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Section 1. Marketing

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TOOLS FOR SHAPING INNOVATIVE MARKETING STRATEGIES IN THE CONSUMER GOODS MARKET

Abstract. This scientific article examines the necessity and tools of application of innovative marketing strategies in the consumer goods market. It also explains the formation of marketing strategies in the context of modernization of the economy, the possibility of identifying and incorporating into the marketing strategy innovative measures aimed at increasing economic efficiency and ensuring the company's long-term competitive advantage.

Keywords: consumer goods market, wholesale, retail, consumer goods, innovative marketing, marketing strategy, marketing planning.

Introduction

Countries with economies in transition are characterized by an underdeveloped consumer market system, which begins to slow down the development of trade relations and limits the prospects for achieving socio-economic growth. The market of consumer goods is the socio-economic basis of the national economy, on the basis of which almost all commercial activities are based.

The study of the consumer market requires any enterprise, both direct producers and sellers, on the one hand, flexibility, the ability to adapt to the effects of objective market factors, on the other hand, to look for ways to target them using various complex research methods.

The study of the consumer goods market is first of all reflected in determining the demand of the population for suitable goods. The demand study should reflect the market capacity and composition, data that help to predict possible changes in the processes of

production and consumption of goods and services [2]. The capacity of the consumer goods market is determined by the indicator of retail turnover (sales) at the district, city, regional and national levels.

From the first days of independence of Uzbekistan [3], the development of the consumer goods market, the introduction of modern methods of organizing its retail sales, the creation of equal conditions for legal entities and individuals in retail trade, regulation of trade in markets, as well as protection of rights and interests Targeted strategies are being identified.

But by the 21st century, demand and attitudes toward the factors that ensure the competitive advantage of the consumer market have changed. From the production of consumer goods, its sale, advertising, after-sales service became impossible without the intervention of information and communication and digital technologies. This process has led to the need to reconsider the tools for shaping innovative marketing strategies in the consumer goods market.

Literature review

The issues of organization and effective management of the movement of goods and materials in the production line in the conditions of innovative economy have been widely studied in the scientific work of foreign scientists. In particular, Langley C. J. studied a wide range of activities associated with the effective organization of the movement of consumer goods in the supply of raw materials on the production line. K. Oliver and M. Webber formulated the concept of business logistics as an integral tool of business management in the organization of the movement of goods and materials, as well as showed that there are significant fundamental differences in the functions of marketing and logistics in distribution channels [4]. The term Supply Chain Management began to be used in the United States in the early 1980s. The first use of the term was proposed by American designers K. Oliver and M. Webber in the framework of an integrated strategy called the delivery of raw materials to manufacturing enterprises, the management of supply chains from manufacturing to the final consumer [5].

Analysis and results

The consumer goods market includes:

- non-durable goods (food, personal hygiene products, cosmetics, detergents, etc.);
- durable items (furniture, home appliances, cars, office equipment, musical instruments, clothing, etc.);
- products obtained as a result of the provision of relevant services (individual sewing of clothes or shoes, typing on a computer, etc.).

The last link in the channels of movement of consumer goods is retail trade. Retail trade is all types of business activities related to the sale of goods and services directly to meet the individual needs of consumers.

Many manufacturing companies, wholesalers, service companies are engaged in retail trade. However, the bulk of retail sales fall on the contribution of retailers.

A retailer is an organization or individual, the main activity of which is retail.

The main volume of retail sales is in retail stores, out-of-store retail, direct sales to the consumer, and sales using vending machines.

In the course of centuries of practice in the organization of retail trade, various types of retail stores have emerged. Below is a description of the most common types of retail stores in the world practice of trade.

In self-service stores, shoppers can choose the goods they need by comparing them with each other, without using the services of sellers. This allows buyers to make purchases.

Shops with a limited level of service are those stores that provide any assistance to customers in purchasing goods. For example, providing information about goods or providing loans is typical of this type of store.

Stores with a full level of service are characterized by the assistance provided by sellers at each stage of the purchase of goods. These services, in turn, lead to higher purchase prices for goods.

The stores that sell on the basis of catalogs are well-known brands of production, offering high-quality goods at low prices, the range of which changes frequently. Here, buyers select goods on the basis of a catalog, fill out order forms for the selected goods, and make purchases in the same warehouses where the goods are placed.

In recent years, the widespread use of such types of retail trade as direct marketing by mail (direct marketing by mail), catalog-based marketing, tele-marketing, television marketing (television marketing), e-commerce (электронная торговля) has led to a wide range of consumer goods. plays an important role in meeting the demand.

Another important type of retail is vending machines. Vending machines sell cigarettes, beverages, sweets, newspapers, groceries and other groceries. There are a number of advantages to organizing sales using vending machines compared to retail stores. Vending machines operate 24 hours a day, do not require the participation of vendors, goods are less

damaged, and they require less sales space. However, due to the fact that special equipment is required to make sales here, the price of goods sold through vending machines will be 15–20% higher than the price of similar products sold in retail stores.

This whole set of tools, methods and actions, which is the process of marketing planning, is based on a single document – the strategy for innovation (also called a business plan in some companies), according to which the innovative activity of the enterprise is organized later. Marketing innovation is characterized by the introduction of constant research and constant change of needs, updating the range, giving new features to the product and achieving new levels of satisfaction, using new forms of communication, new methods of sales and delivery. The fact that the growing number of consumers in the world recognizes the quality of goods and services, their ease of purchase and consumption over price parameters encourages such research.

Recent work illustrates how ICT affects the components of the marketing mix. However, they do not fully take into account the complex impact of ICT on the elements of «8P», the creation of innovation chains that can change all components of the marketing activities of the enterprise.

As a result of the use of ICT in the implementation of marketing strategies, there is an opportunity to conduct marketing research remotely. For example, in the process of studying consumer markets, conducting surveys via the Internet, finding partners through the Internet, getting acquainted with the activities of competitors through their sites, and more.

The consumer goods market is so complex and wide-ranging that it is possible to reduce time and money spent by applying innovative tools of marketing strategy. For this reason, major consumer goods manufacturers such as Apple, Danone, Coca-Cola or consumer goods retailers such as IKEA actively use innovative tools based on ICT and digital systems in the implementation of marketing strategies [12].

Conclusion and recommendations

The development of ICT, the construction of an innovative economy requires significant changes in the organization of marketing activities for companies producing consumer goods.

Among the most important are:

- Systematic approach. In order to gain significant competitive advantages from the use of ICT, marketing is seen as an integral part of company management systems designed and implemented.
- Competence-based approach. The introduction of innovative tools implies not only the ability to collect and present marketing information, but also the ability to solve business problems in times of crisis, to respond quickly to changes in market conditions.
- Focus on innovation. The development of innovative tools in marketing activities allows to identify competitive sources at an early stage, predict the development of innovative chains, achieve competitive advantages through the application of innovative solutions in the field of services emerging in the market.

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Section 2. Mathematical and instrumental methods of economics

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Hantong Li

IMPLICATIONS OF CREDIT APPROVAL

Abstract. Since the advance of the information era, much research has been conducted to help applicants successfully apply for loans. While studies have examined financially related factors, such as income and socioeconomic status, few studies explore aspects outside the financial realm, such as gender and a few other factors. With the loan application data from the Dream Housing Finance Company, we used a logistic regression model to analyze the association between loan approval and other variables. Then, to examine the high correlation impact on the model result, a lasso logistic regression is also fitted, and the out-of-sample performance is compared. We have found that among all the factors, marriage status, the presence of credit history, and geographical locations have significant effects on the application results. In the end, the data is segmented according to male and female groups to investigate the difference in feature importance across gender. The result indicates that female applicant is additionally judged by their income and their co-applicant income, which suggests that women are still, or perceived as, financially unstable in modern society.

Keywords: Logistic regression, credit application, gender inequality.

Statistical Analysis on Credit Application

1. Introduction

Credit application refers to how a customer obtains loans from a bank. Loaning bank credit is critical in helping people make purchases over their budget. With credit loan data provided by the US Dream Housing Finance Company, we sought to investigate the important factors for credit approval [1]. To begin with, we built a logistic regression model, which allows us to compute the level of significance of multiple factors, including credit history, property area, gender, income distribution, loan amount, number of dependents, etc. To account for the high correlation among independent variables, we cross-validated the model results with a lasso logistic regression model and found that the findings are highly aligned.

Loan approval is an extensively investigated field, while many researchers focus on building models to predict the individual probability of approval. For example, in the paper *Loan Approval Prediction based on Machine Learning Approach*, Arun et al. discuss the application of advanced machine learning models, such as random forest, in credit approval prediction [2]. In terms of the applicant's characteristics, Marcelo et al. analyze the relationship between socioeconomic factors and the probability of loan approval. They find that in addition to the usual financial performance variables, business and social relationships between lenders and prospective borrowers significantly affect the likelihood of loan approval [3].

Compared to previous research on credit approval, our research models the approval probability from a

statistics perspective with careful attention paid to data cleaning and multi-collinearity. In addition, our research has extended the investigation scope to a wider range of variables, such as gender and geographical locations, and analyzed their relationship with credit approval. Additionally, the dataset was divided into male and female groups to investigate the discrepancy in influential factors across different genders. The research is thus helpful in answering the following:

1. Finding the correlation between various factors and an applicant's credit acceptance ratio;
2. Analyzing if gender plays a role among these factors;
3. Analyzing if male and female applicants' applications are reviewed on the same standard.
4. Drawing implications from the differences between how the male group and the female group are assessed.

The paper is then organized as follows: section 2 introduces the dataset; section 3 summarizes the re-

sults of an exploratory data analysis and some background research; section 4 presents and interprets the results of a logistic regression and a lasso logistic regression model; section 5 compares model performance and analyzes the model results with female/male group segmentation; section 6 concludes the paper and discusses some limitations as well as future directions.

2. Dataset

This paper has applied data provided by the US Dream Housing Finance company that deals with all home loans. Customers only apply for a home loan after the company validates the customer's eligibility. As Dream Housing Finance company has a presence across all urban, semi-urban, and rural areas, this dataset provides valuable information on all applicants in the United States. We can thus use the dataset to build a predictive model for credit approval. The dataset contains the following information about the applicants:

Table 1. – Variables contained in the dataset

Variable	Type	Description
Credit History	Binary	Whether the applicant's history meets guidelines
Property Area	Categorical	Urban/ Semi Urban/ Rural
Gender	Binary	Male/ Female
Income	Continuous	Applicants' income per month
Loan Amount	Continuous	Loan amount in thousands
Loan Amount Term	Continuous	Term of loan in months
Dependents	Categorical	Number of dependents
Loan Status	Binary	Whether the loan approved
Loan ID	–	Unique Loan ID for each applicant
Education	Categorical	Applicant's education
Coapplicant's Income	Continuous	Coapplicant's income per month
Married	Binary	Whether the applicant married
Self Employed	Binary	Whether the applicant is self-employed

3. Preliminary Analysis

This section summarizes some findings from our background research, where we completed an analysis of skewness within data and utilized the data provided to compare the approval ratios across different groups.

3.1 Exploratory Data Analysis

Before proceeding with a rigorous statistics model, we first conducted an exploratory data analysis to understand the data better. We visualized the distribution scatter plot using R:

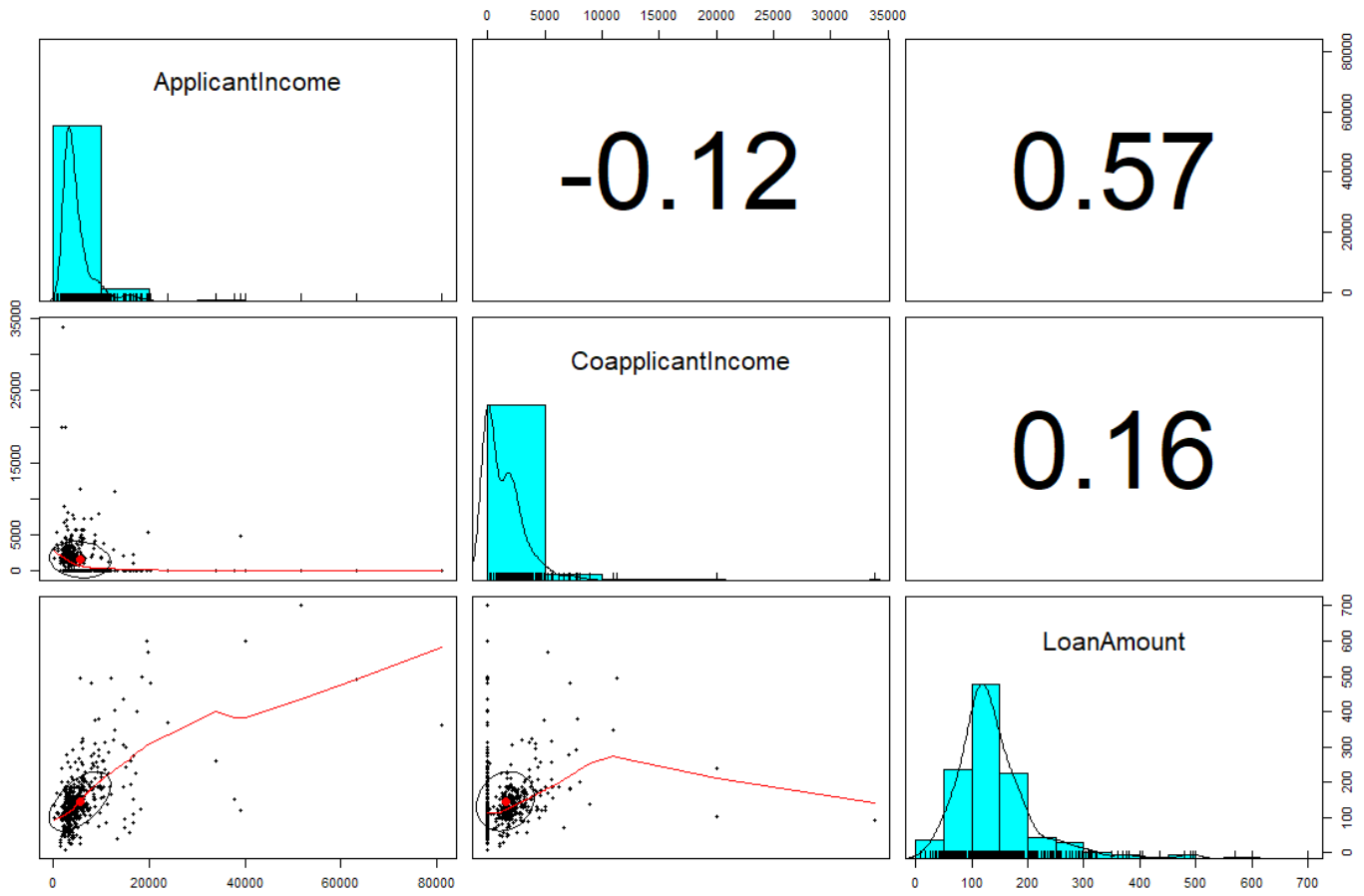


Figure 1. Preliminary analysis results

The plot indicates that the loan amount variable is normally distributed while the applicant's and co-applicant's income distribution demonstrates skewness. This is consistent with reality as the income distribution in modern society is skewed. Another observation from this exploratory data analysis is that the applicant's income is positively correlated with the loan amount. The correlation between them is 0.57, which suggests that the applicant with more income is seeking a higher credit amount. We then decided that a careful examination of the highly correlated independent variable should be addressed from the result. Considering the skewed distribution behind the co-applicant and applicant's income, we dropped the observations with missing income without outlier filtering because the outliers are expected to appear in the applicant's income, while filtering outliers will skew data distribution.

3.2 Credit-Debt Ratio

Theoretically speaking, in the credit application process, when assessing applicants' credit applications, lenders especially value their ability to repay loans. This can be illustrated by applicants' debt-to-income ratio. The debt-to-income ratio is the amount of debt that applicants have relative to their income [4]. Thus, we hypothesized that a factor's significance to the credit application is associated with how it reveals about the applicants' financial ability.

To test this hypothesis, we computed the ratio between applicant income and the loan amount and divide the data into five groups according to the calculated quantile statistics. The first group thus represents the applicant with the lowest debt-to-income ratio.

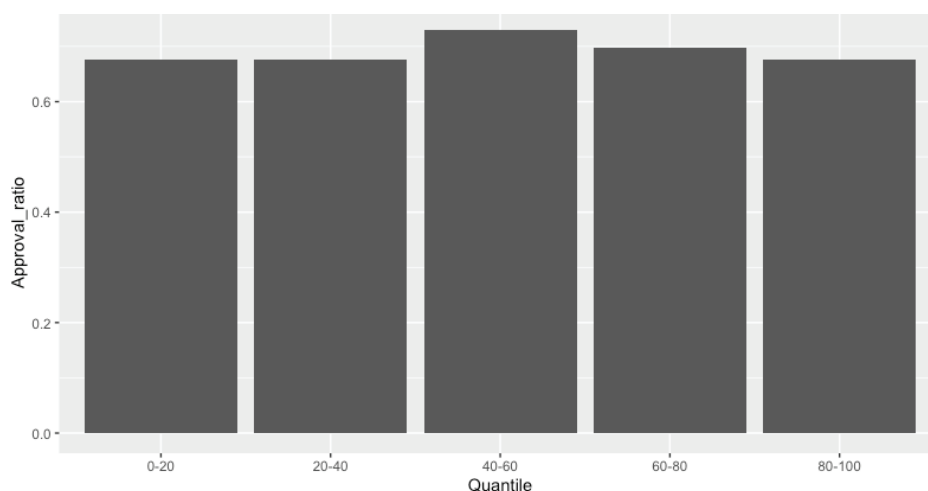


Figure 2. Application approval ratios for different credit-to-debt ratios

However, as the figure indicates, there seems to be no clear correlation between the debt-to-income ratio and the application result.

3.3 Credit History

Another potentially relevant factor is whether the applicant maintains a good credit history. Credit history refers to all the information stored in the credit report, such as credit accounts, balances due, bankruptcies, etc. An applicant's credit history, or credit report, then translates into a nu-

merical calculation known as the credit score. This score is used to assess applicants' creditworthiness [5]. In other words, maintaining a good credit history showcases the applicant not only has the "ability to repay debts" but also has "demonstrated responsibility in repaying them," which accounts for why it's crucial when applicants apply for credits [6]. We used credit history as an example to test this hypothesis. The results are shown in the following graph.

