

STUDY ON THE MATHEMATICAL MODELING OF THE TREASURY DEMAND WITHIN A COMPANY

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Abstract: *When analyzing a company's financial situation, a very important aspect to refer is the financial balance. If the working capital reveals the long term company's financial balance and the need for working capital refers to the short term one, definitely the most important is the company's treasury, that emphasizes the global financial balance, also representing the concrete consequence of an efficient activity throughout a certain period of time. The present study aims to analyze the treasury demand within an agricultural holding during a ten years period, using various mathematical models and methods in order to optimize its dimension. The paper involves a various research methodology such as the case study, the mathematical modeling, the induction or the deduction.*

Key words: *treasury demand, Baumol method, Miller-Orr method, Orgler method, probabilistic method*

INTRODUCTION

The treasury is a key element in analyzing the company's activity. The treasury indicator is an essential element that reflects the efficiency of the company's dynamics and, in the same time, compliance with the requirements of the financial balance [7].

The companies' finances involve many aspects in order to be analyzed, their complexity causing a cumulative amount of giant information to be observed, processed and interpreted. In order to support the specialists, over time, various theories emerged, being based on the use of mathematical tools. The predilection for this category is justified as long as the field of operational research, which is a relevant part of the applied mathematics, uses an approach based on proposing problems and solving them rationally and in a structured manner by using various complex and efficient mathematical methods. At the basis of the economic modeling, there are also a series of models, representing theoretical systems, meant to retain the essential attributes of the various phenomena and the economic processes proposed for the analysis.

By modeling, the decision-maker can opt, as a principle of choosing, either for optimization, under-optimization or satisfaction of the various decisions he has to make. In the context of this paper, both the financial stability criterion and the criterion of the effectiveness of treasury management strategies and policies will be pursued [6].

By optimizing it is desired to choose the best solution from within the set of possible solutions. By under-optimization, if taking into consideration the conceptual terminology, we can assert that we understand a partial, isolated optimization of a sequence of the optimization problem viewed as a whole. A decision-maker can also choose the "optimal" solution by using the principle of satisfaction. According to this principle, the decision-maker does not have to determine the optimal size of the decisional problem, but rather to appreciate and evaluate the importance of the problem, the importance established by a predetermined level of the values that the objective function can take [8].

This is also the case for treasury decision modeling. The problems of optimal treasury management are multiple and are characterized by strong particularities, depending on the type of activity of the company, on the managerial style, on the financial information base and so on.

The mathematical modeling of treasury management must be treated separately, depending on the volume and quality of the information available to the decision maker at each decision moment.

Thus, we distinguish: treasury management models in certainty, in which case full information is available; treasury management models under uncertainty conditions, where there is the possibility of occurrence of several events that, by their different actions, affect the treasury, whose probability of occurrence is unknown; treasury management models in risk conditions that deal with management decision-making in the conditions of the possibility of occurrence of several events affecting the treasury through the overall action in a different way, each alternative being characterized by a certain probability of occurrence [4].

MATERIALS AND METHODS

The paper aims to emphasize various methods of modeling the treasury amount within a company, using as the main research method the mathematical modeling, combined with data analysis, synthesis, brainstorming and the dynamic study. In order to achieve the goal mentioned before, it is taken into consideration within the company (from the agricultural field of activity) the treasury monthly demand for the company during a ten years period [5]. This demand is presented in Table 1.

Table 1.

The monthly treasury demand for a ten years period

Month	The treasury demand for year N	The treasury demand for year N+1	The treasury demand for year N+2	The treasury demand for year N+3	The treasury demand for year N+4	The treasury demand for year N+5	The treasury demand for year N+6	The treasury demand for year N+7	The treasury demand for year N+8	The treasury demand for year N+9
January	772	987	893	1015	1155	1425	980	1028	844	1098
February	965	1069	944	1258	1089	972	951	980	1020	906
March	1018	946	1064	980	976	770	1130	980	837	1128
April	1061	884	926	1171	1164	913	1266	1098	804	1131
May	809	1147	991	710	1065	773	940	1304	907	1062
June	1143	847	1075	974	856	977	983	940	1025	1148
July	1142	1199	942	1056	1217	998	974	884	1187	1048
August	1091	967	1064	820	944	880	1139	1042	1102	898
September	1009	976	1085	1063	750	1064	994	795	1053	788
October	1046	1087	978	1114	912	895	829	827	828	677
November	988	955	1025	1135	964	1230	963	1207	839	1130
December	881	1057	629	814	1134	959	883	960	972	993

Source: own elaboration

An initial statistical processing of the information is presented in Table 2.

