (Gruen & Corsten, 2007):

- low applicability for products that sell slowly,
- based on historical sales patterns, poor predictions can lead to low accuracy,
- initial set up costs are high,
- low trust of store managers because of its mathematical estimations.

In order to exceed these limitations, Papakiriakopoulos & Perpetual (2011) developed special mechanism for identifying and measuring out-of-stocks. They used two different classification algorithms relied on data mostly provided from retailers POS systems and tested them in four Greece retail chains.

Besides manual and POS estimation method, there are many other approaches and techniques for measuring product availability. The implementation of "PI" measurement method (based on the use of Perpetual Inventory data) and the use of RFID technology are one of them. But as PI data can only be used for identifying store and not shelf OOS (Gruen & Corsten, 2007), while RFID technology is not yet able to guarantee the reliable ascertainment of shelf stocks (Grünblatt et al. 2006), the first two methods are still prevalent in practice.

4. The Implementation of POS Estimation Method

As measuring represents one of the key steps in decreasing negative effects of stock-out situations (Roland Berger Consultants, 2003; Gruen & Corsten, 2007; Trautrims, Grant, Fernie & Harrison 2009; Papakiriakopoulos & Perpetual, 2011), in this paper we have identified OOS rates for several FMCG categories. For this purpose we have used the POS estimation method, with accuracy, according to Gruen & Corsten (2007), is 85% or higher. Another extenuating circumstance for the implementation of this method is related to the fact that POS information systems are becoming the inseparable part of retailers' daily operations.

However, bearing in mind the limitation of this method, related to the narrow range of its implementation (Papakiriakopoulos et al. 2009), for calculating indicators in formula (2) we have used additional features proposed by Papakiriakopoulos & Doukidis (2011). In addition, to product categories, subjects of the analysis were retail stores as well.

4.1. Methodology

In this paper we applied the POS estimation method on six FMCG categories, which have been analyzed in several OOS studies and reports (Gruen, et al. 2002; Roland Berger Consultants, 2003; ECR France, 2007): salty snacks, chocolates, coffee brands, waters, soaps and detergents. The research was conducted in four hypermarkets of one of the leading retailers in the Republic of Serbia. In cooperation with its supply chain director, within each FMCG category, we chose several products concerning their market share and importance for customers. Therefore, our sample consisted of 30 FMCG products (6 salty snacks, 5 chocolates, 6 coffee brands, 4 waters, 5 soaps and 4 detergents), all available (listed) in selected hypermarkets.

With the help of retailer's ERP information platform connected with stores' POS terminals we gathered the required POS data for 2013. Besides product daily sales, from all hypermarkets we took the data related to product inventory levels and their changes as well. Consequently, we used the obtained data in POS estimation method and calculated out-of-stock rate for each FMCG product in each hypermarket.

By using OOS rates of different products from all stores, we estimated the average OOS level and median for each FMCG category and compared it with the results of similar researches. Bearing in mind that in most reports and studies (Gruen et al. 2002; Roland Berger Consultants, 2003; ECR France, 2007), out-of-stock rates and their differences between product categories and between retail stores, were only presented, in this study we have tested them by using the following hypotheses:

H1: There is statistically significant difference in out-of-stock levels between different FMCG product categories.

H2: There is statistically significant difference in out-of-stock levels between different retail stores.

Since we are determining the existence of statistically significant difference between more than three groups of an independent categorical variable (FMCG categories or hypermarkets) on a continuous dependent variable (out-of-stock level), where normality assumption does not have to be met, following Berenson, Levine & Krehbiel (2011), for testing both hypotheses we have used Kruskal Wallis H test. In the case of FMCG categories, there are six different groups (categories): salty snacks (24 products), chocolates (20 products), coffee brands (24 products), waters (16 products), soaps (20 products) and detergents (16 products). On the other hand, in the case of hypermarkets we have four groups, where each group (hypermarket) consists of 30 FMCG products: 6 salty snacks, 5 chocolates, 6 coffee brands, 4 waters, 5 soaps and 4 detergents.