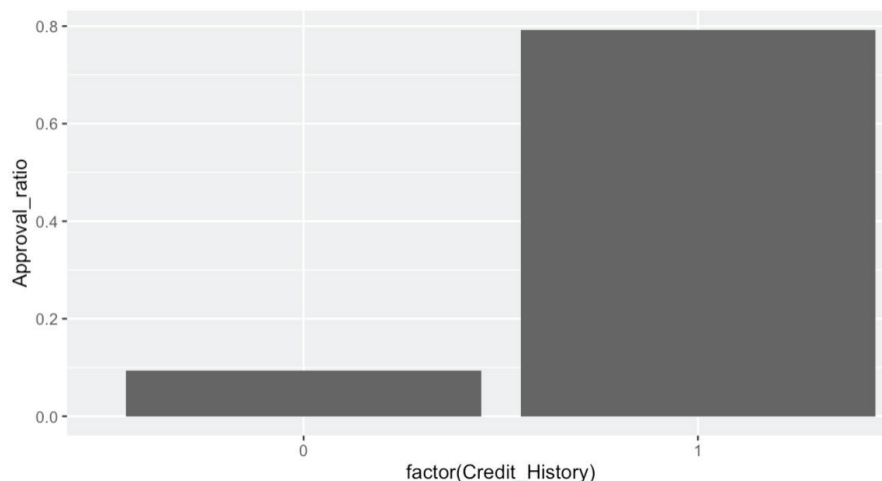


Figure 3. Application approval ratios for different credit history

This graph illustrates that of all applicants whose credit history meets guidelines, roughly 80% of them were approved for the loan. In contrast, only about 10% of those whose credit history is below the guidelines were approved for their applications.

4. Logistic Regression Models

To carefully examine the influential factors of credit approval, we adopted a more rigorous model that analyzes all the variables in-depth. The logistic regression model achieves this by connecting the

credit approval probability with all the independent variables. A lasso logistic regression is also studied and compared with the results from vanilla logistic regression model to investigate whether the model performance can be improved by taking the high correlation among variables into consideration.

4.1 Model Setup

Researchers have used logistic regression to predict the probability of certain events. In this paper, the model will help determine whether an applicant's characteristics will increase or decrease the likelihood of getting their application approved. The model starts by assuming:

$$\text{Log} \frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p$$

where:

p – is the probability for the applicant to have its credit application approved;

X_1, X_2, \dots, X_p are p variables relevant to the credit application.

Note that one can obtain the probability of approval by taking the

$$p = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}{1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}$$

Taking derivative with respect to β_1 , the model transforms into

$$\frac{dp}{dX_1} = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}{(1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p))^2} \beta_1$$

The model is thus assuming that one unit of change of X_1 will change $\frac{dp}{dX_1}$ unit of probability.

4.2 Binomial Probability

We are given the outcome Y of individual credit application result. We use $Y = 0$ to indicate that the application being denied and $Y = 1$ to indicate the application being approved. With only one data and probability p to model the instance's chance of getting approved, we could use Bernoulli distribution to describe the data:

$$P(Y) = p^Y (1-p)^{1-Y}$$

Now suppose we are given application result $(Y_1, Y_2, Y_3, \dots, Y_n)$ with their corresponding application approval probability $(p_1, p_2, p_3, \dots, p_n)$, the binomial model could thus be used to describe the data:

$$P(Y_1, Y_2, Y_3, \dots, Y_n) = \pi_{i=1}^n p_i^{Y_i} (1-p_i)^{1-Y_i}$$

Combined with the result of 4.1, we know that the probability to have its application approved is given by

$$p_i = \frac{\exp(\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip})}{1 + \exp(\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip})}$$

4.3 Model Solution

Since from logistic regression model we have the probability of credit approval $p(x, \beta)$ as a function of data x and coefficients β , we could thus solve for β by maximizing the binomial probability model. For my research, we used R glm function to solve for $(\beta_0^*, \beta_1^*, \dots, \beta_p^*)$ that maximize $\pi_{i=1}^n p_i^{Y_i} (1-p_i)^{1-Y_i}$

$$\text{with } p_i = \frac{\exp(\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip})}{1 + \exp(\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_p X_{ip})}$$

The output indicates:

Coefficients:				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-2.429e+00	9.312e-01	-2.609	0.00909 **
GenderMale	3.254e-01	3.309e-01	0.983	0.32548
MarriedYes	5.739e-01	2.924e-01	1.963	0.04970 *
Dependents1	-3.756e-01	3.460e-01	-1.085	0.27771
Dependents2	2.770e-01	3.782e-01	0.733	0.46378
Dependents3+	1.884e-01	4.874e-01	0.386	0.69915
EducationNot Graduate	-4.210e-01	3.033e-01	-1.388	0.16510
Self_EmployedYes	-1.492e-01	3.523e-01	-0.423	0.67202
ApplicantIncome	6.945e-06	2.862e-05	0.243	0.80827
CoapplicantIncome	-5.143e-05	4.307e-05	-1.194	0.23246
LoanAmount	-2.737e-03	1.773e-03	-1.544	0.12270
Loan_Amount_Term	-9.253e-04	2.032e-03	-0.455	0.64885
Credit_History	3.650e+00	4.331e-01	8.427	< 2e-16 ***
Property_AreaSemiurban	9.873e-01	3.036e-01	3.253	0.00114 **
Property_AreaUrban	1.511e-01	3.007e-01	0.503	0.61527

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Figure 4. Logistic regression results

Notice that here the Intercept represents the baseline, single female applicants without dependents and are not self-employed.

4.4 Results Interpretation

A lot of the predictor variables are indicator variables, which facilitate the presence/absence analysis.

$$\text{Log} \frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p$$

The odds ratio (probability of approval vs denied) $\frac{p}{1-p}$ increases according to the increase of X_1 if β_1 is positive, and the odds ratio decrease according to the increase of X_1 if β_1 is negative. From the fitted β , we observed that $\beta_2 = 0.5739$, $\beta_{13} = 3.6$, $\beta_{14} = 0.98$ are all significantly away from 0 (indicated by the Z statistics), those parameters indicate that while all the other conditions equal:

- The presence of β_2 (marriage) increases the credit card approval probability
- The presence of β_{13} (credit history) increases the credit approval probability
- The presence of β_{14} (living in a semi-urban area) increases the credit approval probability
- The loan amount β_{11} and loan terms β_{12} negatively affect the application result but the effect is not very significant.
- Male applicants β_1 tend to have higher approval probability (indicated by positive slope) but the effect is not statistically significant (as it is indicated by the z value).

The results are generally consistent with the preliminary analysis results in section 3. There are also some findings that deserve more in-depth analysis, such as the effect of gender and credit loan amount in application approval.

4.5 Lasso Logistic Regression

Analysis in section 3 indicates that some continuous variables demonstrate significant correlation. This is problematic for logistic regression. We thus further researched the penalized logistic regression, which seeks the balance between maximizing the probability and minimizing the adequate number of parameters:

$$\begin{aligned} & \text{argmin}_{\beta} -\frac{1}{N} \sum_{i=1}^n y_i \log(p_i) + \\ & + (1-y_i) \log(1-p_i) + \lambda (|\beta_0| + |\beta_1| + \dots + |\beta_p|) \end{aligned}$$

Where the first summation term is the negative of the log-likelihood from binomial probability, the

second term is a penalization term that increases when some of $(|\beta_0|, |\beta_1|, \dots, |\beta_p|)$ are not 0. The λ measures the penalization strength. As a result, the minimization of the above equation strikes a balance between maximizing the probability and minimizing the effective number of parameters.

We adopt R glmnet package to find optimal $\lambda = 0.0271032$.

	s1
(Intercept)	-2.205579e+00
Gender	.
Married	3.762623e-01
Dependents	.
Education	-4.340732e-02
Self_Employed	.
ApplicantIncome	.
CoapplicantIncome	-8.038692e-06
LoanAmount	-8.497286e-04
Loan_Amount_Term	.
Credit_History	3.075231e+00
Property_Area	.
deb_income_group	.

Figure 5. Lasso logistic regression results

The outputted lasso logistic regression model is:

$$\text{Log} \frac{p}{1-p} = \beta_0 + \beta_2 X_2 + \beta_{13} X_{13}$$

Where

- The presence of β_2 (marriage) increases the credit approval probability;
- The presence of β_{13} (credit history) increases the credit approval probability;
- All the other coefficients have minor impact on the credit approval probability.

This conclusion differs slightly from the logistic regression model where the presence of β_{14} (living in a semi-urban area) increases the credit approval probability in the logistic regression model. The lasso logistic regression model tends to attribute the “in a semi-urban area” to marriage or the intercept variable.

5. Model Comparison and Further Analysis

After careful analysis of the logistic and lasso logistic regression, we found a similar conclusion regarding the feature importance. However, it is

also important to compare those two models to determine which model will be used for follow-up research. Therefore, we used this section to evaluate and compare the predictive performance of the two models. We found that logistic regression has performed slightly better than the lasso logistic regression. As a result, we decided to apply logistic regression for male/female segmentation research.

5.1 Train-Test Dataset Split

The dataset is partitioned into two smaller datasets for training and test purposes: the training dataset for model development and the test dataset for model test and validation. Specifically, we randomly selected 75% of the 480 data sample to fit the model and used the rest 25% of the 480 data to validate the result.

5.2 Accuracy Score

Consider a two-class prediction problem, where the outcomes are labeled either as positive or negative. There are four possible outcomes from a binary classifier. If the outcome from a prediction is positive and the actual value is also positive, then it is called a true positive (TP); however, if the actual value is negative, then it is said to be a false positive (FP). Conversely, a true negative (TN) has occurred when both the prediction outcome and the actual value are negative, and false negative (FN) is when the pre-

diction outcome is negative while the actual value is positive. In this way, the true positive rate (TPR) can be calculated as follows:

$$TPR = \frac{TP}{TP + FN}$$

And the false positive rate (FPR) can be calculated as:

$$FPR = \frac{FP}{TN + FP}$$

Then the accuracy score is commonly used to judge for the model performance, which is calculated as follows:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

The logistic model achieved an accuracy score 0.800 on the test set, while the lasso logistic model outputted an accuracy score of 0.798. The out of sample result indicates great predictability for both models, and the logistic regression has performance slightly better than the other.

5.3 ROC plot

A receiver operating characteristic curve, or ROC curve, is a graphical plot that illustrates the diagnostic ability of a binary classifier system as its discrimination threshold varies. The ROC curve is created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings [7].

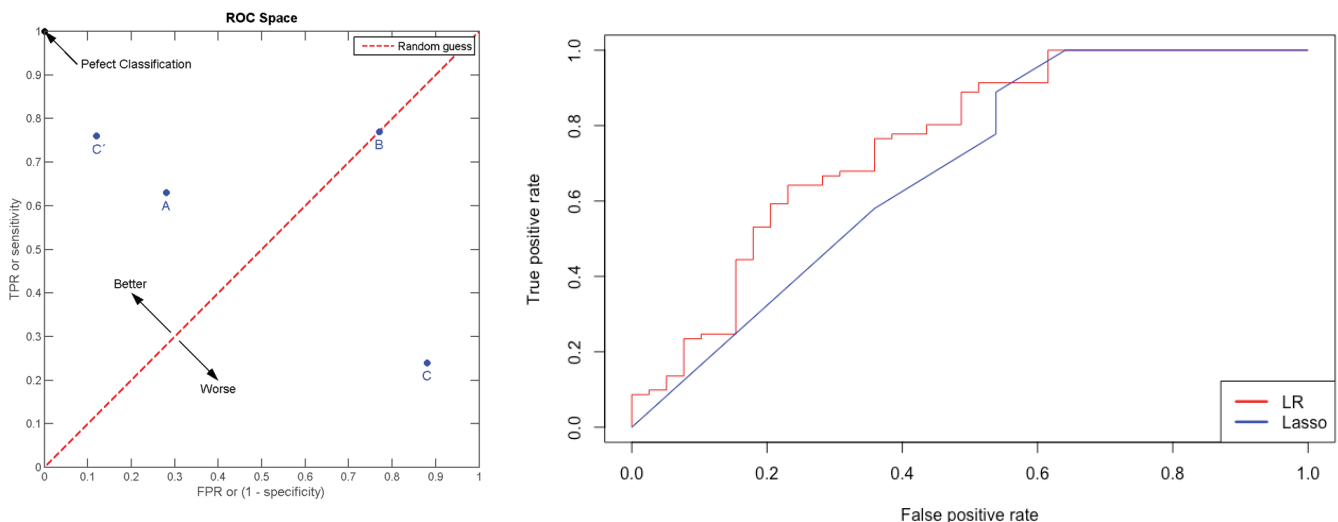


Figure 6. Sample ROC plot (left), ROC plot for logistic and lasso logistic regression (right)

The best possible prediction method would yield a point in the upper left corner of the ROC space. A random guess would give a point along a diagonal line from the left bottom to the top right corners. Points above the diagonal represent better than random classification results, while points below the line represent worse than random results. A sample ROC plot is shown below. In general, ROC analysis is one tool to select possibly optimal models and to discard suboptimal ones independently from the class distribution. Sometimes, it might be hard to identify which algorithm performs better by directly looking at ROC curves. Area Under Curve (AUC) overcomes this drawback by finding the area under the ROC curve, making it easier to find the optimal model.

As shown on the right of figure 6, the logistic regression model has performed better than the lasso logistic regression model at the most discrimination threshold. Combined with section 5.2, we concluded that the logistic regression model has an overall better performance than lasso logistic regression. Therefore, we only applied logistic regression in the following sections for further analysis.

5.4 Logistic Regression on Segmented Data

This section will build on the previous model solution. However, instead of assessing the importance of each factor on the approval ratio for all applicants, this section will break the data according to a specific group (i.e. female versus male) and attempt to investigate whether male and female applicants' are assessed differently.

5.5 Findings and Implications of the Results

From the results above, credit history and the property area of the applicants continue to have a significant impact on credit approval despite splitting the dataset into the male group and the female group. However, male and female applicants are assessed rather differently despite these two factors. Male applicants' approval rates are significantly impacted by their educational background. Specifically, the approval probability for male applicants without a

graduate degree is much lower, suggesting that banks value their academic experience. On the other hand, interestingly, two factors that play a crucial role in assessing female applicants are their income and co-applicant income. While it is true that banks especially value applicants' loan to income ratio, the income factor does not play a role when assessing both male and female applicants, nor was it shown critical in the preliminary analysis in section 3. This suggests that the credit quality of women is still poor, and they are still financially prejudiced by banks. Suppose such discrimination against the financial situation of women persists. In that case, it will lead to a detrimental cycle with women having more difficulty applying for loans and thus contribute negatively to their financial situation.

Coefficients:				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-7.324e+00	2.662e+00	-2.751	0.00594 **
MarriedYes	4.531e-01	7.578e-01	0.598	0.54984
Dependents1	-6.758e-01	8.155e-01	-0.829	0.40727
Dependents2	-2.248e+00	1.402e+00	-1.603	0.10895
Dependents3+	1.637e+01	1.455e+03	0.011	0.99103
EducationNot Graduate	6.089e-01	8.621e-01	0.706	0.47996
Self_EmployedYes	-1.649e+00	1.059e+00	-1.556	0.11960
ApplicantIncome	2.063e-04	1.254e-04	1.645	0.09990 .
CoapplicantIncome	4.586e-04	2.608e-04	1.758	0.07868 .
LoanAmount	-3.370e-03	4.915e-03	-0.686	0.49289
Loan_Amount_Term	4.212e-03	5.073e-03	0.830	0.40642
Credit_History	5.228e+00	1.680e+00	3.112	0.00186 **
Property_AreaSemiurban	1.859e+00	7.669e-01	2.424	0.01536 *
Property_AreaUrban	1.043e+00	8.594e-01	1.214	0.22471

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Figure 7. Logistic regression results for female applicants

Coefficients:				
	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-1.374e+00	9.973e-01	-1.378	0.1682
MarriedYes	5.539e-01	3.262e-01	1.698	0.0895 .
Dependents1	-2.305e-01	4.008e-01	-0.575	0.5653
Dependents2	4.964e-01	4.080e-01	1.217	0.2237
Dependents3+	1.829e-01	5.051e-01	0.362	0.7173
EducationNot Graduate	-6.359e-01	3.393e-01	-1.874	0.0609 .
Self_EmployedYes	-1.247e-01	3.968e-01	-0.314	0.7533
ApplicantIncome	-5.732e-06	3.383e-05	-0.169	0.8655
CoapplicantIncome	-6.657e-05	4.556e-05	-1.461	0.1440
LoanAmount	-3.377e-03	2.085e-03	-1.620	0.1053
Loan_Amount_Term	-2.266e-03	2.333e-03	-0.971	0.3314
Credit_History	3.641e+00	4.764e-01	7.643	2.12e-14 ***
Property_AreaSemiurban	8.791e-01	3.455e-01	2.544	0.0109 *
Property_AreaUrban	4.431e-02	3.329e-01	0.133	0.8941

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Figure 8. Logistic regression results for male applicants

6. Conclusion

In this project, we studied the driving forces behind credit applications. With the home loan dataset, we completed preliminary research and conducted an in-depth analysis using logistic regression and penalized logistic regression for credit approval prediction. we found:

1. The geographical location of the applicants, the marriage status of the applicant and the credit history of the applicant all have significant effects on applicants' application result.

2. Application income are surprisingly not the first concerns when financial associates approve for credit application.

3. Among all the factors affecting credit application, credit history is the most important factor when banks review their applicants.

4. Female applicant is additionally assessed by their income and their co-applicant income.

5. Male applicants are additional assessed by their education and marital status.

Though with two models to reach the conclusion, it is important to recognize that this dataset

does not represent the application process for all types of loans and across all countries and under all economic circumstances. Thus, further research using a variety of dataset is needed to confirm the findings of this paper. Another limitation of this study is that data entries with missing values are excluded for analysis. This is a timesaving but defective approach. Depending on the number of data entries with missing values, we may have removed too many sample points, which may weaken the conclusion we draw from the model. Therefore, for future studies, we may use more advanced techniques such as mean value imputation or k-nearest neighbors (kNN) to impute a value for the missing entries. The mean value imputation method completes missing values with the mean of the entire feature. This is a simple and effective way to make those entries usable by the logistic regression model. Other techniques include the k-nearest neighbor approach, which replaces missing values with the mean of k (a value assigned by users) nearest neighbors of that sample [8]. This technique requires more effort but can generally achieve better performance.

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PROOF THAT THERE IS NO ALGORITHM TO THE OPTIMAL WORK ASSIGNMENT IN CONSTRUCTIVE MATHEMATICS

Abstract. This paper proves that in constructive mathematical economics, there could not exist an algorithm that always does the optimal assignment of workers to the working positions. The main method is based on the fact that there does exist a computable function that does not admit an everywhere defined computable extension.

Keywords: Constructive Mathematics, Economics, Optimal Work Assignment.

Introduction

Constructive mathematics is the field which studies describable constructive numbers and constructive topological or metric spaces. It is characterized by proofs based on explicit, algorithmic solutions, and proofs by contradiction are considered to be not constructive. The idea of constructive mathematics started from A. A. Markov, who proposed the Markov's Principle, that is, for a decidable P , $\forall n (P(n) \vee \neg P(n))$, then $\neg \neg \exists n P(n)$ implies $\exists n P(n)$.

A computable number can be determined by a finite computer program. It was defined by A. M. Turing, that computable numbers are the real numbers whose binary expansions can be enumerated by a finite procedure. He similarly defined computable functions. However, his definitions turned out to be incorrect, as under his definition, the addition and multiplication of computable numbers are no longer computable.