Table 2.

Initial statistical processing of the information related to the company's treasury

The treasury demand		Kurtosis	33%
		Skewness	6%
Mean	995	Range	796
Standard Error	12.43	Minimum	629
Median	982	Maximum	1425
Mode	-	Sum	119352
Standard Deviation	136.16	Count	120
Sample Variance	18538	Confidence Level (95.0%)	24.61

Source: own elaboration

Also, some financial indicators necessary to be taken into consideration when analyzing the company's treasury are presented below (Table 3):

Table 3.
Financial indicators related to the company's treasury

Initial data	
Yearly average demand	99
Shortage cost	5
Interest rate	15%
Administration cost	2
Average payments for the first day in month	15

Source: own elaboration

Finally, in order to elaborate the concrete modeling, the data grouping by frequency is needed:

Table 4.
The data grouping by frequency

	Frequency
730 lei	3
830 lei	13
931 lei	18
1032 lei	40
1132 lei	27
1233 lei	15
1334 lei	3
More	1

Source: own elaboration

RESEARCH RESULTS

The Baumol model

The Baumol model is a model derived from Wilson-Whitin's inventory optimization model, folded, however, on the demand for liquidity and the need to hold a minimum level of liquidity that engages a minimum level of cost. This model is part of the treasury management within a certain environment category [10].

The Baumol model is justified in validating the following assumptions: the size of payments and receipts is known, the firm constantly transfers (at equal or different intervals) a sum of money (constant or variable), these funds do not bring earnings for the firm, the sale or the purchase of placements involves direct trading expenses, assumed to be fixed, liquidity inflows are discontinued, while liquidity outflows are continuous, the opportunity cost of cash is constant [7].

If the liquidity fund's diminution is linear, then the intervals between two transactions are equal and the amount spent is constant per unit of time. In this case, we obtain a minimum level of the treasury balance from the relation $n_{optimum} = \sqrt{2 \cdot \frac{N \cdot c_t}{D \cdot i}}$ at the

$$\text{cost } C_{optimum} = C(n_{optimum}) = \sqrt{2 \cdot N \cdot optimum \cdot i \cdot c_t} .$$

If the liquidity fund's diminution is not linear, which means that the time intervals between two consecutive payments are unequal, we point to the difference with the constant liquidity model, namely the introduction of the hypothesis of stock breakdown after a period $T_1 < T$ of at the last payment. In this case, we get

$n_{optim} = \sqrt{2 \cdot \frac{N \cdot ch_{tr}}{D \cdot i}} \cdot \sqrt{\frac{i + c_p}{c_p}}$ at a cost level expressed as it follows:

$$C_{optimum} = C(n_{optimum}, s_{optimum}) = \sqrt{2 \cdot N \cdot D \cdot i \cdot ch_{tr}} \cdot \sqrt{\frac{c_p}{i + c_p}}$$

The following notations were used: D - the analyzed period, i - the interest rate, N – the total demand level, ch_{tr} - the trading expenses, c_p - the penalty cost, s - the period without stock shortages.

The Baumol model applied on our case study could be presented as it follows (Table 5):

Table 5.

The Baumol model

Unitary feeding	364 lei
Optimum period	4
Optimum number	3
Treasury cost	15 lei
Optimum treasury	995 lei

Source: own elaboration

The Miller - Orr model

This model is a real alternative to the Baumol model, which limits the area of analyzing the optimization of the minimum liquidity level by assuming the working hypothesis that the liquidity outflows can be predicted over a period of time.

Through specific non-linear programming methods, there was achieved the minimization of cash costs through an arbitration process between the total transaction and management costs and the total cost of options, reaching the gap ratio

$$Spread = 3 \cdot \sqrt[3]{\frac{\frac{3}{4} \cdot \sigma^2 \cdot c_a}{c_d}} [2],$$

where the opportunity cost is the interest rate for the treasury

bills.

Once the optimal spread has been determined, the limits $L_{superior}$ and $L_{inferior}$ of the model are calculated. The lower boundary $L_{inferior}$ is predetermined by the decision-maker, representing a minimum accepted threshold of the treasury at the end of the day. In order to be able to cover the due payments immediately the next day, up to the collection of other liquidities, a positive threshold of the average of payments made prior to the first daily receipts in the past was chosen as the minimum threshold. As far as the upper limit of the $L_{superior}$ model is concerned, it is determined according to the relation $L_{superior} = L_{inferior} + \frac{Spread}{3} [2]$.