However, as Kruskal-Wallis H test cannot tell which specific groups of independent variable differ significantly from one another, following Sudarević & Radojević (2014) for comparing differences between two groups we used series of Mann-Whitney U tests. All analyses were conducted in statistical software SPSS 20.0.

4.2. Results and discussion

After calculations, total average OOS rate of sampled products amounted 2,93%, whereby median value equalled 0. Average out-of-stock levels and medians for different product categories are presented in the following Table.

Table 1. OOS rates - Categories

Categories	N	Mean OOS	Median
Salty Snacks	24	0.31	0.00
Coffee brands	24	0.61	0.00
Chocolates	20	0.88	0.00
Waters	16	1.01	0.62
Soaps	20	5.68	2.37
Detergents	16	11.38	2.16
Total	**120**	**2.93**	**0.00**

Source: Authors' calculations

Among analyzed categories, salty snacks have the highest level of shelf availability with average OOS rate under 0,4%. Two more categories (chocolates and coffee) also have out-of-stock rates under 1%. On the other hand, the lowest levels of shelf availability are recorded at soaps and detergents, which average OOS rates exceed 5% (5,68% and 11,38% respectively).

Compared to the average European FMCG out-of-stock rate of 8,6% (Gruen et al. 2002), the obtained OOS levels are substantially lower. They are more similar to the results of Ehrenthal & Stolzle (2013), in which the average OOS rate was also under 3% (2,15%). Significantly lower mean out-of-stock levels in relation to previous researches, according to the authors above (2013, p. 65) indicate "that the causes of stock-outs are likely to be retailer and store-specific". In relation to this, our research was conducted in hypermarkets, which according to several studies (Fernie & Grant, 2008; Aastrup & Kotzab, 2009), because of better space allocation possibilities, have higher product availability levels than smaller stores.

Similar to mean OOS levels, salty snacks, coffee brands and chocolates have the lowest out-of-stock median (0) as well. Opposite to these FMCG categories, for detergents and soaps, they amounted 2,16 and 2,37, respectively. In order to additionally examine differences between sampled FMCG categories, we have used Kruskal Wallis H test.

Table 2. Kruskal Wallis Test - Categories

	OOS
Chi-Square	36.436
df	5
Asymp. Sig.	0.000

Source: Authors' calculations

As presented in Table 2. Kruskal-Wallis H test shows that there is statistically significant difference in out-of-stock rates between different product categories, $\chi^2(5) = 36.436$, $p = 0.000$, which confirms hypothesis H1. Mean rank for salty snacks is 41.5, for chocolates 45.25, coffee 53.77, water 63.06, soaps 89.68 and for detergents 79.13 (See Table 3).

Table 3. Ranks – product categories

	Categories	N	Mean Rank
OOS	Salty Snacks	24	41.50
	Chocolates	20	45.25
	Coffee	24	53.77
	Waters	16	63.06
	Soaps	20	89.68
	Detergents	16	79.13
	Total	**120**	

Source: Authors' calculations

In addition to Kruskal Wallis Test, differences in OOS rates between specific FMCG categories have been examined by the use of Mann-Whitney U test. Its results are presented in Table 4.

According to these results, it can be concluded that salty snacks (U=48, p=0.000), chocolates (U=58, p=0.000), coffee brands (U=79, p=0.000) and waters (U=74, p=0.006) have statistically significant lower OOS levels than soaps. Significantly lower out-of-stock levels are also recorded at salty snacks (U=89, p=0.001), chocolates (U=80, p=0.004) and coffee brands (U=113, p=0.002) compared to detergent category. Therefore, as other studies (Gruen et al. 2002; Ehrenthal & Stolzle, 2013), these results have also shown that non-food categories are more problematic from the availability aspect than food categories.