Definition 1.1.

$$A_{n,k} = \begin{cases} 1, & \text{if } H \text{ by step } k \text{ did not terminate yet or it terminated already and gave } 1. \\ 1 + 2^{-m}, & \text{if } H \text{ by step } k \text{ terminate and gave } 0, m \text{ is the number of steps when this happens.} \end{cases}$$

Definition 1.2.

$$B_{n,k} = \begin{cases} 1, & \text{if } H \text{ by step } k \text{ did not terminate yet or it terminated already and gave } 0. \\ 1 + 2^{-m}, & \text{if } H \text{ by step } k \text{ terminate and gave } 1, m \text{ is the number of steps when this happens.} \end{cases}$$

Definition 1.3.

Constructive Real Numbers: A constructive number is a pair of programs $\alpha(i)$ and $\beta(i)$, where $\alpha(i)$ is a Cauchy sequence and $\beta(i)$ is the convergence regulator, such

The Optimal Work Assignment problem is significant in the field of economy. Solving the problem would help corporations to lower the cost and save money. In this paper, we will prove that there is no algorithm that can solve the general Optimal Work Assignment problem.

Algorithm to the optimal work assignment

The paper mainly proves the following theorem:

Theorem 1.1.

In constructive mathematical economics, there does not exist an algorithm that always does the optimal assignment of workers to the working positions.

To start the proof, we consider an algorithm H that is partially defined that is not extendible to all natural inputs. Note that such algorithm is valid since non-extendible programs exist (1).

First, we define two sequences $A_{n,k}$ and $B_{n,k}$, generated by algorithm H :

that for every i, j greater or equal to $\beta(N)$, we have $I\alpha(i) - \alpha(j) < 2^{-N}$. [2; 3].

We first observe the following fact that sequences $A_{n,k}$ and $B_{n,k}$ both lead to constructive real numbers

when we fix n and vary k , as it is obvious that such convergence regulator $\beta(i)$ do exist for the two sequences.

An example of the cost matrix

Now, consider the specific case when the cost matrix is:

	Job 1	Job 2
Worker 1	A_n	1
Worker 2	B_n	1

[1]

In this particular case, Worker 1 and Worker 2 receives a payment of A_n and B_n for doing Job 1, respectively. Both Worker 1 and Worker 2 get 1 for Job 2.

In order to determine the optimal work assignment in this situation, we need to choose the case when the total payment is the least. Therefore, a comparison between the value of A_n and B_n needs to be made.

Specifically, algorithm H will lead to the choice of the combination Worker 1 \rightarrow Job 1 & Worker 2 \rightarrow Job 2 if the program prints 1, because in this case, A_n , which is equal to 1, is smaller than B_n , which is equal to $1 + 2^{-m}$.

$$H' = \begin{cases} 1, & \text{when } P \text{ gives the combination of Worker 1} \rightarrow \text{Job 1, Worker 2} \rightarrow \text{Job 2} \\ 0, & \text{when } P \text{ gives the combination of Worker 1} \rightarrow \text{Job 2, Worker 2} \rightarrow \text{Job 1} \end{cases}$$

This is an extension of algorithm H at x , which can be all natural numbers that is initially not defined in algorithm H , so H can be extended to all inputs.

However, if there exist such algorithm P that can solve the Optimal Work Assignment problem, the conclusion (Theorem 1.2.) will contradict with the fact that algorithm H is not extendible, which we mentioned before.

Therefore, there could not exist an algorithm P , such that it can solve the Optimal Work Assignment problem.

A generalization of the cost matrix

As mentioned previously, we constructed cost matrix when there are only two workers and working

Similarly, it will lead to the choice of the combination Worker 1 \rightarrow Job 2 & Worker 2 \rightarrow Job 1 if the program prints 0, because in this case B_n , which is equal to 1, is smaller than A_n , which is equal to $1 + 2^{-m}$.

However, note that algorithm is inextendible, and therefore cannot give an answer to all natural inputs.

Now, we prove the problem by contradiction by introducing a new algorithm P .

Definition 1.4.

Algorithm P: A hypothetical algorithm that will always give an answer to the optimal work assignment problem for every cost matrix.

We state that if there is such algorithm P that can always solve the problem, there would be an extension of H to all natural numbers.

Theorem 1.2. *The existence of Algorithm P will lead to an extension of program H. Proof.* Suppose that algorithm H will never terminate at x .

According to the definition, algorithm P would be able to compare A_n and B_n , giving an answer to the Optimal Work Assignment problem when the input is s .

However, if this was true, the extension H' of algorithm H could be defined at x as follows:

positions. Based on the construction we already had, we can also give constructions and proofs of the cost matrix when there are arbitrary numbers of workers and working positions.

We start with a simple case. First, we analyze the situation when three workers need to be assigned to three working positions.

Based on matrix [1], which there are only two workers and two jobs, consider the specific case when the cost matrix is:

	Job 1	Job 2	Job 3
Worker 1	A_n	1	1
Worker 2	B_n	1	1
Worker 3	A_n	1	1

This time, A_n , B_n , and A_n are the payment Worker 1, Worker 2, and Worker 3 get respectively for Job 1. All three workers get 1 for Job 2 as well as Job 3.

Still, to determine the optimal work assignment in this situation, we need to choose the option when the total payment is the least, so a comparison between the value of A_n and B_n needs to be made.

However, as we already proved, there is no such algorithm that can do this, or otherwise, the program can be extended to all natural inputs.

Here, we finished constructing an example of the cost matrix for three workers and working positions.

The construction is very similar when there are k workers and jobs. Consider the following cost matrix:

	<i>Job 1</i>	<i>Job 2</i>	<i>Job 3</i>	...	<i>Job k</i>
<i>Worker 1</i>	A_n	1	1	...	1
<i>Worker 2</i>	B_n	1	1	...	1

<i>Worker 3</i>	A_n	1	1	...	1
<i>Worker 4</i>	A_n	1	1	...	1
...	\ddots	...
<i>Worker k</i>	A_n	1	1	...	1

All the workers get A_n for Job 1 except for Worker 2, who gets B_n for Job 1. All the k workers get 1 for Job 2, Job 3, ..., Job k .

The reason why there is no algorithm that can do the Optimal Work Assignment is the same, that is, a comparison between A_n and B_n cannot be made. If there was such algorithm, an extension of this algorithm to all natural numbers can be found, which leads to a contradiction.

Conclusion

We conclude that in constructive mathematical economics, there does not exist an algorithm that always does the optimal assignment of workers to the working positions.

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Section 3. Management

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CONCEPTUAL MODEL OF CONFLICT MANAGEMENT IN AN ORGANIZATION

Abstract. The article reveals the problem of conflict management, gives the author's definition of the concept of "conflict management in an organization". The forms of conflict management and methods of conflict resolution are considered, and a general model of conflict management in an organization is developed.

Keywords: conflict, conflict management, organization, prevention, conflict diagnostics.

Conflict occupies a key place in the management of an organization due to the enormous organizational significance of its innovative, creative and destructive consequences, as well as due to the time costs associated with it. "Conflict management", "conflict resolution" and "conflict resolution" – all these terms are found in the literature on conflictology and, as a rule, are used by various authors to denote the process of completing a conflict interaction. Some authors of conflict literature in the content (structure) of their textbooks include a section (chapter, paragraph) on conflict management, others – on settlement, some – on resolution; there are also those that contain all the terms without exception.

All of the above speaks of the need to draw a precise boundary between these terms, to determine their place and role in the process of ending the conflict. One of the definitions of the term "conflict management" is interpreted as a conscious and purposeful activity in relation to the conflict, implemented at all stages of its development (emergence, escalation, completion) directly by the conflicting parties or by a third party in order to change the natural dynamics of the conflict.

In conflictology, there are two main stages of the conflict:

1. Prevention, consisting of symptoms, diagnosis, and prevention
2. Completion includes weakening, resolution, settlement, suppression, extinguishing, overcoming, suppression, and elimination of the conflict.

In addition, in the literature on conflictology, one can find a different definition of the term "conflict management", which is interpreted as a conscious influence on the conflict in order to achieve the desired results, which should be the result of settlement through the impact on the conflict, one way or other participating elements. According to the author, conflict management includes the following forms: "conflict prevention, conflict suppression, conflict resolution, conflict manipulation" [1].

Conflict management is a procedure of purposeful influence on the conflict situation from the moment of its inception to the resolution of the conflict, which consists of several stages: prevention, diagnosis, forecasting, settlement, and resolution. Thus, settlement and resolution, in accordance with

this interpretation, are forms of managing conflict interaction.

There are also many other definitions of the term “conflict management”, which will be considered and analyzed in this article. Conflict management is interpreted as a directed influence on the procedure of conflict interaction in order to implement socially significant tasks. Conflict management consists of predicting, preventing, stimulating, stopping, suppressing, regulating, and resolving conflicts. It is conflict management that allows you to reduce the degree of confrontation between opponents, transfer it to an acceptable level of interaction and achieve your goals.

There is a similar definition of the term “conflict management”, but it is noted that it consists of symptoms, diagnosis, prediction, prevention, resolution, settlement, mitigation, and prevention of conflict.

In addition, conflict management is interpreted as the ability to direct it in the direction necessary for the organization, achieve adjustments in the actions of participants in conflict interaction, increase the level of management, and make organizational adjustments. Allocate analysis, prevention, and conflict resolution as the main components of conflict management. However, conflict resolution in this definition is not singled out as a separate area, which is a distinctive feature of such an interpretation.

A more detailed formulation of the conflict interaction management process is a procedure of directed, predetermined by objective laws, influence on the dynamics with the aim of developing or destroying a particular social system in which a conflict has arisen. Considering the structure of conflict interaction management, forecasting, assessment, prevention, stimulation, regulation, and conflict resolution are singled out.

According to scientists, in the event of a conflict, it is necessary to predict and prevent a conflict situation. The need for conflict prevention arises in the process of understanding one of the subjects of the conflict, and in regulation – at the beginning of an open confrontation between the parties. The final

stage is a resolution when the conflict comes to an end. There is another formulation of the concept of “conflict management”, which is interpreted as the ability of a leader to recognize a conflict situation, analyze it and implement actions to eliminate the conflict. There are four stages of conflict management: firstly, it is necessary to give an initial assessment of the conflict situation; secondly, to analyze the conflict and recognize its causes; thirdly, to identify ways to resolve the conflict; at the fourth stage, it is necessary to take and implement organizational measures.

The central component of conflict management is its diagnostics, which is able to reveal the causes of the conflict situation, the events of the emergence and formation of the conflict, the subjects of the conflict, the positions, and opinions of the participants in the conflict. It is these data that make it possible to determine the key elements of the conflict and its dynamics. Conflict forecasting is a directed impact of competent persons (bodies, groups of persons) who have sufficient awareness, level of knowledge, skills, and abilities and are able to diagnose and recognize a conflict in advance, as well as make a competent management decision in order to influence the current conflict and minimize negative impact and its speedy completion.

After analyzing the literature on conflictology, we can conclude that there are two fundamental aspects in the disclosure of the terms “conflict resolution” and “conflict resolution”. Some authors find the difference between them in that the end of the conflict is the result of the joint efforts of the direct participants, and when regulating the conflict situation, in order to end it, a third party is involved, whose participation is possible both with the consent of the opponents and without their consent. Other researchers interpret conflict resolution as an activity aimed at the complete elimination of contradictions and problems between opponents and the normalization of relations between them, achieved both through joint efforts and through the involvement of a third party. Conflict resolution

involves its partial elimination, prior to the conflict resolution procedure, aimed at mitigating the negative impact of the confrontation, localizing and limiting the conflict, transforming the conflict interaction of opponents into other socially acceptable forms of interaction.

In the styles of conflict behavior, which are also referred to as models, strategies, and techniques of conflict behavior, one can distinguish common features. These include avoidance (withdrawal, avoidance), accommodation, coercion (confrontation), cooperation (consensus), and compromise. When avoiding, one of the parties purposefully seeks to avoid conflict interaction;

- adaptation is characterized by the refusal of one of the parties to enter into conflict relations and inaction in relation to the realization of their own goals;

- the participant in the conflict, who has chosen the strategy of coercion (competition, confrontation, rivalry, confrontation), sets as his goal the satisfaction of his own needs and desires;

- one of the most effective ways of conflict behavior is cooperation (consensus), in which there is a search for ways out of conflict interaction on mutually beneficial terms;

- in the case when the parties to the conflict, subject to mutual concessions, partially satisfy their own needs, such a style as a compromise manifests itself.

However, consensus and compromise are considered more preferable strategies for conflict behavior, but under certain conditions, evasion, accommodation, and confrontation can be effective. The choice of a conflict behavior strategy is directly dependent on the specific situation in which the conflict arose and proceeds, the importance of the object for opponents of their internal potential and resource endowment, as well as the ultimate goals of the conflicting parties. As a result of the regulation of the conflict, there is a compromise, and in its resolution – cooperation.

Conflict resolution consists of three stages:

I. Recognition of the conflict as a reality,

II. Institutionalization of the conflict

III. Legitimization of conflict

The prerequisites for conflict resolution are:

a) Organization of the conflicting parties, b) Willingness to recognize the legitimacy of each other's demands and accept any result of the conflict settlement, c) Belonging of the conflicting parties to the same social community.

The technologies used in the process of conflict regulation are divided into four blocks: informational, communicative, socio-psychological, and organizational.

Conflict resolution consists of three stages: a) Diagnosis of the conflict, b) Choosing a conflict resolution method, c) Management impact and assessment of its readiness.

At the third stage of conflict resolution, there are three prerequisites necessary to start conflict resolution:

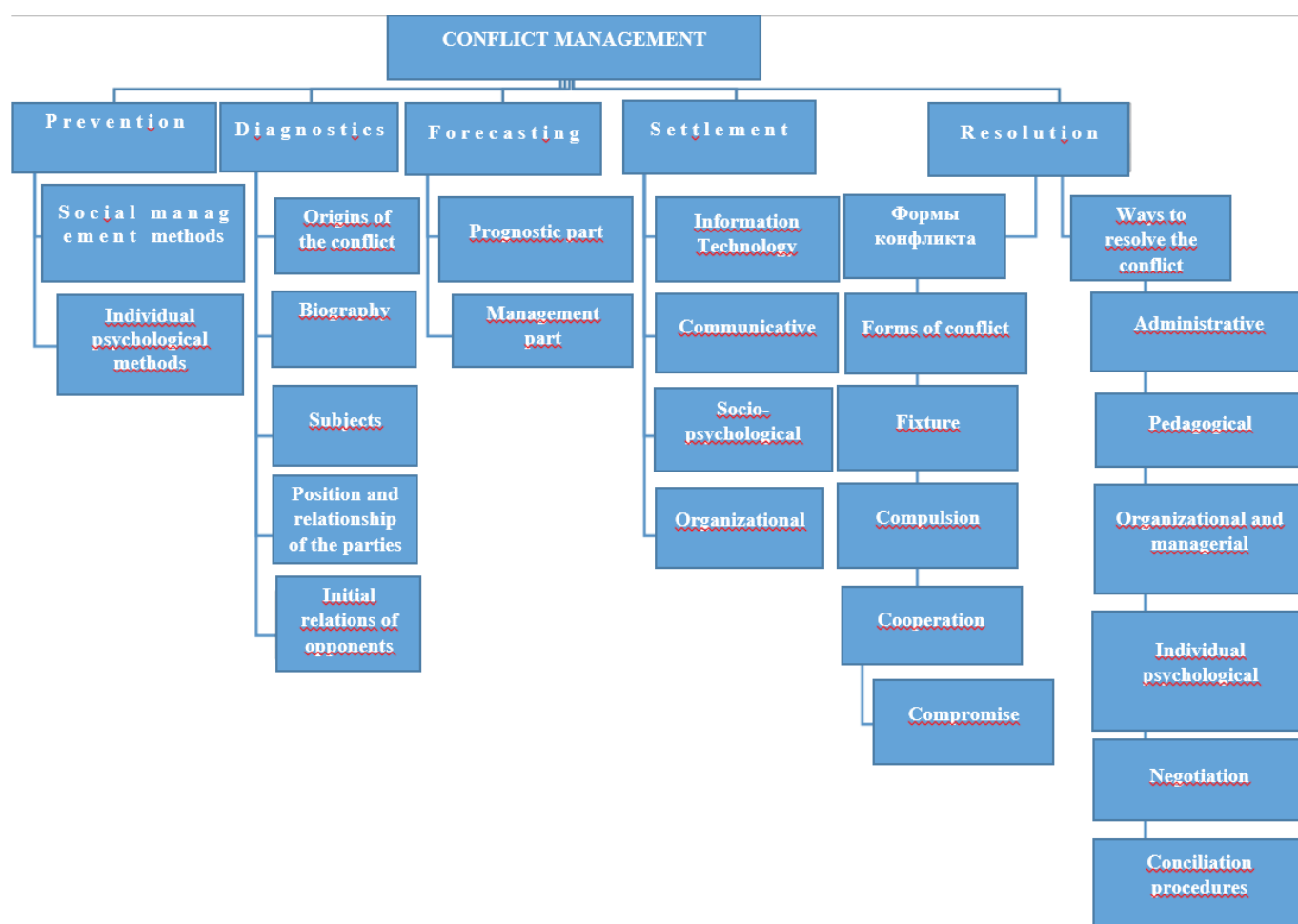
1. Sufficient maturity of the conflict;
2. Opponents must feel the need to resolve the conflict;
3. Sufficient amount of funds and resources to resolve the conflict among the conflicting parties.

Thus, we can conclude that it is necessary to start resolving the conflict after its settlement. "The forms of conflict resolution are the strategies of conflict behavior identified earlier: withdrawal, adaptation, confrontation, consensus, compromise.

In order to conduct conciliation activities, it becomes possible to participate in the conciliation procedures of a third party – a "facilitator". In addition, this term means the institution of mediation.

Mediation (mediation) is an intrusion of an outside disinterested party into the process of conflict interaction in order to find a compromise and satisfy the desires of both parties in order to resolve the conflict.

The conceptual model of conflict management in an organization can be represented in the following form, which is shown in the figure.



Conclusion. Summing up, we can conclude that the rapid and complete resolution of conflict situations is a necessity for the organization since

excessive aggravation of conflict contradictions and prolonged confrontation of opponents can lead the organization to a general crisis and disintegration.

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MANAGEMENT ACCOUNTING AS A GLOBAL ACCOUNTING SCIENCE

Abstract. The article proposes the author's definition of management accounting. In addition, it has supplemented the principles of management accounting, such as the principle of matching the business model and information technologies; the principle of correspondence between real and remote management of the management accounting system; the principle of a fashion house, etc. As an activator of the wide introduction of modern-level management accounting, Georgian economic entities recommended its standardization.

Keywords: management accounting, business model, accounting virtualization, controlling.

Introduction. The tasks of increasing the efficiency of the practical implementation of the theoretical developments of management accounting and determining the further ways of its development are in the focus of attention of the international scientific community. These tasks have gained special significance for our country at the present time. Their successful solution depends on the consistency and potential of the science of "Management Accounting", the contribution of scientists to its innovative enrichment and can have a direct impact on increasing the competitiveness of Georgian companies. Based on the analysis of the process of formation and development of management accounting in Georgia, the priority of a broad interpretation of management accounting and its perception as a global accounting science is substantiated.