The Miller-Orr model starts from the assumptions that: the mean of the daily cash-flow variations is equal to 0, the variance of the random variable of the liquidity flows is positive and finite, the buying and selling of investment securities determines fixed transaction costs, inputs and outputs of cash flow follows a random statistical distribution so that any increase or decrease in liquidity is equally probable and, finally, the transactions using securities are instantaneous.

The decision rule for using this model is quite simple. As long as the treasury's level does not exceed the sum of Z^2 cash units, the cash-flows are accumulating within the company's cash volume in order to avoid the recording transaction costs [13].

However, once the volume of liquidity exceeds this spread, the company manager will place the treasury surplus in placements until it returns the treasury to the initial currency of Z units. Similarly, as the liquidity level falls below the target Z, the company will sell the held placements in a way that reduces the liquidity stock to the target of Z value. The Miller - Orr model applied on our study could be presented as it follows [3]:

Table 6.

The Miller - Orr model

Minimum treasury	15 lei
Optimum spread	293 lei
Superior level	113 lei

Source: own elaboration

The probabilistic model

In order to provide values closer to the random variation of treasury behavior, it is considered appropriate to use the information on the distribution of the treasury values' frequencies.

The probabilistic model of optimal sizing for liquidity should be treated separately, depending on the shape of the random variable. If the random variable representing the liquidity demand L takes a lot of finite values, it is said that this is a discrete random variable, whereas if this variable takes a lot of infinite values, we are talking about a continuous random variable.

Model solving is limited to determining the optimal liquidity level S_0 , which respects the dual inequality $M[C(S_0 - 1)] \geq M[C(S_0)] \geq M[C(S_0 + 1)]$, where M is the average of the random variable analyzed. By virtue of this information, the double inequality is reduced to the practical relation of determining the optimal liquidity S_0 , i.e.

$$P(X \leq S_0 - 1) \leq \frac{c_p}{c_d + c_p} \leq P(X \leq S_0),$$

where P is the function of distribution for the

random variable X liquidity demand. The average total cost of ownership or lack of liquidities is fully emphasized by the following mathematical relation:

$$C(S_0) = c_d \cdot \sum_{r=0}^{S_0} (S_0 - r) \cdot p(r) + c_p \cdot \sum_{r=S_0+1}^{\infty} (r - S_0) \cdot p(r) \quad [15].$$

In the present study, the probabilistic model is emphasized as it follows:

Table 7.

The probabilistic model

Inferior	Superior	Middle of the interval	Absolute frequency	Relative frequency	Cumulative frequency	Test	
629 lei	730 lei	679 lei	1	0.83%	0.83%	0 lei	15120 lei
730 lei	830 lei	780 lei	2	1.67%	2.50%	0 lei	12090 lei
830 lei	931 lei	881 lei	13	10.83%	13.33%	0 lei	9060 lei
931 lei	1032 lei	981 lei	18	15.00%	28.33%	0 lei	6060 lei
1032 lei	1132 lei	1082 lei	40	33.33%	61.67%	0 lei	3030 lei
1132 lei	1233 lei	1183 lei	27	22.50%	84.17%	1183 lei	0 lei
1233 lei	1334 lei	1284 lei	15	12.50%	96.67%	0 lei	2 lei
1334 lei	1435 lei	1384 lei	3	2.50%	99.17%	0 lei	1 lei
1435 lei			1	0.83%	100.00%	0 lei	35490 lei
			120			1183 lei	

Optimum treasury	1183 lei
Treasury cost	80853 lei

Source: own elaboration

The Orgler model

The Orgler model integrates the treasury within the overall framework of company strategies and policies. That is why such a model is especially useful in shaping the general strategy of the firm [3].

In order to emphasize all the essential aspects of the company's management strategy, the method of multiple linear programming proved to be the most appropriate within this issue.

The model starts from the establishment of the treasury policy planning horizon, followed by the specification of the variables, and, finally, the conferring of an outline to the treasury management strategy [13].

The mathematical program is based on four categories of variables that influence the company's treasury management, namely the payments board, the due debts board, the sale-purchase plan for the placements and, last but not least, the treasury balance.

In the hands of managers comes the task of building an objective function in order to reflect the effectiveness of the strategy for which it opts, along with a set of budget constraints [10].