Table 4. Mann-Whitney U test – product categories

Categories		**Mann-Whitney U test**		
		U	**z**	**p**
Salty snack	Chocolates	228	-0.421	0.674
	Coffee	217	-1.823	0.068
	Waters	114	-2.588	0.010*
	Soaps	48	-4.838	0.000*
	Detergents	89	-3.338	0.001*
Chocolates	Salty snacks	228	-0.421	0.674
	Coffee	198	-1.198	0.231
	Waters	107	-1.962	0.050*
	Soaps	58	-4.029	0.000*
	Detergents	80	-2.899	0.004*
Coffee	Salty snacks	217	-1.823	0.068
	Chocolates	198	-1.198	0.231
	Waters	157	-1.045	0.296
	Soaps	79	-3.877	0.000*
	Detergents	113	-2.331	0.020*
Waters	Salty snacks	114	-2.588	0.010*
	Chocolates	107	-1.962	0.050*
	Coffee	157	-1.045	0.296
	Soaps	74	-2.760	0.006*
	Detergents	89	-1.522	0.128
Soaps	Salty snacks	48	-4.838	0.000*
	Chocolates	58	-4.029	0.000*
	Coffee	79	-3.877	0.000*
	Waters	74	-2.760	0.006*
	Detergents	157	-0.096	0.923
Detergents	Salty snacks	89	-3.338	0.001*
	Chocolates	80	-2.899	0.004*
	Coffee	113	-2.331	0.020*
	Waters	89	-1.522	0.128
	Soaps	157	-0.096	0.923
* p<0.05				

Source: Authors' calculations

The explanation for this may be in their different sales frequencies, where food categories, compared to non-food, have higher average daily sales (speed of turnover rates), as well as larger shares in retailers' revenues. In relation to this, retailers are paying more attention to these products, especially bearing in mind the conditions on Serbian retail market, additionally burdened with low purchasing power (GFK, 2013) and lack of working capital (Lovreta, 2009). According to Angerer (2005), in addition to sales frequency, FMCG out-of-stock levels are also related to other product characteristics, such as sales variance, speed of turnover, price, case pack size, product size and shelf life.

Besides different product categories, we have analyzed the out-of-stock levels in different stores as well. Their average rates and medians are shown in Table below.

Table 5. OOS rates – Hypermarkets

Retail stores	**N**	**Mean OOS**	**Median**
Hypermarket 1	30	3.29	0.10
Hypermarket 2	30	1.59	0.00
Hypermarket 3	30	3.03	0.00
Hypermarket 4	30	3.80	0.77
Total	**120**	**2.93**	**0.00**

Source: Authors' calculations

While hypermarkets 1, 3 and 4 have average shelf OOS rates higher than 3%, its value in hypermarket 2 amounts 1.59%. In addition, opposite to hypermarkets 1 and 4 (where OOS medians equal 0.10 and 0.77), in hypermarkets with lower average OOS rates, 2 and 3, OOS medians are 0. As in the case of product categories, for investigating these differences, we have used Kruskal Wallis H test.

Table 6. Kruskal Wallis Test - Hypermarkets

	OOS
Chi-Square	10.362
df	3
Asymp. Sig.	0.016

Source: Authors' calculations

Like in previous analysis, Kruskal Wallis H test has confirmed the existence of statistically significant difference in OOS rates between different retail stores, $\chi^2(3) = 10.362$, $p = 0.016$; and thus H2 hypothesis. Their mean ranks are presented in Table 7.

Table 7. Ranks - Hypermarkets

Retail stores		N	Mean Rank
OOS	Hypermarket 1	30	62.52
	Hypermarket 2	30	46.13
	Hypermarket 3	30	60.98
	Hypermarket 4	30	72.37
	Total	120	

Source: Authors' calculations

By comparing mean ranks, hypermarket 4 has the largest (72.37), while for hypermarkets 1 and 3 they amount 62.52 and 60.98 respectively. The lowest rank is recorded at hypermarket 2 (46.13). For additional analyses, we have conducted Mann-Whitney U test.