Discussion. First, it is necessary to once again determine the place of management accounting in the hierarchy of sciences related to providing external and internal users with information about the activities of economic entities, i.e. sciences responsible for the information and economic space.

Let us note the factors that are significant for the formation and development of management accounting in Georgia.

- Georgian accounting (financial) accounting is being reformed towards convergence with

International Financial Reporting Standards (IFRS), and national standards (Accounting Rules) are already largely in line with international standards.

- In English-speaking countries, whose accounting systems served as a prototype for IFRS, there are such types of reporting as financial, managerial, and tax reporting. If we chose IFRS as an example, which is typical of English-speaking countries, then it is also advisable to recognize the existence of three types of reporting/accounting.
- The place to be taken by the management accounting (or/and controlling) system remains vacant in many Georgian companies; introducing management accounting does not require the elimination of any other system and retraining of personnel (which is often more difficult than primary training).
- Financial accounting has changed significantly in the last 20 years, especially in the XXI century, and management accounting is changing as well. If financial accounting is no longer similar to the one that was previously considered accounting ("posthumous"), then management accounting cannot remain traditional, for example, only dealing with business accounting, costing, etc. virtual econo-

my, a significant breakthrough in all areas of civilization is accompanied by an increase in threats and uncertainties. The current stage of economic, technological, information and communication development can be compared with the almost simultaneous transition of mankind to another dimension, which provoked an increase in the entropy of the economic environment.

- Many scientists and practitioners from different countries are involved in the development of information support for economic entities, and new directions are often created, new names and terms are introduced into scientific circulation. This is a natural process of scientific knowledge, however, over time, some teachings are built into others, some may stop in their development, some may be enriched by related sciences and updated. Management accounting has been around long enough to require reform to meet the modern needs of business entities. The reform process creates the prerequisites for including all innovative ideas, concepts, methodologies into management accounting, and improving its structure.

In this regard, we believe that one of the following options for perceiving the accounting sphere should be adopted. The first option we proposed is more traditional, with three types of accounting, although interacting, but largely independent. These three types of accounting can be considered (albeit ambiguously) grown from a common basis – accounting.

The second option is a broad interpretation of management accounting, which combines management accounting with accounting and tax accounting for managers, becoming a global accounting science. This approach seems more logical because:

- It is in financial accounting that the financial statements involved in the value's creation of the enterprise are formed, and management

must know how this or that operation will affect the financial statements, what we will bring information image of the company to users;

- Each major operation of an enterprise must undergo a preliminary analysis to determine its tax effect, which is important for the development of tax policy, tax planning, and for organizing effective business management.

Thus, we believe that management accounting can be considered as accounting, comprising three types (accounting areas): financial; directly managerial for managers; tax – which should be coordinated from a single center (enterprise) and, ultimately, be considered from the position of solving the problems of company management. Each type of accounting creates its own reporting according to its own rules, but the knowledge generated as a result both reveals shows and is used for management (we will not consider further note that financial and tax accounting in the article).

Since accounting is always carried out to generate reporting data, then for any variant of perception of management accounting, firstly, financial, managerial, tax reporting and, secondly, as a result of their reasonable synthesis, integrated reporting should be generated. We also note that management accounting involves not only the collection but also the processing of information. Thus, analysis (including mathematical modeling [3]) should also be included in management accounting; as a result, it will be closer to the nature of reporting data and will respond faster to conceptual and methodological changes in accounting.

Trying to prove the commonality of the purpose and content of management accounting and controlling systems, we, of course, did not mean their complete identity. Naturally, each of these systems is characterized by originality, which was the result of different mentalities of users of accounting and analytical information” [1].

Moreover, we believe that controlling has no independent significance, and its constituent parts are

separate constituent elements of management accounting. This approach provides a more coherent and logical conceptual structure in the field of providing users with information related to the activities of economic entities. The rejection of the perception of controlling as an independent science, in our opinion, will only clarify and make an unambiguous understanding of the issues in the field of information support for company management, eliminating duplication. That is, everything that was created in the field of controlling should be built into management accounting with the formation of a single terminology. Moreover, where appropriate, the terminology should be the same for all three types of accounting.

Without describing in detail all the arguments used by us to identify the concept of “management accounting”, we consider it possible to offer the most, in our opinion, the broadest and most unencumbered definition – a business management information support system. This definition, of course, implies all the processes taking place in this system, which, from the standpoint of traditional approaches, can be divided into a generally accepted collection of information, its transformation into the required form, decision-making about the future (taking into account the assessment of the past) based on its analysis.

The main results of this system should be variable forecasts of strategic business development; selection and evaluation of the implementation of the appropriate business model; selection and monitoring of an adequate operating policy for the current situation; management of business segments; management within the selected business model of individual business resources – human, financial, tangible and intangible, informational (including communication).

The question arises: is this definition suitable for a non-profit organization, which means “an organization that does not have profit-making as the main goal of its activities and does not distribute the profits among its participants”? Non-profit organizations pursue social, charitable, cultural, educational, scientific, and managerial goals to protect the health

of citizens, develop physical culture and sports, meet the spiritual and other non-material needs of citizens, protect the rights and legitimate interests of citizens and organizations, resolve disputes and conflicts, provide legal assistance, as well as for other purposes aimed at achieving public benefits.

We believe that, although we do not create such organizations to make a profit, they also conduct business processes, i.e. carry out “a set of interrelated activities or tasks aimed at creating a specific product or service for consumers.”

In the light of the foregoing, we believe that business accounting, as well as controlling, as strategic accounting, should be considered within the framework of management accounting, which, as already noted, is constantly changing in response to the demands of the time, priorities are shifting in it and accents are placed differently. Nevertheless, the concept of “management” remains; it is this concept that should form the name of science.

In connection with the last principle we have named, the following conceptual question arises: about the usefulness of standardizing management accounting. On the one hand, standardization leads to the ordering of terminology, technical comparability of data, meets the needs of globalization, allows you to train personnel with the competencies necessary for implementing standards, sets a certain level that should be met, i.e. acts toward reducing the entropy of the environment of existence. The obligatory nature of standards leads to the impossibility of applying an individual approach (sometimes unique, breakthrough), the only one capable of reflecting the actual situation, ensuring the achievement of business goals, and solving current problems. We believe that management accounting standards can and even should exist, but they should be advisory, serve more than a guide for businesses that are not leaders, perform the function of training, disseminate best practices. These standards should be constantly updated, perhaps more often than it happens with financial reporting standards, and serve as an activa-

tor for the spread of management accounting practices. In connection with the principle of freedom of action proposed by us and the standardization of management accounting, which is not mandatory, we consider it appropriate to express our point of view on the achievements of management accounting in Georgia. The wins in management accounting are not as big as we would like them to be. Over the past 20 years, the only positive result I have achieved is that management accounting, as a system, is recognized by all scientists and its necessity is no longer questioned. In addition, we consider it a great achievement that thousands of Georgian enterprises, if they do not keep “full” management accounting, have implemented it in separate sections, and this despite the optional nature of management accounting,

a significant tax burden, conflicts in the legislation on economic activity.

Conclusions. Based on the analysis of the identified factors influencing the formation and development of management accounting in Georgia, two options for the perception of management accounting in the accounting field are proposed. The first is the recognition of management accounting, as well as accounting and tax accounting, as one type of accounting; the second is to recognize management accounting as comprehensive, including both direct accounting for managers and accounting and tax accounting. This approach seems to be more correct. It is recommended that management accounting be standardized, provided that the standards are optional.

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COUNTRY OF ORIGIN EFFECT AND BRAND ORIGIN – A LITTERATURE REVIEW APPROACH

Abstract. In this article you will find a literature review approach on the effect of country of origin in a constant evolution leading to brand origin. Overall, the value of literature reviews lies in their ability to provide scholars, students, and practitioners with a critical assessment of existing research, helping to identify and develop further studies. The country-of-origin effect is controversial but retains all interest in a globalized and regionalized world, especially when we are talking about the current hybrid character of many products and when perceptions about brands' countries of origin are important from the consumer's point of view. The country of origin becomes a potential competitive and differentiating factor when we are talking about international markets. The studies appeared in 1965, but we have seen a growth in studies since the mid-1990s of the last century looking for an approach that redefined the concept, leading us to research topics such as brand origin, product country image and product place image. The European Union, for example, promotes protected designation of origin or protected indication of origin for some products. As important or even more important is the perception of the brand origin as a source of brand appeal, relegating to the background the question about where the company produces its goods or services, and giving importance to this perception, even for reasons related to stereotypes.

Keywords: Country of Origin, Brand, Brand Origin.

Country and Brand Origin – an Introduction

It is from the 1960s that we find studies on the country-of-origin effect (COO). An ongoing area of interest, although controversial, it has been studied from the effects around the idea of country of origin, perceived in many ways (Samie [45]). Consumer be-

havior seen as an intangible barrier to entry into new markets arises against the consumption of imported products. For others (Cattin, Jolibert & Lohnes [10]), which consider the country of origin to be the one where the headquarters of the company selling the product or trademark is located, the effects

generated fall on that nation. It is also known that the country is a factor or element inherent to some brands (Samie [45]). Place and date are important elements, so the country of origin can be defined as “*the country of manufacture or assembly*” (Cattin, Jolibert, & Lohnes [10]) (Han, 1989) (Papadopoulos [21]). The evaluation of products and the attitude towards them benefit, or not, from information such as the country of origin of the product, the price, the brand, etc., (Chamorro, Rubio, & Miranda [11]). Today we give more importance to other phases of product design (important and of very high added value), allowing us to associate the country with manufacturing companies, to understand the global vocation or the network of suppliers over which the company can exercise some power. The term “*made in*” has been used for long to define the country of origin of the product (Cattin, Jolibert, & Lohnes [10]) (Parameswaran & Mohan [41]). We can also find sub dimensions such as “*designed in*”, “*assembled in*”, “*made in*”, “*invented in*”, “*made by a producer whose domicile is in ...*”. Complexity emerged from the emergence of multinational companies and the hybrid (These are those products considered as containing the components or ingredients manufactured in third countries) character of the products (Chao [12]). This is why brand origin becomes then, a fact. Increasing globalization has led researchers and investigators to study more intensively the country-of-origin effect (Ahmed [2]). Adjustments were seen and now we find it much more similar to the concept of country brand (*country-of-brand*) or the origin of the brand (*brand origin*) because of the hybridization of goods, that is higher, and because of the relocation of industries (Ahholt [1]). We should also have in mind that the brand is often and perhaps the only component that still holds the national origin of the product (Fruchter, Jaffe, & Nebenzahl [18]).

For products under a less well-known brand, the country of origin can act as a brand, enhancing their value. For products under a well-known brand, origin tends to be less important (Schaefer [46]), but it

still can help to reinforce brand attributes. Country image can leverage brand attributes, acting as an external signal about product quality, so perceptions of a country’s brand influence local brands and vice versa. Therefore, separating the influences of brand perceptions and country-of-origin associations can be difficult (Profeta, Balling, & Roosen [43]). The brand images of different nations vary a great deal, and we may consider that a certain product in the market becomes significant to customers when the brand positioning is strong and there is a unique brand association with other products. Because brand image is primarily based on the customers perspective, the marketer’s control over this issue is minimal. The positioning of product elements in the market differs according to personal characteristics, desired objectives, and customer values (Chen, Mathur, & Maheswaran [14]). However, external factors affect brand positioning in the market. These factors include competition, social issues, and cultural issues in the economy (Johnson, Tian, & Lee, [26]) (Kim, Choi, Kim, & Liu [30]).

Country of origin brand personality results from the association of individual personality characteristics with a COO product or brand. Positive COO brand personalities are those that are preferred by customers because they create trust, loyalty, and security and allow companies to have different types of positioning strategies among multiple marketing techniques that can influence consumers’ purchase intentions. (Dinnie [16]).

Marketers emphasizing COO brand personality should strive to match the personality or self-image of the consumer via segmentation-based efforts (Casidy, Tsarenko, & Anderson [9]) (Lin [36]).

The approach to consumers’ perceptions of a country, its products and services is dynamic. Consumer attitudes towards products improve significantly if consumers are exposed to communication or promotion (Samie [45]). The image of the stereotype “*made in*” was heavily influenced by familiarity and the availability of the product (Samie [45]).

Stereotypes are a phenomenon that can be considered universal, and the existence of the phenomenon called stereotype is evident (Cattin, Jolibert, & Lohnes [10]) (Roth & Diamantopoulos [44]). Stereotypes are also perceived differently by consumers in different countries, since consumers who share the same cultural values tend to be similar in their assessments to the country of origin (Cattin, Jolibert, & Lohnes [10]). The issue of information and its relevance (not being ambiguous) is gaining importance in the studies. Consumer knowledge is increasing and information as a type of attribute is a moderator of the effects of country of origin on product evaluations. If the information is ambiguous, both consider the country of origin differently (Parameswaran & Mohan [41]). High brand equity can be strongly associated with brand origin. In contrast, low heritage brands generally have weak and therefore incongruent brand associations, so information about the country of production is likely to have a pervasive effect on all beliefs about the featured products (Hui & Zhou [51]).

Assessing products and services

A considerable number of studies focus on product evaluation concluding on the existence of the country-of-origin effect and affecting consumer behavior, but less so if a multi-attribute approach is used. Relying on the relationship between domestic and foreign products, several studies have concluded that the country effect is a variable that affects the decision when the stereotyping phenomenon is present. Familiarity then has a strong influence – consumers are reluctant to buy when the brand is not known (Samie [45]) (Usunier & G. Cestre [49]). Country of origin and brand name affect the perception of the consumer given the quality of the product and stimulation of the country-of-origin effects who are relevant on the evaluation of bi-national products (Han [21]). Sometimes we are in the presence of the *halo effect* and the *summary effect* on product evaluation. The image of a country can then be used by consumers in product reviews in the following directions, or both: as a *halo*

(In terms of brand management, a *halo effect* is one where the perceived positive aspects of a particular item are extended to the full range of the brand. For example, in a range of oils a brand that stands out, but that serve as the basis for all remaining range or even for products other than oil. The effect is also exploited in the industry in general. It is perceived more in the relationships of the agro-food sector) construct (the image of a country is used to consider products that consumers know little); as a *summary* (The consumer purchase attitudes are, generally, routines. Search showed that in this sense simplifications and shortcuts are present in their decisions. After careful review, the consumer tends to synthesize aspects that lead to the decision and to structure his thinking and analysis purchase according to this simplification. Categorizes the goods and also the sources as if it was a photograph) construct (as the consumer becomes familiar with a product of a country, the image of the country can be a construct that summarizes the beliefs of the consumer in relation to product attributes and directly affects their attitudes toward the brand). Consumers tend to associate the product categories to the perception they have of the country, “deciding” if the country has a profile for producing a certain product (Roth & Diamantopoulos [44]). With the globalization phenomenon the notion of mass production and the concept of hybrid products enhancing the importance of the origin, suggested that manufacturers should pay more attention to the potential consumers’ reactions in situations of international partnerships or alliances (Chao [12]). The studies evolve towards the perception of the country-of-origin effect when, when purchasing, the consumer evaluates perceived quality, purchase price, and product profiles such as country of design, country of assembly, brand, price, and warranty. Country of origin dilution occurs when other attributes are present, showing that familiarity plays a relevant role and thus country of origin information has little influence on consumer attitudes towards the foreign brand. In some cases, brand names are a particularly strong advantage for hedonic products and more ef-

fective than country of origin information. (Thakor & Lavack [48]). For ethnocentric reasons origin can regain some status by concluding that there is an importance and impact of both product and country images, and the presence of ethnocentrism on purchase intention (positive and negative). This ethnocentrism can be a source of competitive advantage, especially when domestic products are substitutes for imported ones, based on price/performance. In addition to changes in brand value, consumers classify products on different dimensions as production originates in other countries, which has implications for changing marketing strategy and policies (Knight & Calantone [32]). The image of the country of origin tends to be an antecedent of attitudes and beliefs, and beliefs, in turn, are a significant antecedent of attitudes. Stating this, national cultures play an important role in purchase decisions (Knight & Calantone [32]), valuing products from countries with different (higher) socioeconomic and technological levels. Studies reveal that the more technologically sophisticated the consumer, the more favorable he is to the products of newly industrialized countries (Ahholt [1]) (Laroche, Papadopoulos, Heslop, & Mourali [35]). The fact that the country of manufacture is a country of low reputation means that this information can produce negative effects on product evaluations if the brands have little value (Ahholt [1]). Relevant for the study of the effect is the idea that the image of a country is a three-dimensional concept consisting of cognitive, affective, and conative components (Laroche, Papadopoulos, Heslop, & Mourali [35]). (The image of a country and beliefs about a product, affect the evaluation of a product simultaneously and independently of the level of familiarity with the products of that country, and the structure of the image of a country influences the reviews of products directly and indirectly through beliefs about products. When the image of a country has a strong affective component, it influences product evaluations stronger than its influence on the beliefs of the products. Alternatively, when the image of the country has a strong cognitive component, its

direct influence on product evaluations is smaller than its influence on the beliefs of products).

Access to low-cost resources can improve a company's competitiveness in a global market, but country of origin (COO) has been shown to have an indirect influence on consumer purchasing behavior (Berry, Mukherjee, Burton, & Howlett [7]) (Koschate-Fischer, Diamantopoulos, & Oldenkotte [33]) (Samie [45]). As already mentioned, the COO effect can be differentiated between the brand's country of origin and country of production (COP) considering that a poorly perceived country of production can devalue the brand (Godey, et al. [19]) (Nebenzahl & Jaffe [37]).

As for studies focusing on the quality of the service available, much work has been done around the issue of the price variable. Price in services is a strong, recognized variable and can override country loyalty, but is reversed when the consumer has higher incomes. Still, country of origin seems to be relevant for consumers, albeit stronger than brands when it comes to quality and attitude. Less engaged consumers tend not to think much about associations to country of origin and therefore need more information to support their decision. Consumer-related behaviors emphasize high and low involvement purchases, but also services involving high or low involvement (Usunier & G. Cestre [49]). The level of consumer involvement depends on the degree of personal relevance that the service has for the customer. If it is relevant to the consumer, he documents himself and demands adequate information. Risk perception is one of the antecedents of involvement, therefore risk and involvement seem to be related to the degree of information seeking. High involvement acquisitions are important to the consumer because they pose more risk, as opposed to low involvement ones. (Usunier & G. Cestre [49]). Studies conclude that more important than brand origin is the perception of brand origin, which should be given more attention (Thakor & Lavack [48]).