CONCLUSIONS

A positive treasury balance describes a forecasted financial situation, representing the primary wish of each treasurer. However, although the company is "healthy" in terms of covering the liquidity risk, it must also be careful about the opportunities offered by the market, in the sense of investment opportunities [1].

The placements must be rigorously selected, based on a range of criteria set by each individual company. Typically, they are targeted those securities which are characterized by a higher rate of return and a minimum risk. However, in the context of a liquidity-spreading portfolio, we are talking about short-term securities, and, as a result, their liquidity is gaining real meaning [14] The return on a placement is the plus of market value obtained during the period of ownership, in relation to its initial trading price. The risk of a placement title expresses the variance of the random return in relation to the expected return \bar{R} .

The optimization of a portfolio of placements is reduced to set the structure of the portfolio, i.e. the weight of each portfolio composition title x_i , where $i = \overline{1, m}$, as portfolio was set it to m placements.

The solution to this model of the liquidity surplus fund allocation starts from several working hypotheses [12]:

- The criterion of hierarchy of efficient placements is used the "hope-dispersion" criterion;
- All placements are risky and related;
- The expected profitability of the portfolio is a variable established from the hypothesis of the problem.

That being said, it is possible to proceed to the elaboration of the specified model, which represented mathematically the program from below:

$$\left\{ \begin{array}{l} \sigma_p^2 = \sum_{i=1}^m \sum_{j=1}^m x_i \cdot x_j \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j \\ E^*(R_p) = \sum_{i=1}^n x_i \cdot E(R_i) \\ \sum_{i=1}^n x_i \cdot l_i = l^* \\ \sum_{i=1}^n x_i = 1 \end{array} \right.$$

where $E^*(R_p)$ is fixed by the hypothesis of the problem by the investor, representing the expected profitability of a portfolio of m investment titles and the minimum liquidity level accepted [11].

Taking into consideration a portfolio of five types of placements (A, B, C, D, E), we are lead to the following situations:

Table 8.

The monthly profitability of the A type of placements during the analyzed period

Month	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
January	0.144	0.113	0.146	0.140	0.115	0.164	0.167	0.150	0.133	0.151
February	0.124	0.130	0.140	0.164	0.135	0.156	0.137	0.159	0.134	0.137
March	0.155	0.135	0.189	0.142	0.098	0.131	0.132	0.149	0.141	0.139
April	0.176	0.108	0.167	0.165	0.179	0.145	0.172	0.129	0.141	0.167
May	0.174	0.139	0.198	0.121	0.124	0.153	0.126	0.115	0.140	0.166
June	0.185	0.142	0.137	0.133	0.137	0.161	0.119	0.167	0.167	0.159
July	0.106	0.153	0.183	0.120	0.165	0.153	0.164	0.159	0.160	0.164
August	0.145	0.143	0.118	0.143	0.159	0.132	0.163	0.162	0.138	0.183
September	0.172	0.143	0.161	0.149	0.167	0.188	0.194	0.154	0.176	0.156
October	0.128	0.143	0.168	0.151	0.162	0.160	0.179	0.129	0.115	0.162
November	0.136	0.177	0.188	0.144	0.123	0.151	0.176	0.175	0.161	0.187
December	0.116	0.148	0.148	0.194	0.128	0.167	0.152	0.144	0.148	0.143

Source: own elaboration

Table 9.

The monthly profitability of the B type of placements during the analyzed period

Month	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
January	0.186	0.180	0.218	0.148	0.202	0.217	0.220	0.205	0.169	0.204
February	0.185	0.203	0.183	0.203	0.199	0.189	0.158	0.228	0.183	0.203
March	0.152	0.167	0.161	0.192	0.145	0.187	0.191	0.200	0.139	0.209
April	0.195	0.172	0.183	0.193	0.208	0.188	0.183	0.191	0.203	0.227
May	0.183	0.180	0.171	0.225	0.182	0.195	0.193	0.205	0.188	0.181
June	0.196	0.203	0.198	0.209	0.183	0.175	0.172	0.169	0.179	0.188
July	0.205	0.172	0.169	0.242	0.212	0.194	0.164	0.217	0.149	0.168
August	0.187	0.194	0.174	0.186	0.170	0.233	0.156	0.186	0.183	0.168
September	0.238	0.232	0.198	0.169	0.216	0.199	0.183	0.202	0.207	0.210
October	0.172	0.188	0.163	0.184	0.176	0.198	0.195	0.163	0.188	0.212
November	0.220	0.155	0.206	0.199	0.197	0.188	0.210	0.180	0.218	0.163
December	0.191	0.179	0.185	0.188	0.172	0.195	0.154	0.161	0.182	0.222

Source: own elaboration

Table 10.