Table 8. Mann-Whitney U test – hypermarkets

Categories		Mann-Whitney U test		
		U	**z**	**p**
Hypermarket 1	Hypermarket 2	324	-2.187	0.029*
	Hypermarket 3	440.5	-0.151	0.880
	Hypermarket 4	375	-1.151	0.250
Hypermarket 2	Hypermarket 1	324	-2.187	0.029*
	Hypermarket 3	337	-1.991	0.046*
	Hypermarket 4	258	-3.138	0.002*
Hypermarket 3	Hypermarket 1	440.5	-0.151	0.880
	Hypermarket 2	337	-1.991	0.046*
	Hypermarket 4	361	-1.373	0.170
Hypermarket 4	Hypermarket 1	375	-1.151	0.250
	Hypermarket 2	258	-3.138	0.002*
	Hypermarket 3	361	-1.373	0.170
* p<0.05				

Source: Authors' calculations

Following results presented in Table 8, we can conclude that hypermarket 2 has statistically significant lower OOS level than hypermarkets 1 (U=324, p=0.029), 3 (U=337, p=0.046) and 4 (U=258, p=0.002). Higher availability level in this hypermarket may be explained through better organization of in-store processes, such as ordering, forecasting and replenishment activities. According to several authors (Gruen et al. 2002; Aastrup & Kotzab, 2009; Ehrenthal & Stolzle, 2013), most out-of-stocks are caused in the store, by poor realization of mentioned activities. Different OOS levels between hypermarkets may also occur as a result of the influence of several store factors, in which Angerer (2005) includes SKU density, work intensity, store managers' experience and backroom size. Therefore, stores with higher SKU density, lower work intensity, inexperience managers and large backroom sizes may have lower levels of FMCG product availability.

5. Conclusion

In order to satisfy their customers, retailers have to provide adequate levels of on-shelf availability in their stores. If they don't succeed to accomplish this task, customers are not the only one that will be negatively affected. Negative effects of out-of-stock situations influence retailers and their suppliers as well. Sale decrease and loss of loyal customers are just some of them.

In regard to this, special attention should be dedicated to solving this problem. Before taking any actions, the out-of-stocks should be measured first. Thus, this activity occurs as the first lever in a "Coherent consumer-centric business system" developed by ECR Europe, which implementation helped in reducing

out-of-stocks by nearly 50% (Roland Berger Consultants, 2003).

Bearing in mind the importance of measuring process, special attention was devoted to its two main methods, manual and POS estimation method. While the first one is based on periodic checks of displayed product categories by store audits, the second one assumes the use of POS and inventory data. Starting from the advantages of POS estimation method, compared to manual, such as automatic data collation, higher accuracy, longer duration and frequency, we demonstrated the use of this approach on several FMCG categories in different retail stores. In addition, the differences in OOS levels between selected categories and stores were examined.

The obtained results have shown that the average out-of-stock level was much lower than the worldwide average OOS rate, which can be attributed to some retailer and store characteristics. As mean and median OOS values varied among product categories and stores, additional tests have been used.

They confirmed the existence of statistically significant differences in out-of-stock levels between them. Higher availability of food compared to non-food categories can be explained by their higher sales frequencies and larger shares in retailers' revenues. In the case of hypermarkets, higher out-of-stock levels are usually caused by poor in-store processes, including ordering, forecasting and replenishment activities.

By measuring and analyzing OOS rates among different FMCG categories and retail stores, retailers can identify those that are problematic from the availability aspect. Besides this, they can investigate the main causes of their higher out-of-stock levels. In this way, more attention could be dedicated to products and stores with low product availability levels. Therefore, measuring process represents the starting point for taking further out-of-stock reduction operations, usually related to the improvement of in-store processes. In this regard, future researches could include some additional product- and store-related factors, which analysis could improve identification of potential causes and operational solutions for out-of-stock problems.

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