Brand Origin

If the country-of-origin perspective was strong, this trend has evolved to the importance of the origin of the brand or the region of origin of the brand. It is argued that globalization, product hybridization, commercial communication, global branding and the decline of origin labelling in World Trade Organization rules are responsible for making COO difficult (Samie [45]) (Usunier & G. Cestre [49]). Consumer's perception of the place, region, or country to which a brand belongs defines the brand origin (Costa, Carneiro, & Goldszmidt [15]). The country where a product is manufactured is related to several unique elements (culture and sub-cultures, climate, political climate, landscape, languages, economic and technological development, people, heritage, history and religions) (Allman, Fenik, Hewwtt, & Morgan [3]) (He & Wang [22]). The country's image is viewed as an asset of the organization, and it has a positive impact, and it's considered to be a liability when a country's image has negative impacts on the nation (Cheah, Phau, Kea, & Huang [51]) (Hui & Zhou [23]). Previous studies have suggested that there should be a positive correlation between the perception of where a product is manufactured and the image that is portrayed by the brand to avoid negative impacts on the economy (Allman, Fenik, Hewwtt, & Morgan [3]) (Cheah, Phau, Kea, & Huang [13]).

Accordingly, brand origin can be understood simply as the place a consumer associates with a brand (P. Magnusson, Westjohn, & Zdravkovic [39]). Considering the immense commercial relevance of brands for marketing success (Ambler [4]) (Keller K. L. [28]), the question of how various facets of place-category interrelationships influence brand equity (BE) has emerged as an interesting avenue for advancing knowledge of origin effects in general. While the impact of COO on consumer attitude towards products has been studied for decades, the impact of brand country of origin (COBO) on consumers has only recently gained some interest (Pikturnienė & Treigytė [42]). Their research revealed

unique results where consumers have a different attitude towards products with different combinations of COO and COBO. They reveal that consumer attitude towards products with different combinations of COO and COBO does not depend on the product category but on the consumer's susceptibility to interpersonal influence. If a consumer's attitude is considered as a relatively constant opinion about something, this opinion often helps the consumer to make an easier decision – the opinion is formed, and if the situation is repeated, there is no need to deal with the problem again (an attitude represents the intention of a predisposition, motivation and can be positive or negative). (Godey, et al., [19]).

Anyway, the location (involving the country, region or even city) is now emerging as an important topic from the point of view of economy and society, recognizing that each place builds its own image (Ahholt [1]) (Usunier & G. Cestre [49]) and the origin encloses a set of benefits presented as a proposal in a clear and captivating brand. Business location has been shown to generate different effects in terms of country of origin (COO) and in terms of brand origin and country of production (COP). The country of production and brand origin may not be the same, potentially highlighting the effect of incongruence on a brand, consumer ethnocentrism and location issues, particularly when a well-known brand is from a developed country and the COP is in a developing country. If perceived by the consumer, it can generate a differential effect between the origin of the brand and the country of production (COP), with the effect of devaluing the brand (Godey, et al., [19]) (Nebenzahl & Jaffe [37]).

There is a trend towards regional differentiation reinforced by geographical protection, which is reinforced by consumers who increasingly demand products with some proof of authenticity and traceability. Localization brings several benefits such as presenting a proposition in a clear and fascinating brand. It has been shown that if the country of origin of the brand is respectable, this element has a posi-

tive and significant effect on brand value and brand dimensions. Consequently, there is a propensity for regional differentiation strategies reinforced by geographical protection. Thus, as a variable, the country or region of origin is similar to price, brand, or retailer reputation in the sense that none of these factors has relevance on the functional performance of the product, but can be worked on without physically modifying the product (Ahholt [1]) (Samie [45]). Since it has been realized that the country-of-origin effect portrays the association of the product or service with the country's image and influences it on consumer perceptions, attitudes, and purchase intention. In most of these investigations, the brand has been treated as an extrinsic product attribute (Samie [45]) (Papadopoulos [40]) (Usunier & G. Cestre [49]) as has been the case with the country of origin. But as stressed and suggested by other authors (Zhou, Yang, & Hui [51]) (Roth & Diamantopoulos, [44]) the notion of origin is now over "*the matter of brands and their content*". The brand has played a peripheral role and presents itself as a moderating variable of the country-of-origin effect at the time of product evaluation and purchase decision, sometimes masked in holistic brand constructs such as brand image, brand equity and brand success. brand. Other studies, starting in the mid-1990s, have tried to understand how assessments of global brands vary when associated with different countries or production locations. (Papadopoulos, Ahmed [2]) (Usunier & G. Cestre [49]). Over time, it evolved towards the origin of the brand, creating the opportunity to study the origin of brands, in addition to the origin of the products. The term provenance, like location, seems, on the other hand, to be more appropriate because the origin may not be exclusively linked to a country. The term provenance is considered (Zhou, Yang, & Hui [51]) because also deals with the question of origin in another dimension – the time – and the origin is often perceived as both an historical time or date (*since 1850* and *founded in 1850*) and sometimes as the site of an initial design (*created or*

established in the Azores) even though this may seems confusing. As consumer perceptions are not aligned with everything the organization says about itself and its brands, we can assume that there are only reflections that allow us to talk about brand image. If the origin can be associated with the brand, then it is possible to apply the characteristics that are attributed to the phenomenon of association with brands: strength, favorability, and the fact of being unique. The strength of the brand's link with its origin can happen due to the geographic position of the source in relation to the brand's core values and the long exposure of consumers to marketing strategies (Ahholt [1]). As for favorability, some brand associations can be evaluated by consumers more positively than others, thus, it is possible to trust them promoting positive attitudes towards the brand (Cattin, Jolibert, & Lohnes [10]), so that other brands may evoke the origin implicitly. An association is considered unique when it is not shared with another brand and is exclusively linked to the brand taking an important role in the market especially in conditions such as private market oligopoly situations and the period relating to the early life cycle of the product (Fruchter, Jaffe, & Nebenzahl [18]) (Zhou, Yang, & Hui [51]). The country embraces within its borders a wide range of entities and powers, leaving to him the difficulties of developing a strong component of strategic management that serves the desired positioning of the country. Images that consumers associate to the country of origin of a trademark function as signals of quality and guide the brand value (Laroche, Papadopoulos, Heslop, & Murali [35]). Consumers generally perceive the place of origin of the brand and the place of manufacture of the product. It is worth noting that the image for the country of origin comprises micro and macro images (Laroche, Papadopoulos, Heslop, & Murali [35]). The macro images correspond to beliefs held by consumers (eg level of economic development) while the micro images correspond to beliefs related to very specific products produced by a country (German cars as

being technological and sophisticated). Micro and macro images of countries influence the brand value differently. When approaching the country of origin of the macro point of view we consider it as global level variable related to aspects such as associations in the country including national symbols, political and economic conditions, levels of industrialization, levels of education, and cultural values (Laroche, Papadopoulos, Heslop, & Murali [35]). The micro level, on a product category, implies that either the country or the product benefits from the association with the product category. The destinations, territories, and geographies, such as brands, end up having unique characteristics and it is strategic to aggregate all of them and understand then how all these activities are communicated (Ahholt [1]). This is relevant because some researchers argue that Country of production may provide a weaker brand association than brand origin (Johansson & Nebenzahl [25]) (Thakor & Lavack [48]).

The complexity arises in the exact measure that management of the country, region or local brand is not dependent on a single entity. In many cases, and often, is dependent of the political cycle and is implicitly given to numerous entities and organizations with regularly divergent interests (Ahholt [1]). The application of branding techniques to develop and sustain a local image is something very recent. The interaction between the consumer, the brand, the place, and the awareness that the place favors products or services (and therefore the citizens), in the logic of an umbrella brand, creates new dynamics and new products. People's perceptions gain strength because that is what is relevant from the point of view of image construction in the present and in the future. (Ahholt [1]) (Zhou, Yang, & Hui [51]). Building a local reputation, whose qualities and attributes are recognized and inspire associations, motivates capacities to trigger investments, attract people, companies, sell goods and, therefore, building a reputation requires a strategy, qualities, positive elements, exclusivity, and sustainability throughout of time (Ahholt [1]).

We have seen that the research has taken a hedonistic perspective approaching such terms as brand origin, product-country image, and product-place image. In post-industrial economies, the service sector is changing daily, and globalization is one of the main drivers of this, taking us to the assessment of the origin in the service sector. It is important to notice that the use of origin cues should be subtle and implicit sometimes, and more explicit in others. However, the origin is incentivized by some politic entities being they regional, national or multinational like the European Union, for instance when fomenting the protected denomination of origin (PDO) or the protected indication of origin (PIO) for some products. Both PDO and PIO are growing in Europe becoming a distinctive point promoting the origin and its competitiveness. This development involves today new local narratives and discourses and in an emergent global economy of places the opportunities to make different outcomes depends on the capacity to value local resources, reorganize strategies and reshape territorial identity. In this context, the processes of diversification and integration to improve competitiveness and quality of life hold the territorial identity through several products (Woods & McDonagh [50]) (Kipnis & Broderick [31]). As important or even more is the perceived brand origin as a source of brand appeal, relegating to the background the question about where the company produces its goods or services, and giving importance to this perception, even for reasons of stereotyping. In a recent study by Josiassen (Josiassen, Lukas, Whitwell, & Assaf [27]) he developed and tested a framework that divided the basis of the association to a place into three facets: general place image, product image, and category image. All three facets exert an effect on a consumer's summative judgment of product quality. In doing so, this model can explain variations in the effect of the association with a place on judgment with greater accuracy than models that view categories as a moderator. What is particularly interesting about the Josiassen framework is that the relative significance of these different facets can be compared.

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Section 4. World economy

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COVID IMPACT ON GLOBAL ECONOMY

Abstract. Millions of people lost their jobs and small businesses, hospitals and medical care professionals experienced unprecedented hardships, children all over the world face the loss of family members and the psychological consequences of the isolation from remote learning ... just to name a few aftermath caused by the pandemic. This paper aims to draw insights from analyzing the pandemic data. The data used in this study includes 210 countries concerning the impact of covid-19 on the global economy. 6 feature indicators including 4 economic indicators and COVID-19 Total Cases (TC) and Total Deaths (TD). The economic indicators are Human Development Index (HDI), Stringency Index (STI), Population (POP), and Gross Domestic Product per capita (GDPCAP). The Organization for Economic Co-operation and Development (OECD) unemployment data is also included in the analysis, which includes 38 member countries' unemployment values from January 2020 to October 2020. From these key dimensions of global development, lessons can be learned to aid government officials in response to future pandemics.

Keywords: Covid19, economic indicator, impact, employment, global economy.

1. Introduction

The COVID-19 pandemic disrupted almost every corner of the world in countless ways for the past two and half years. Millions of people lost their jobs and small businesses, hospitals and medical care professionals experienced unprecedented hardships, many children all over the world face the loss of family members and the psychological consequences of the isolation from remote learning ... just to name a few. While we can't solve or alleviate any of these problems by looking back at the pandemic data, insights and lessons for the future can be drawn by harvesting the power of data.

The data used in this study includes 210 countries concerning the impact of covid-19 on the global economy. 50418 data entries and 6 feature indicators

including 4 economic indicators and COVID-19 Total Cases (TC) and Total Deaths (TD). The economic indicators are Human Development Index (HDI), Stringency Index (STI), Population (POP), and Gross Domestic Product per capita (GDPCAP). The HDI is the composite statistic of life expectancy, education, literacy, and income indices used to rank countries into four stages of human development.

The stringency Index represents the systematically collected information on several different common policy responses governments have taken, measured, and aggregated. STI is a composite measure of nine of the response metrics calculated by The Oxford Coronavirus Government Response Tracker (OxCGRT) project. The metrics include school closures; workplace closures; cancellation

of public events; restrictions on public gatherings; closures of public transport; stay-at-home requirements; public information campaigns; restrictions on internal movements; and international travel controls.

The Organization for Economic Co-operation and Development (OECD) unemployment data is also included in the analysis, which includes 38 member countries’ unemployment values from January 2020 to October 2020. The OECD is a group of developed countries with high HDI that commit to democracy and market economy intending to stimulate economic progress and world trade.

Although we can’t paint a complete picture of the world with only these economic indicators, financial hardship is an integral part of people’s suffering and an important metric for governments’ performances.

2. Data analysis and Results

The data (.csv file) is imported as a DataFrame using Python programming language. Figure 1 shows the result from the.info() function from the Pandas library. The HDI column has 6202 null values according to figure 1. No obvious missing values in other columns and three columns have object data

types while the rest are all numeric. Figure 2 visualizes the dispersed missing values in the HDI column.