The monthly profitability of the C type of placements during the analyzed period

Month	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
January	0.080	0.117	0.091	0.103	0.106	0.102	0.107	0.091	0.087	0.094
February	0.090	0.096	0.087	0.112	0.093	0.083	0.093	0.085	0.100	0.095
March	0.088	0.110	0.101	0.093	0.113	0.088	0.087	0.104	0.113	0.110
April	0.112	0.124	0.102	0.103	0.084	0.113	0.114	0.100	0.110	0.097
May	0.119	0.086	0.101	0.097	0.117	0.119	0.087	0.091	0.117	0.108
June	0.087	0.100	0.114	0.095	0.087	0.103	0.099	0.095	0.091	0.101
July	0.103	0.109	0.097	0.100	0.121	0.079	0.101	0.096	0.093	0.107
August	0.108	0.101	0.090	0.103	0.097	0.097	0.098	0.115	0.101	0.096
September	0.102	0.104	0.068	0.099	0.103	0.100	0.100	0.110	0.114	0.088
October	0.090	0.097	0.088	0.088	0.101	0.111	0.091	0.101	0.107	0.084
November	0.111	0.108	0.106	0.098	0.101	0.111	0.095	0.105	0.096	0.103
December	0.111	0.096	0.094	0.082	0.107	0.111	0.103	0.090	0.075	0.101

Source: own elaboration

Table 11.

The monthly profitability of the D type of placements during the analyzed period

Month	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
January	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
February	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
March	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
April	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
May	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
June	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
July	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
August	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
September	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
October	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
November	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
December	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050

Source: own elaboration

Table 12.

The monthly profitability of the E type of placements during the analyzed period

Month	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
January	0.475	0.420	0.172	0.529	0.192	0.105	0.451	0.124	0.181	0.105
February	0.435	0.253	0.081	0.186	0.386	0.202	0.302	0.433	0.230	0.125
March	0.282	0.375	0.422	0.378	0.079	0.293	0.327	0.418	0.223	0.535
April	0.343	0.482	0.223	0.364	0.306	0.316	0.383	0.355	0.415	0.483
May	0.082	0.231	0.410	0.444	0.290	0.212	0.156	0.272	0.385	0.408
June	0.283	0.005	0.287	0.232	0.197	0.288	0.211	0.293	0.228	0.038
July	0.549	0.351	0.269	0.253	0.283	0.284	0.230	0.351	0.250	0.282
August	0.029	0.459	0.213	0.371	0.227	0.255	0.299	0.280	0.547	0.214
September	0.234	0.556	0.230	0.139	0.446	0.555	0.212	0.321	0.331	0.305
October	0.413	0.320	0.228	0.227	0.192	0.131	0.061	0.097	0.490	0.179
November	0.350	0.489	0.079	0.291	0.087	0.336	0.154	0.359	0.181	-0.090
December	0.225	0.272	0.572	0.296	0.341	0.245	0.261	0.368	0.130	0.391

Source: own elaboration

The average profitability of the five placements that represent parts of the portfolio is emphasized as it follows [13]:

Table 13.

The average profitability of the five placements being parts of the portfolio

Average profitability A	0.150
Average profitability B	0.189
Average profitability C	0.100
Average profitability D	0.050
Average profitability E	0.286

Source: own elaboration

The matrix of correlations generating is presented below:

Table 14.

The matrix of correlations

Matrix of correlations					
	A	B	C	D	E
A	1.000	-0.014	-0.061	-0.039	-0.096
B	-0.014	1.000	-0.040	-0.043	0.080
C	-0.061	-0.040	1.000	-0.033	0.135
D	-0.039	-0.043	-0.033	1.000	-0.145
E	-0.096	0.080	0.135	-0.145	1.000

Source: own elaboration

The conditions of derivatives and the reverse, both involved, are presented below:

Table 15.