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50418 entries, 0 to 50417
Data columns (total 9 columns):
#   Column      Non-Null Count  Dtype
---  ---
0   CODE        50418 non-null  object
1   COUNTRY     50418 non-null  object
2   DATE        50418 non-null  object
3   HDI         44216 non-null  float64
4   TC          50418 non-null  float64
5   TD          50418 non-null  float64
6   STI         50418 non-null  float64
7   POP         50418 non-null  float64
8   GDPCAP     50418 non-null  float64
dtypes: float64(6), object(3)
memory usage: 3.5+ MB
```

Figure 1. Information of the dataset

To aid the further investigation, the DATE column was transferred to the Date Time type using the to_datetime function from the Pandas library. The time frame of the dataset is from 2019-12-31 to 2020-10-19. The month information is extracted and formed a new column called “MONTH”.

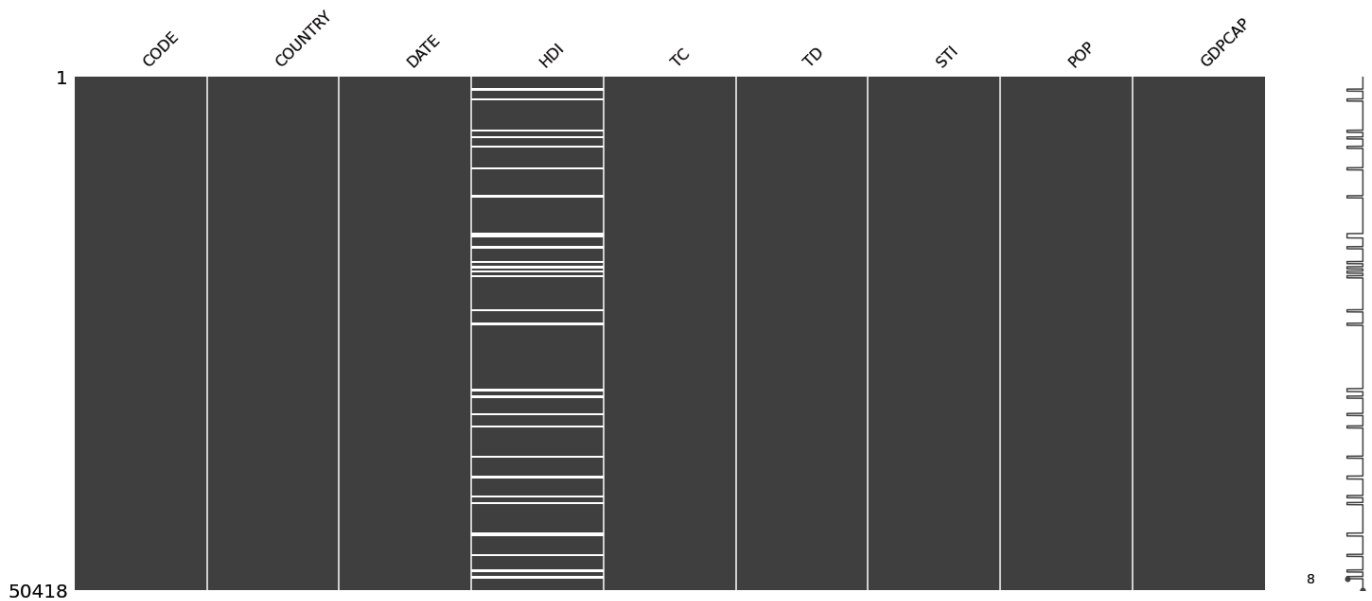


Figure 2. Missing values in the dataset

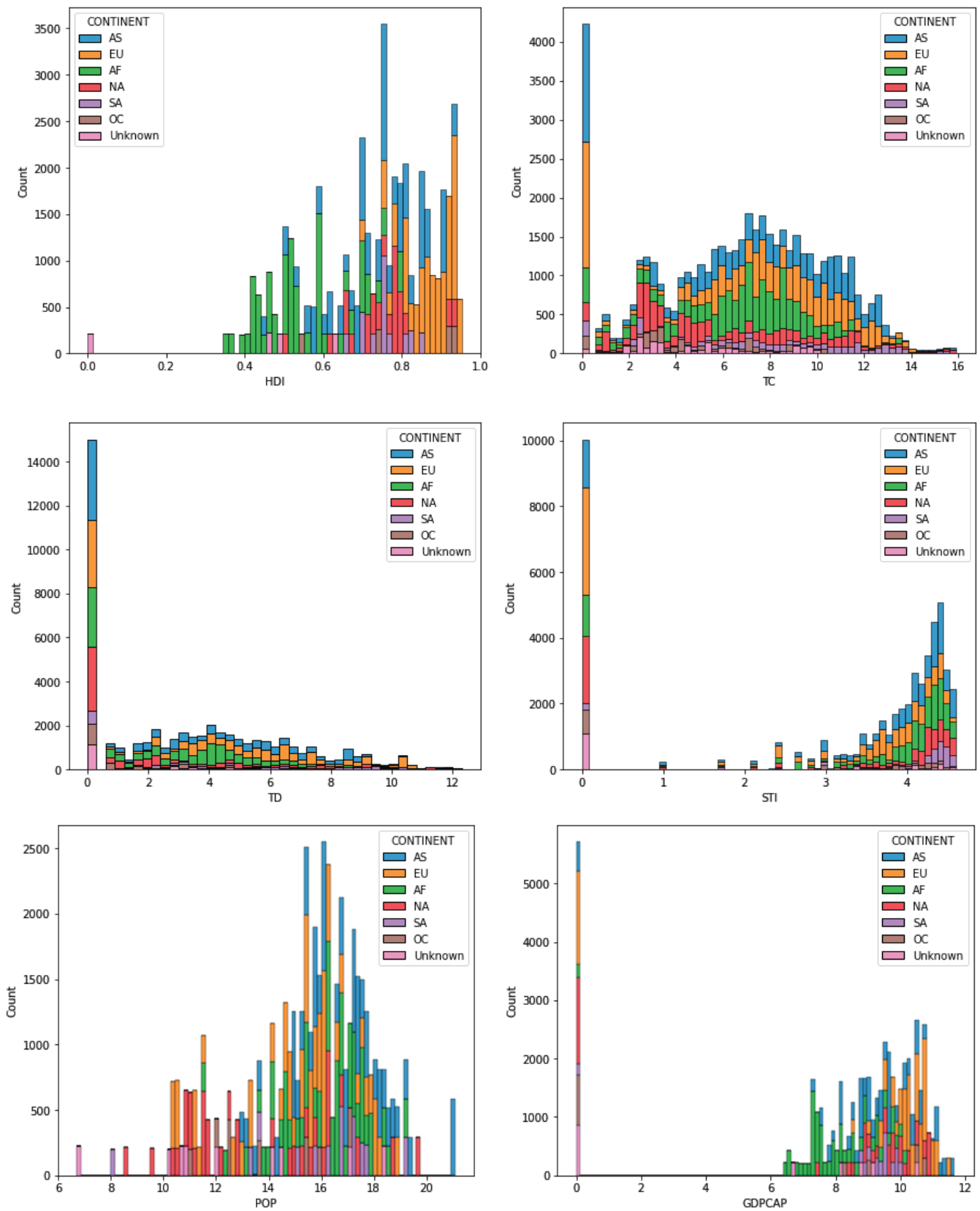


Figure 3. Histograms of each feature, color-coded by continent

With the `pycountry_convert` library, continent information was created from each country name. The following countries resulted in an “Unknown” continent: ‘Bonaire Sint Eustatius and Saba’, «Cote d’Ivoire», ‘Curacao’, ‘Democratic Republic of Congo’, ‘Faeroe Islands’, ‘Kosovo’, ‘Sint Maarten (Dutch part)’, ‘Timor’, ‘Vatican’.

Figure 3 shows the histograms for every feature column in “stacked” mode color-coded by the Continent. Histograms visualize the distribution of data

with the x-axis being the “bins” and the y-axis is the count of observance for the data that fall inside each range (bin). Missing values are omitted in the histograms. In the HDI histogram, a small amount of “Unknown” Continent data is close to zero which means potential missing data as well. The same conclusion can be drawn for the STI and GDPCAP columns according to the COVID-19 stringency index data from Our World in Data and the GDP per capita data from the World Bank.

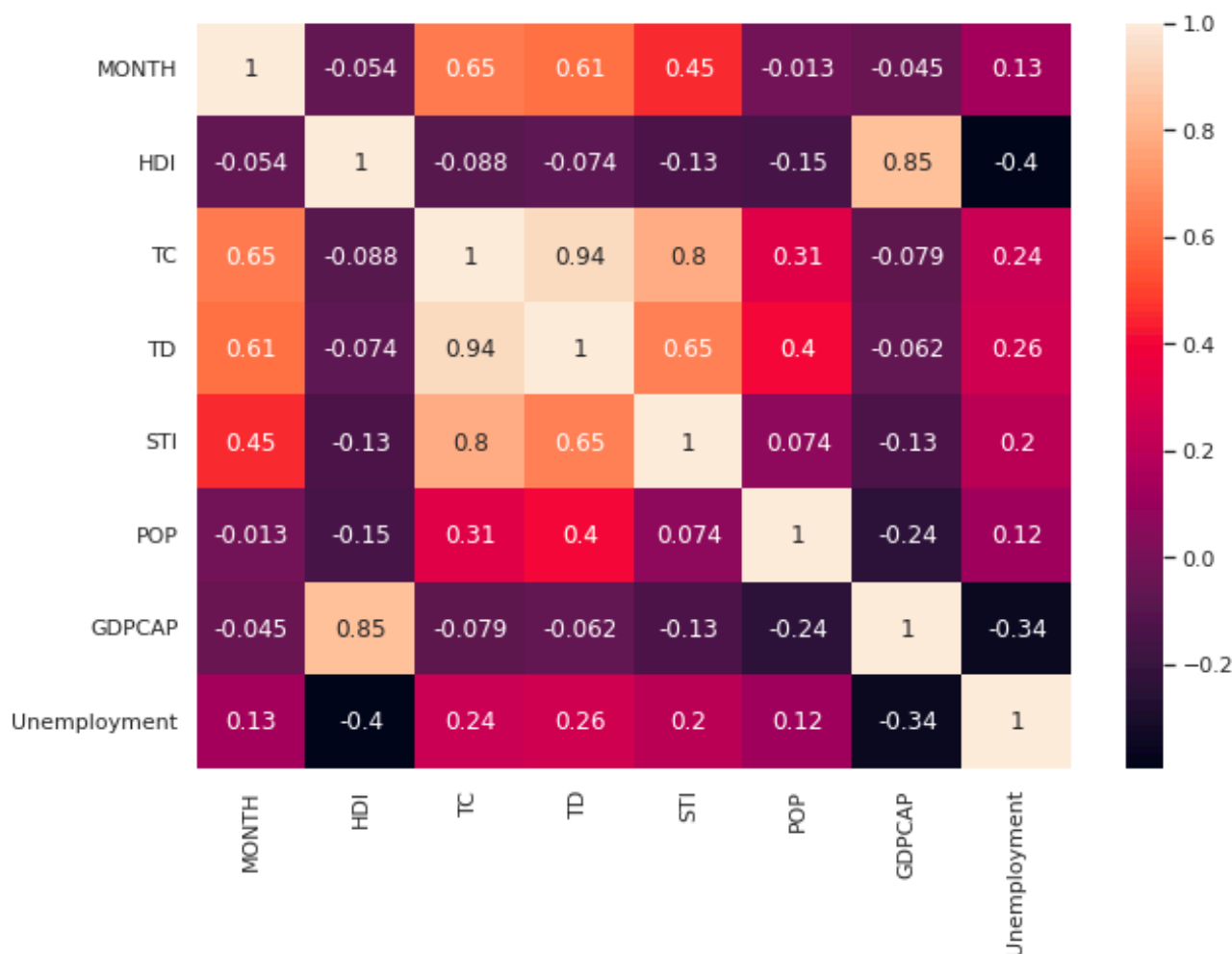


Figure 4. Heatmap of the correlation matrix of the features

After merging the unemployment data with the previous DataFrame, the correlation matrix can be calculated and shown as a heat map in figure 4. A heat map is a visualization tool that uses color intensity to represent the magnitude of numbers. From figure 4, HDI and GDP per capita are highly correlated with

a correlation coefficient of 0.85. Total cases and total deaths, total cases, and STI are highly correlated as well. TD and STI, POP and TC, POP and TD, POP and STI, POP and GDPCAP, GDP and TD are all moderately correlated. HDI and unemployment, GDPCAP, and unemployment are negatively correlated.

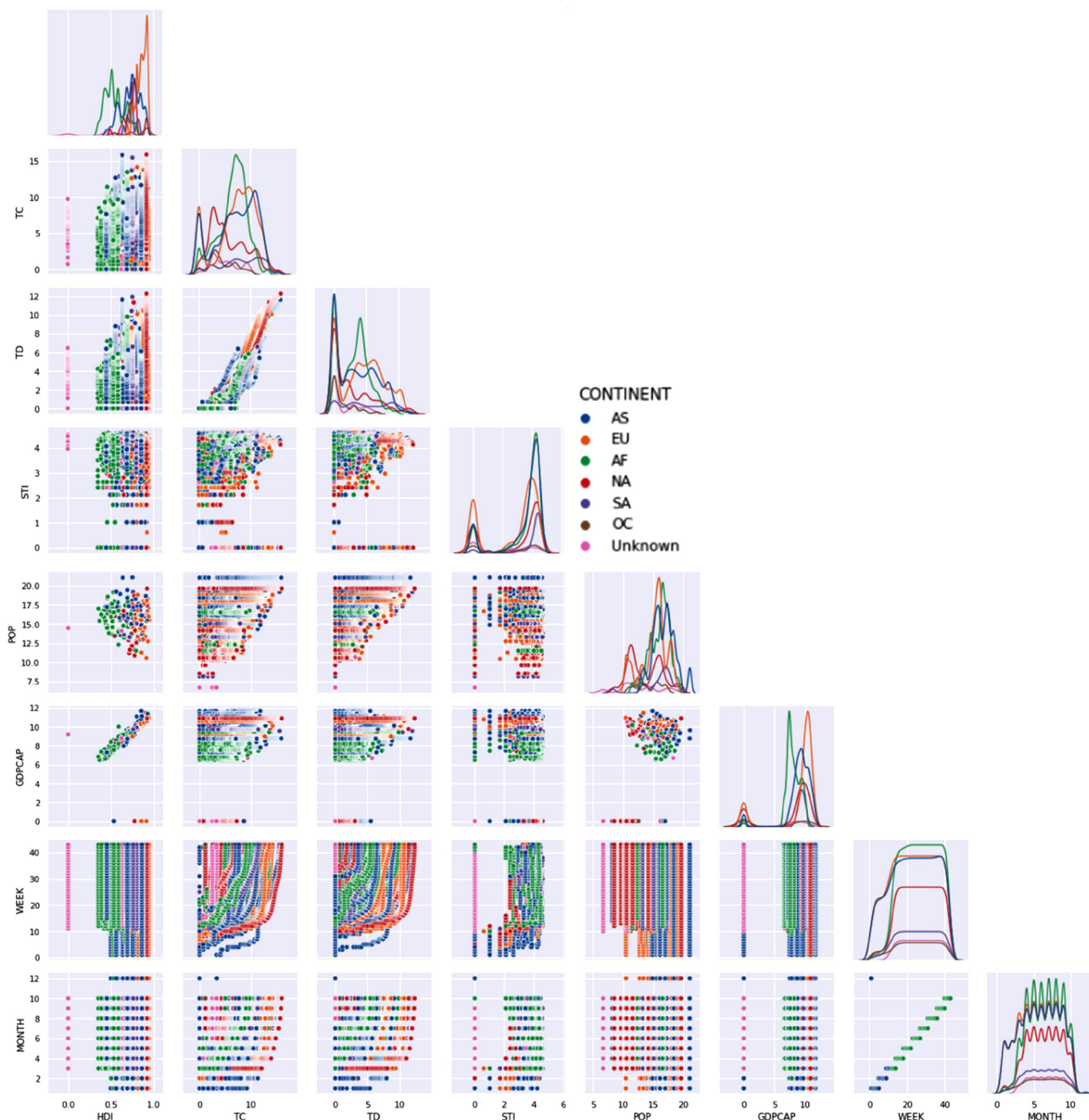


Figure 5. Pair plot of features to show pair-wise relations

HDI (human development index)

Figure 5 shows the pairwise relationships between each feature column. It is color-coded by the continent column as well. TC and TD, GDPCAP and HDI both have a linear relationship with each other.

After dropping missing values in the HDI column, 182 countries remained. The index also stayed constant during the time frame in the dataset. From figure 6, the top 5 countries with the highest HDI are Germany, Ireland, Australia, Switzerland, Nor-

way; the bottom 5 countries with the lowest HDI are Kosovo, Niger, Central African Republic, South Sudan, Chad.

Figures 7, 8, 9, 10, 12, 14, 15, 16, 17 are generated by the `lineplot()` function from the Seaborn library which automatically calculates the average value of the y-axis at any given point on the x-axis and generates a colored range for the y values.

Figure 7 shows that European countries have the highest average HDI, the second-highest continent is Australia. The lowest HDI continent is the “Unknown” category.

	CODE	COUNTRY	CONTINENT	HDI
25104	OWID_KOS	Kosovo	Unknown	0.000
33784	NER	Niger	AF	0.354
9180	CAF	Central African Republic	AF	0.367
42568	SSD	South Sudan	AF	0.388
9398	TCD	Chad	AF	0.404
...
17652	DEU	Germany	EU	0.936
22604	IRL	Ireland	EU	0.938
2434	AUS	Australia	OC	0.939
44296	CHE	Switzerland	EU	0.944
34494	NOR	Norway	EU	0.953

Figure 6. Top 5 and bottom 5 countries ranked by HDI

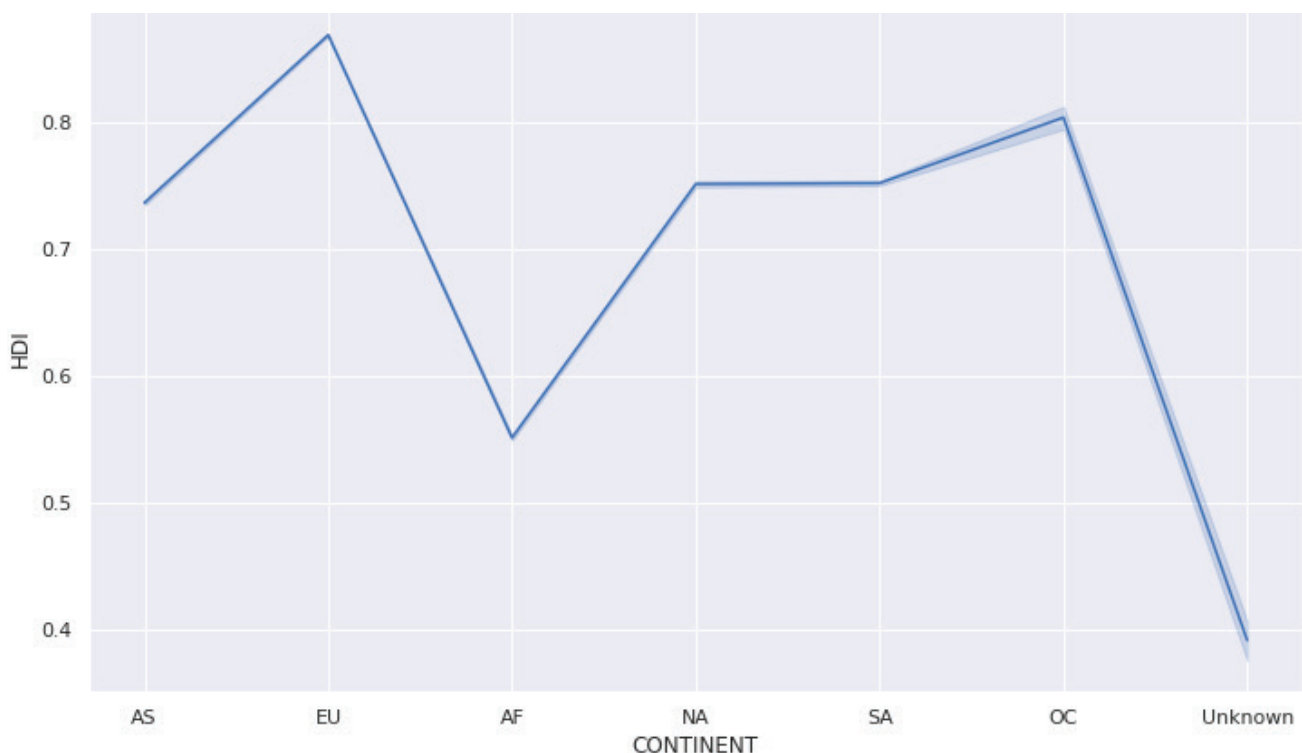


Figure 7. Line plot of HDI in each continent

Total Cases (TC) and Total Deaths (TD)

The COVID-19 total cases and total deaths data recorded 210 countries for most of 2020. Figure 8 shows the time-series data of total cases color-coded by continent. There is a sharp increase worldwide in March 2020 and South America has the biggest

increase since then. Figure 9 confirms that South America has the most total cases with Europe being the second. Figure 10 shows the time-series data of total deaths color-coded by continent. South America has the most total deaths again. Oceania has the lowest case and death count.

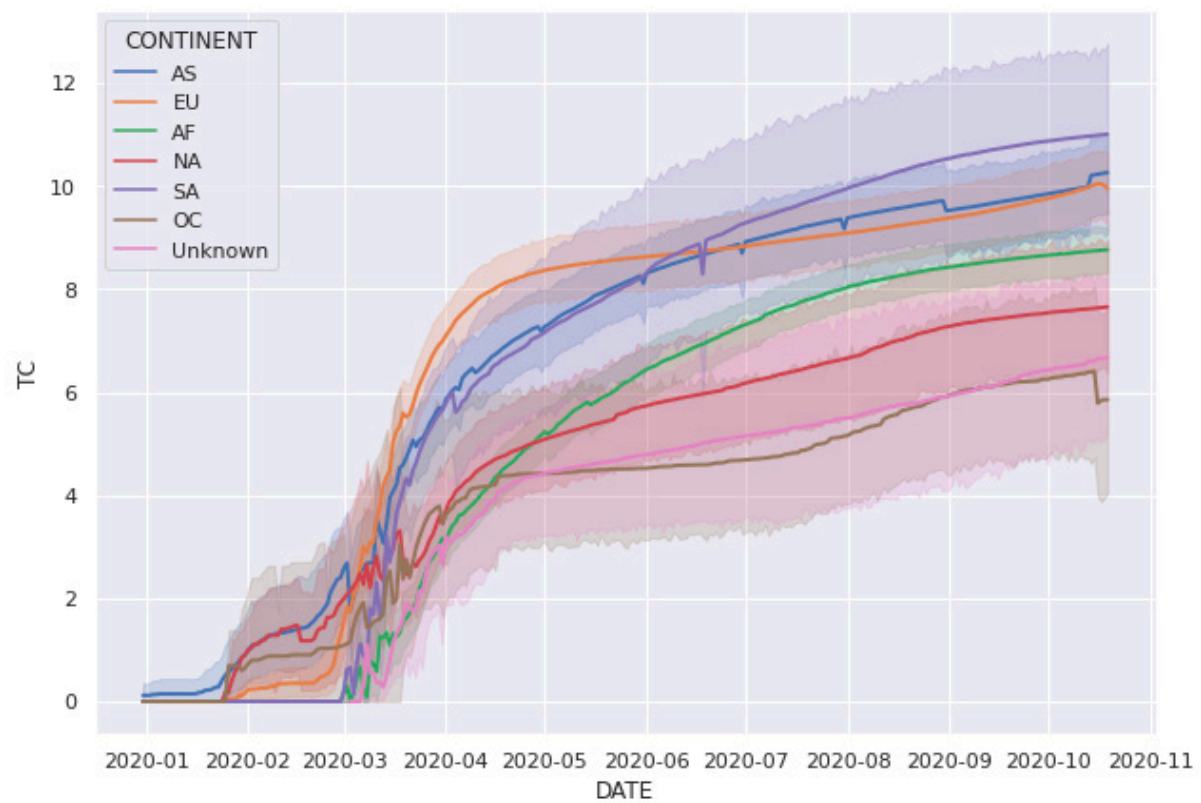


Figure 8. Line plot of total cases over time, color-coded by continent

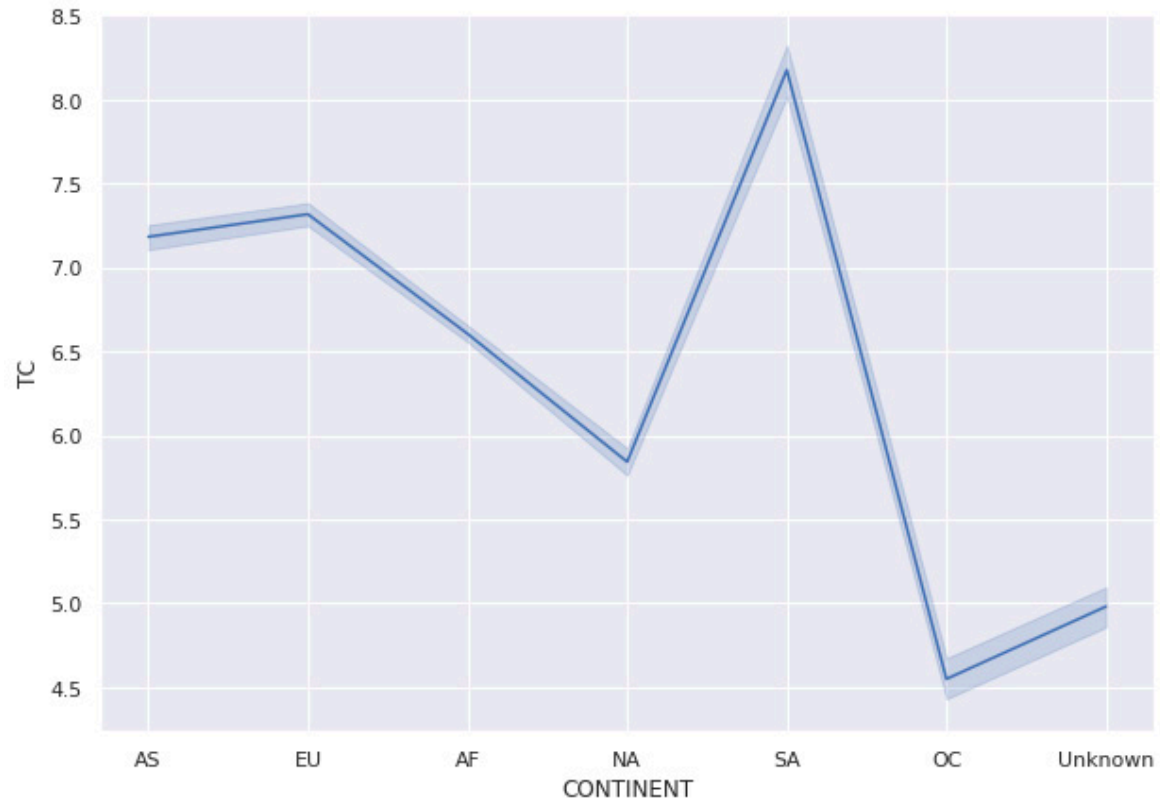


Figure 9. Total cases in each continent

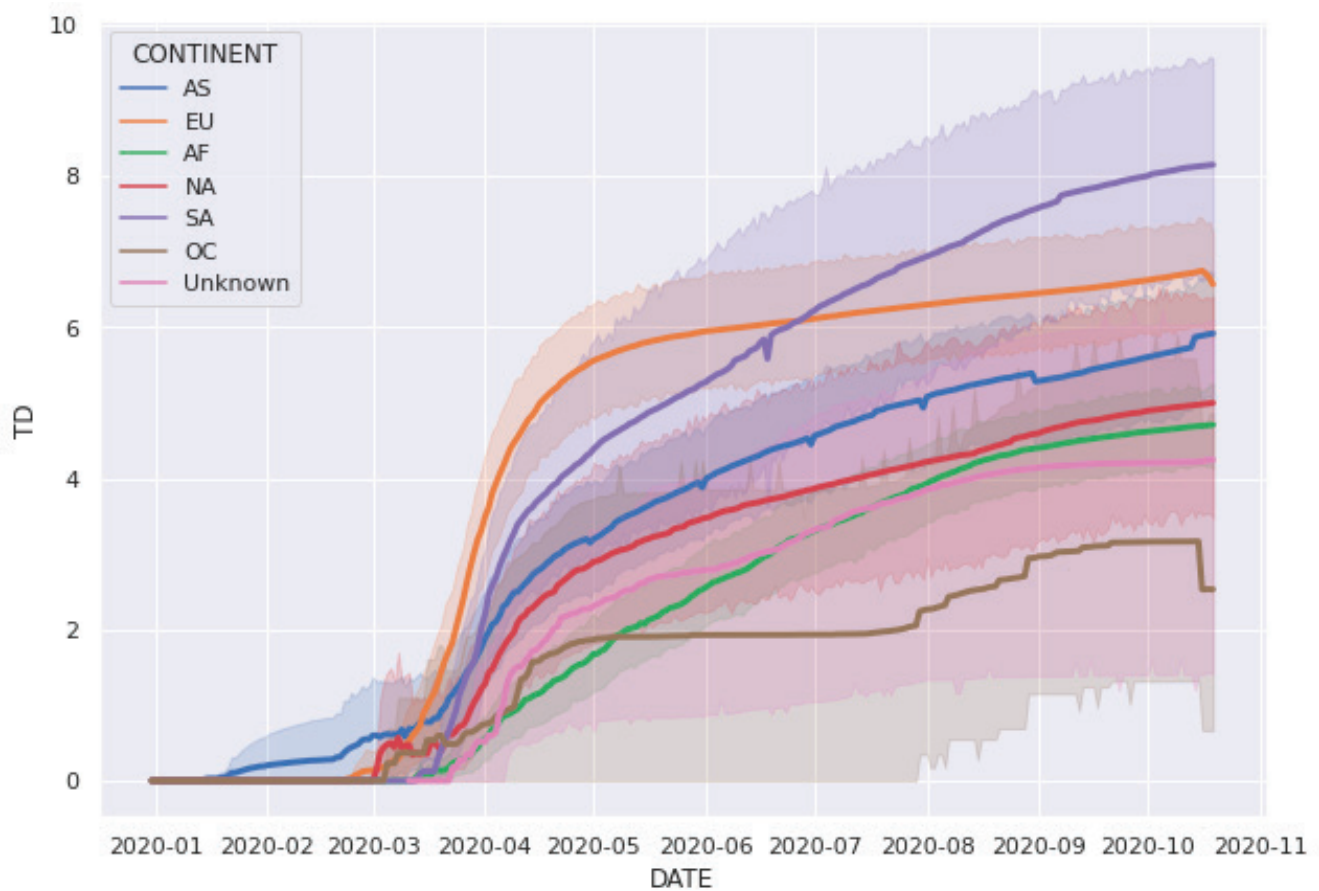


Figure 10. Line plot of total deaths over time, color-coded by continent

	COUNTRY	TC
87	Hong Kong	0.000000
173	Solomon Islands	3.988984
5	Anguilla	224.574488
65	Falkland Islands	493.373289
24	Bonaire Sint Eustatius and Saba	497.356421
...
178	Spain	2843.820343
97	Italy	2873.314489
27	Brazil	2913.256895
41	China	3128.587021
200	United States	3343.050755

Figure 11. Top 5 and bottom 5 countries in total cases

Figure 11 lists the top and bottom 5 countries ranked by total cases. Hong Kong, Solomon Islands, Anguilla, Falkland Islands, and Bonaire Sint Eustatius and Saba have the least amount of total cases. Spain, Italy, Brazil, China, and United States have the highest count of total cases. Figure 12 shows the time series plot of total cases in 10 countries with the most COVID-19 cases. China had the earliest increase but contained the situation rapidly and steadily, while the United States had the fastest increase and the highest count from April to November 2020.

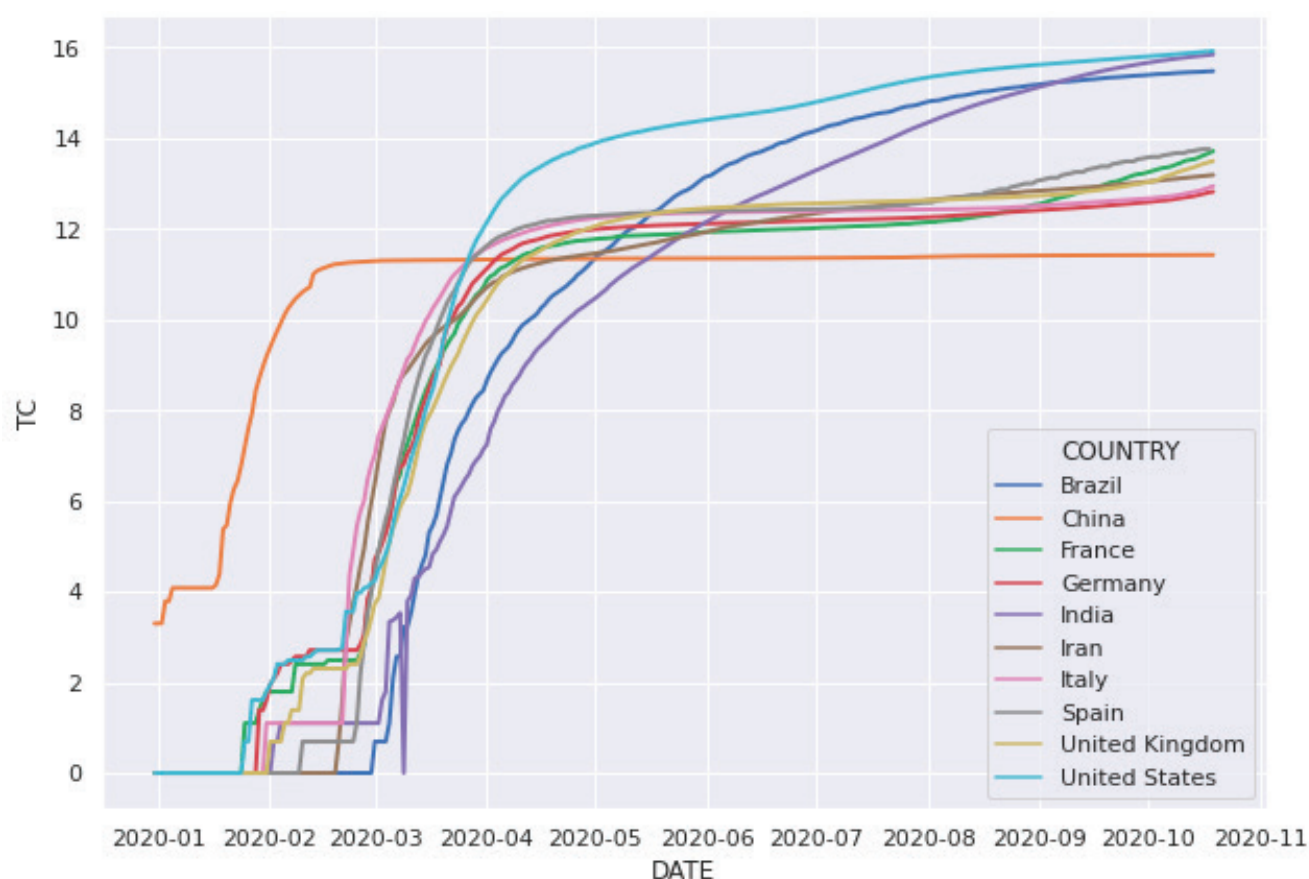


Figure 12. 10 countries with the most COVID cases

28 countries had zero total deaths during the time in the data. Some examples are Monaco, Timor, Liechtenstein, British Virgin Islands, and Gibraltar as shown in figure 13. The five countries that had the most deaths due to the pandemic are France, China, the United Kingdom, Italy, and United States. Figure 14 shows the time series plot of total deaths in 10 countries with the most deaths from the pandemic. Similar conclusions can be drawn as the total cases in figure 12.

STI (stringency index)

The OxCGRT's STI is a composite measure of nine of the response metrics rescaled to a value from 0 to 100 (100 = strictest). It represents the different common policy responses governments have taken. There are 210 unique countries in the dataset, 30 of those have STI of zero which are missing values. Figure 15 shows the time series plot of STI color-coded by continents. Australia, Africa, and South America have the strictest pandemic responses.

	COUNTRY	TD
127	Monaco	0.000000
190	Timor	0.000000
113	Liechtenstein	0.000000
28	British Virgin Islands	0.000000
75	Gibraltar	0.000000
...
68	France	2203.766710
41	China	2205.740166
199	United Kingdom	2209.519314
97	Italy	2327.710204
200	United States	2480.576064

Figure 13. Top 5 and bottom 5 countries in total deaths

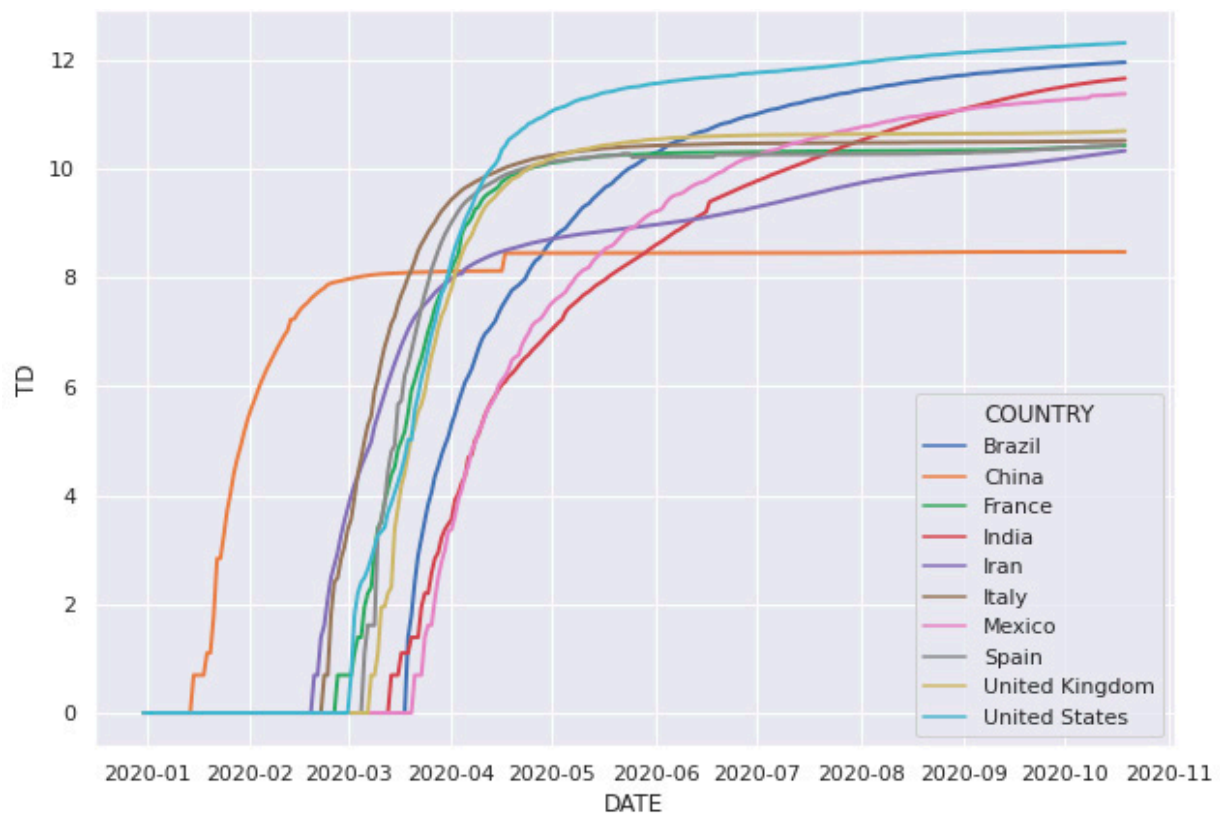


Figure 14. 10 countries with the most deaths caused by the pandemic

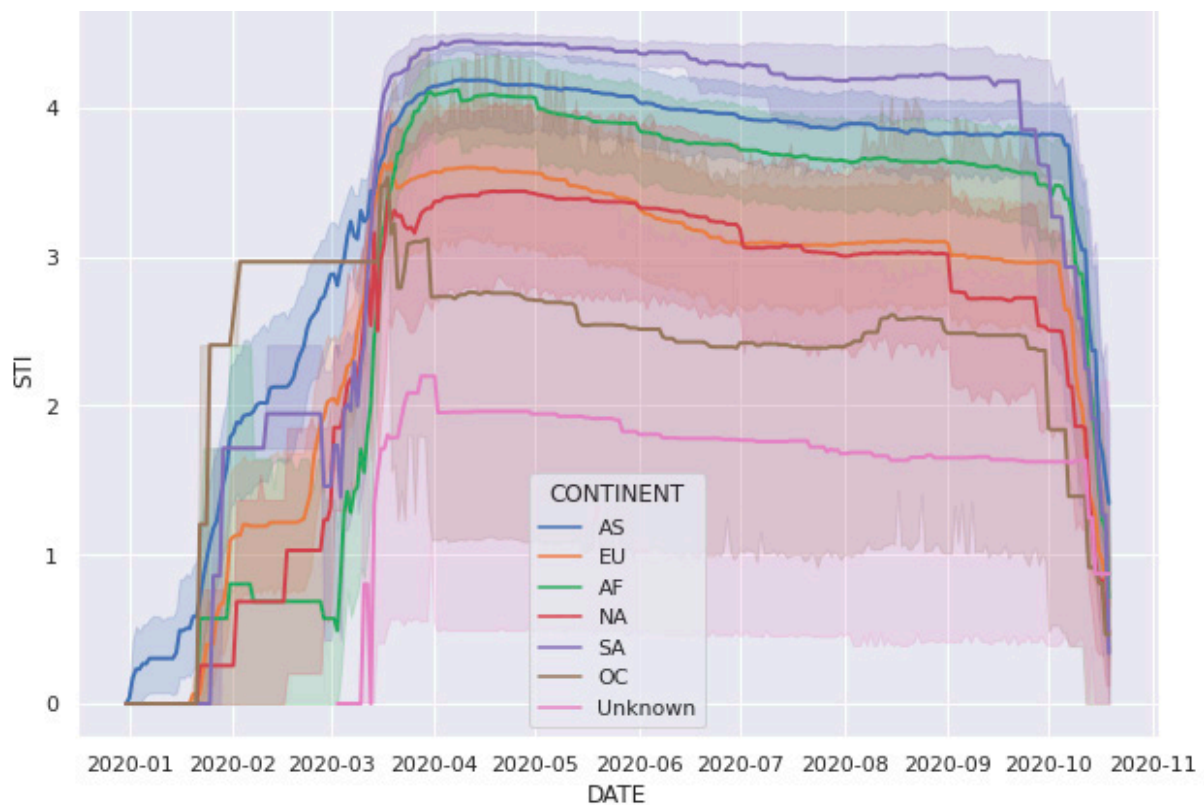


Figure 15. Line plot of stringency index over time, color-coded by continent

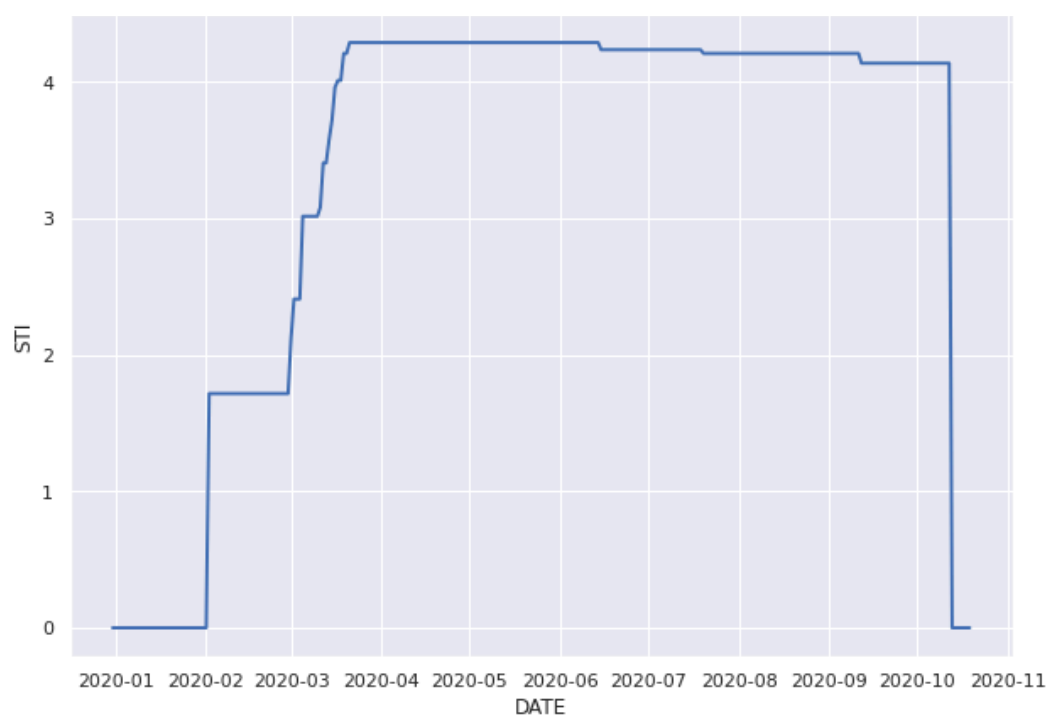


Figure 16. United States STI over time

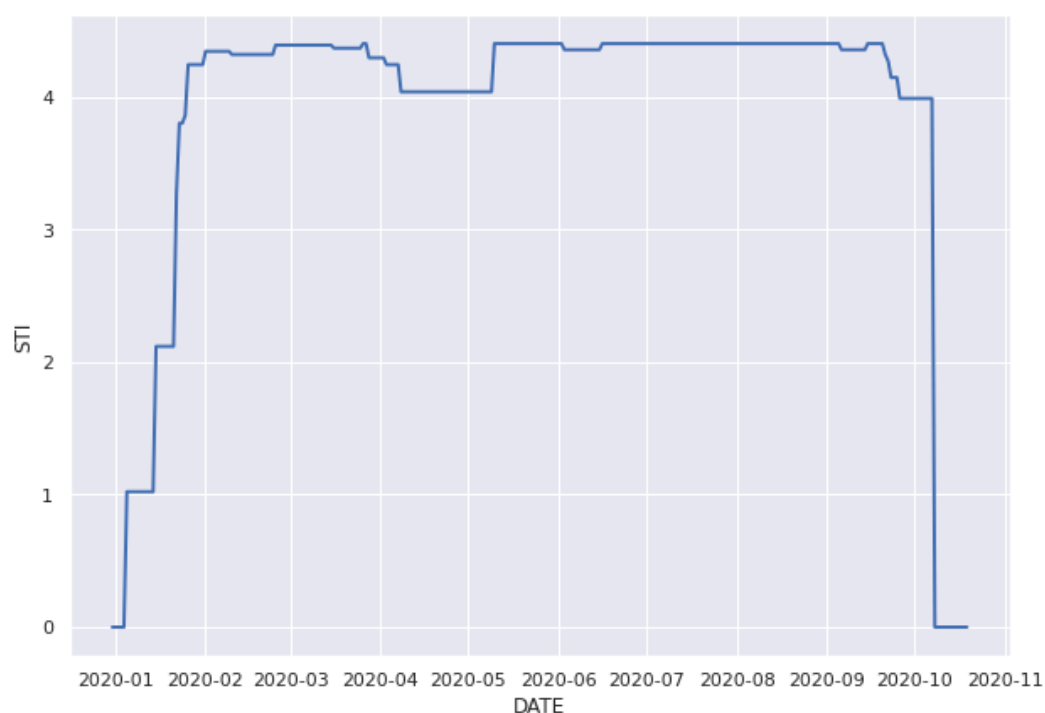


Figure 17. China STI over time

Figures 16 and 17 illustrate the STI of the US and China over time. US's response to covid is slower and more gradual than China's. However, after April 2020, they had similar STIs despite the common im-

pression. Figure 18 shows the five strictest countries towards the pandemic are Panama, Uganda, El Salvador, Honduras, Eritrea.

	CONTINENT	COUNTRY	STI
209	Unknown	Vatican	0.000000
127	EU	Malta	0.000000
129	EU	Monaco	0.000000
130	EU	Montenegro	0.000000
123	EU	Liechtenstein	0.000000
...
170	NA	Panama	4.374658
49	AF	Uganda	4.406101
160	NA	El Salvador	4.414523
165	NA	Honduras	4.424304
15	AF	Eritrea	4.507309

Figure 18. Countries ranked by their average STI value over the time in the data

Population (POP)

Population in the 210 countries stayed constant within the time frame in the dataset. The top five countries are India, China, the United States, Indonesia, and Pakistan. And the five countries with the smallest population are the Vatican, Falkland Islands, Montserrat, Anguilla, and Bonaire Sint Eustatius and Saba. And Anguilla, Falkland Islands, and Bonaire Sint Eustatius and Saba are among the five countries with the least amount of total cases.

The Gross Domestic Product per capita (GDP-CAP)

As justified earlier, the countries with the GDP-CAP of zero are missing data. Out of the 210 countries in the dataset, 27 countries have GDPCAP=0. From figure 20, the richest countries are San Marino, Switzerland, Norway, Kuwait, United Arab Emirates, Ireland, Brunei, Singapore, Luxembourg, and Qatar.

	COUNTRY	POP
49062	Vatican	6.695799
15656	Falkland Islands	8.155649
31363	Montserrat	8.516993
1251	Anguilla	9.615939
5945	Bonaire Sint Eustatius and Saba	10.174316
...
35082	Pakistan	19.213186
21722	Indonesia	19.426899
48121	United States	19.617637
21428	India	21.045353
9841	China	21.087439

Figure 19. Top 5 and bottom 5 of the countries ranked by population

	CONTINENT	COUNTRY	GDPCAP
39208	EU	San Marino	10.948373
44296	EU	Switzerland	10.957977
34494	EU	Norway	11.079062
25324	AS	Kuwait	11.090272
47533	AS	United Arab Emirates	11.116819
22604	EU	Ireland	11.117440
7072	AS	Brunei	11.181769
40821	AS	Singapore	11.356685
27693	EU	Luxembourg	11.454003
37464	AS	Qatar	11.669379

Figure 20. Top countries in GDP per capita

Unemployment in OECD countries

Even before the pandemic hit, global economic growth had slowed. COVID-19 put a big dent in the world economy. Millions of jobs were lost and the worst recession since the Great Depression happened in 2020.

Among OECD members, the Czech Republic and Japan have the lowest unemployment rate

around 2 and 2.5. Spain, Greece, and Colombia have the highest unemployment rate at around 16 and 20. Figure 21 shows the color-coded stacked histogram of the unemployment data. European countries and

Australia on average have lower unemployment rates. North America is more spread out while South American countries typically have higher unemployment rates.