The conditions of derivatives and the inverse

Conditions of derivatives

1.00	-0.01	-0.06	-0.04	-0.10	0.15	1.00
-0.01	1.00	-0.04	-0.04	0.08	0.19	1.00
-0.06	-0.04	1.00	-0.03	0.14	0.10	1.00
-0.04	-0.04	-0.03	1.00	-0.14	0.05	1.00
-0.10	0.08	0.14	-0.14	1.00	0.29	1.00
0.15	0.19	0.10	0.05	0.29	0.00	0.00
1.00	1.00	1.00	1.00	1.00	0.00	0.00

The reverse

0.75	-0.22	-0.16	-0.21	-0.16	0.13	0.20
-0.22	0.81	-0.08	-0.14	-0.37	0.68	0.08
-0.16	-0.08	0.68	-0.41	-0.03	-2.33	0.53
-0.21	-0.14	-0.41	0.50	0.26	-2.74	0.64
-0.16	-0.37	-0.03	0.26	0.29	4.27	-0.45
0.13	0.68	-2.33	-2.74	4.27	-32.66	4.95
0.20	0.08	0.53	0.64	-0.45	4.95	-0.93

Source: own elaboration

Finally, the optimum structure of the potential portfolio is presented in Table 16.

Table 16.

The optimum structure of the potential portfolio

x_A	22.42%	The profitability of the portofolio		20.00%		
x_B	21.52%	The risk of the portofolio		25.38%		
x_C	6.69%					
x_D	9.49%					
x_E	39.89%					
		x_A	x_B	x_C	x_D	x_E
		22.42%	21.52%	6.69%	9.49%	39.89%
x_A	22.42%	0.050	-0.001	-0.001	-0.001	-0.009
x_B	21.52%	-0.001	0.046	-0.001	-0.001	0.007
x_C	6.69%	-0.001	-0.001	0.004	0.000	0.004
x_D	9.49%	-0.001	-0.001	0.000	0.009	-0.005
x_E	39.89%	-0.009	0.007	0.004	-0.005	0.159

Source: own elaboration

In order to conclude, the treasury demand has the evolution emphasized within the figure below and, also, the portfolio consisting of the five types of placements has the optimum structure illustrated within the second figure below:

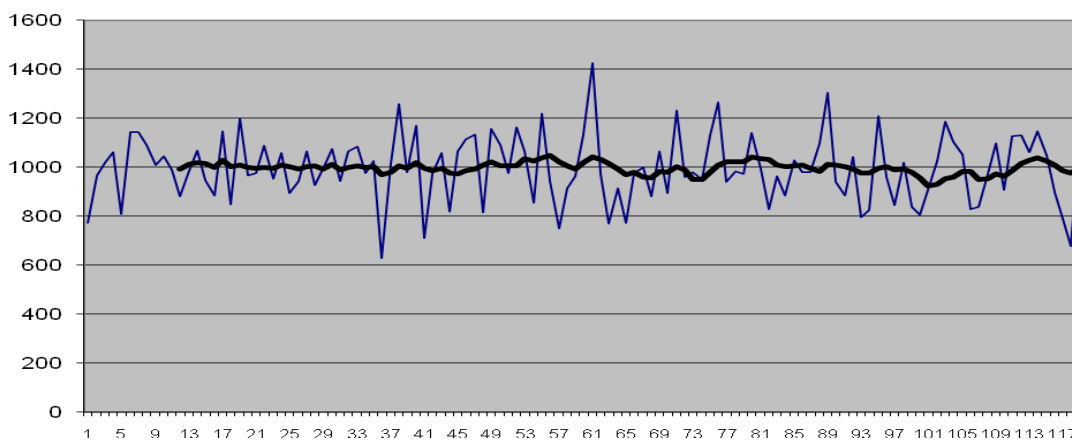


Figure 1. The treasury demand evolution

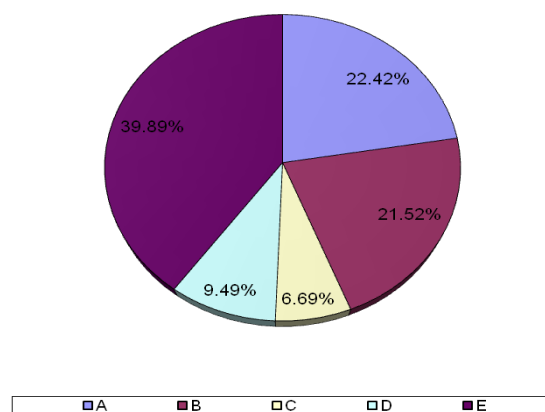


Figure 2. The structure of the potential portfolio

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