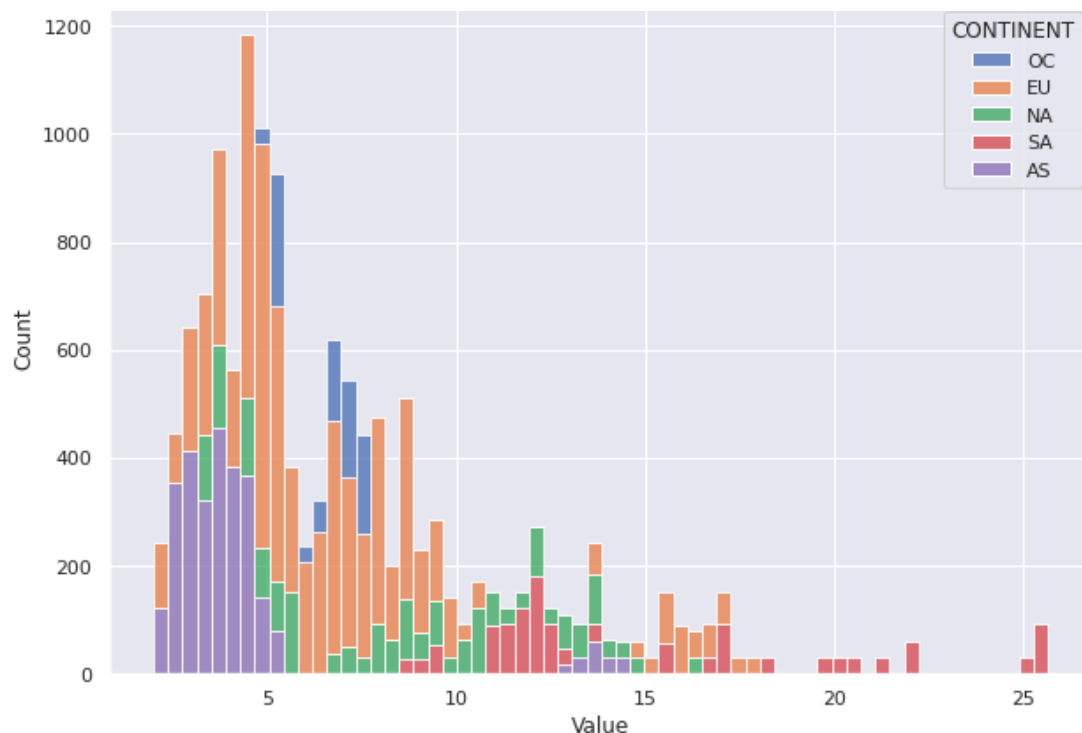


Figure 21. Distribution plot of unemployment rate in OECD countries color-coded by continent

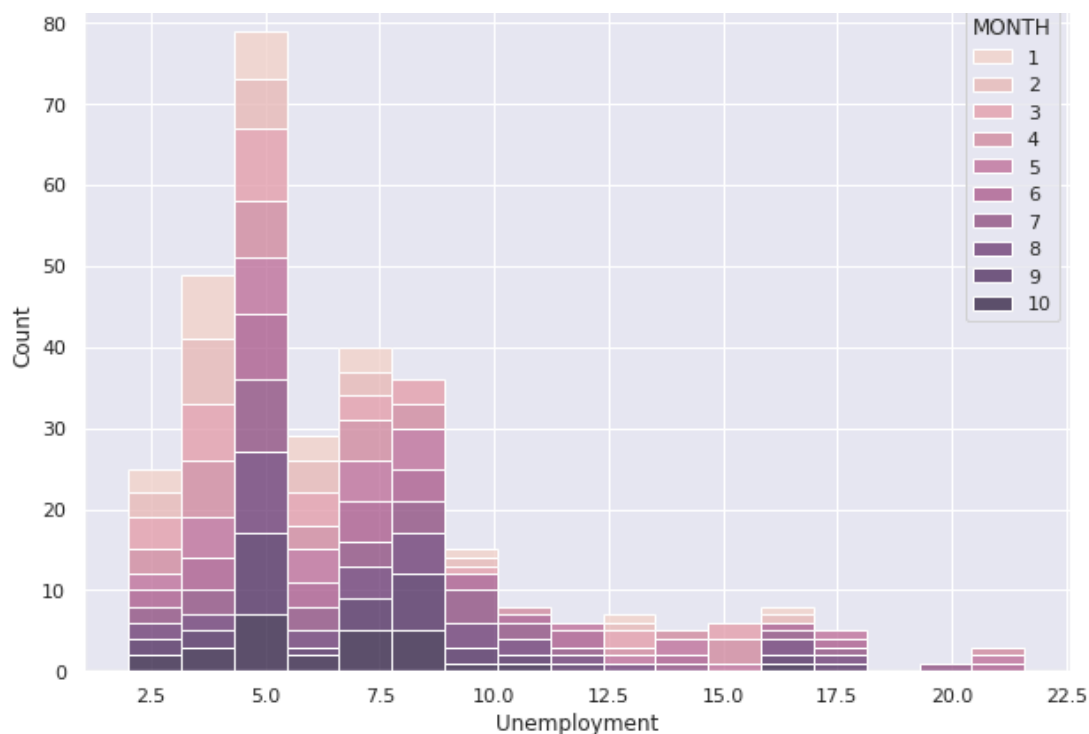


Figure 22. Distribution plot of unemployment rate in OECD countries color-coded by month

Figure 22 shows the stacked histogram of unemployment data color-coded by month. While some countries don't seem to be affected by the pandemic, more countries have higher unemployment rates during the height of the pandemic.

Figure 23 shows the line plot of the unemployment time series data color-coded by continent. The

"Unknown" category experienced the most dramatic change in February and June compared to other continents. Most countries had a sharp increase in March and a gradual fall around June except African and European countries which had a slow increase in most of 2020.

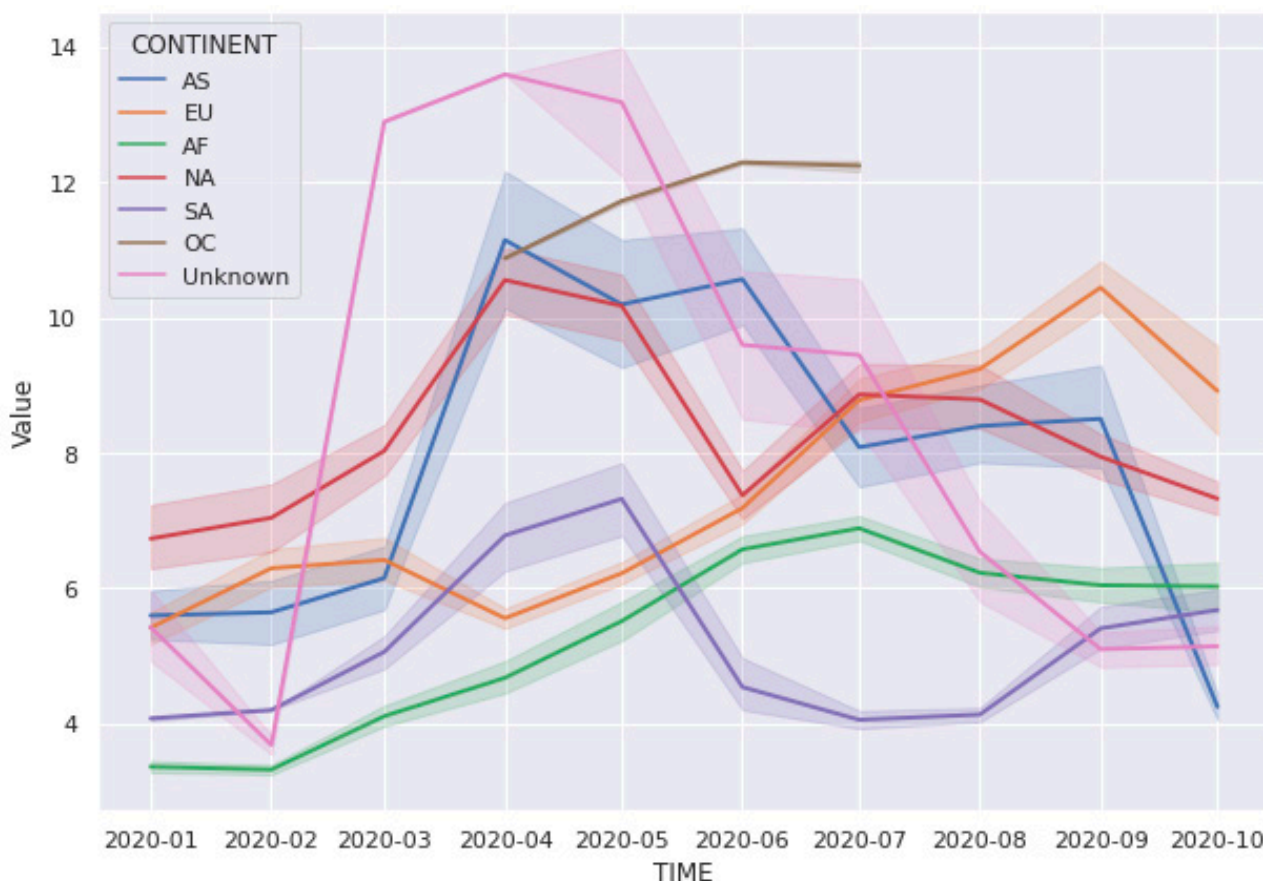


Figure 23. Line plot of unemployment rate in OECD countries color-coded by continent

3. Conclusion

Unsurprisingly, HDI and GDP per capita are highly correlated with a correlation coefficient of 0.85. Total Covid cases and deaths are closely related. And STI is highly correlated with total cases meaning most countries impose more stringent policies in response to higher case counts. The unemployment rates in OECD countries are negatively correlated with HDI and GDP per Capita.

COVID-19 brought the worst recession since the Great Depression in 2020. Most countries have higher unemployment rates during the height of the pan-

demic. European countries and Australia have the highest average HDI and lower unemployment rate on average in comparison with other countries. Most countries had a sharp increase in the unemployment rate in March and a gradual fall around June except African and European countries which had a slow increase in most of 2020. Among OECD members, Spain, Greece, and Colombia have the highest unemployment rate at around 16 and 20.

A sharp increase in total Covid cases also happened worldwide in March 2020 and South America has the biggest increase since then. Spain, Italy, Brazil,

China, and United States have the highest count of total cases. China had the earliest increase but contained the situation rapidly and steadily, while the United States had the fastest increase and the highest count from April to November 2020. The five countries that had the most deaths due to the pandemic are France, China, the United Kingdom, Italy, and United States.

Australia, Africa, and South America have the strictest pandemic responses. US's response to covid is slower and more gradual than China's. However, after April 2020, they had similar STIs despite the

common impression. It can be concluded that the initial response is crucial in fighting the pandemic.

The limitations of this study can come from the explicit and inexplicit missing data in almost all the variable columns. Also, during the data analysis stage, some countries were classified as the "Unknown" continent which has the lowest HDI and experienced the most dramatic change in the unemployment rate in February and June of 2020. The countries in this category may need further investigation.

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Section 5. Regional economy

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IMPACT OF THE REGIONAL TECHNOLOGY DEVELOPMENT AND INNOVATION ON THE UKRAINIAN LIGHT INDUSTRY'S EXPORT

Abstract. Empirical data refers to the light industry's export and indicators of the regional technology development and innovation (RTDI) including the technological and innovative activity, expenditure on innovation and R&D, its implementation and taxes in 25 Ukrainian regions from 2012 to 2019. The research methodology consists of: regression analysis to detect linear interactions; the spatial analysis to investigate spatial relations; the Hausman test to confirm the coherence of the random effect; difference-in-differences (DID) technique to calculate the impact of tax-free policy. The research verifies justification of the centralized policy on the digitalization and innovative transformations for the Ukrainian light industry.

Keywords: innovation, Ukrainian light industry, spatial analysis, difference-in-differences.

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1. Introduction

The light industry in Ukraine involves three groups: 1) textiles; 2) apparel; 3) leather and footwear. In 2020 the industry is represented by more than 2.5 thousand enterprises engaging about 88 thousand employees [1]. However, it faces a con-

stant decline in production and exports, which aggravated during the COVID-19 period. Thus, the domestic production index decreased dramatically by 19.4% for 2020 comparing to the corresponding period of 2019 (Figure 1), while the export dropped sharply by 17.6% [2]. Besides, the declining trend in the light industry's performance was observed for 2019, where the export activity and production were less by 9.16% and 9.9% comparing

to 2018, respectively [3]. Additionally, the export volume did not exceed 18842.2 thousand USD for 18 regions in January – May, 2020 which referred to 31% of the total light industry's export (Figure

2). Meanwhile, 36.7% contributed by two regions in Western Ukraine which export volume reached more than 49595 thousand USD per region in the reporting period [4].

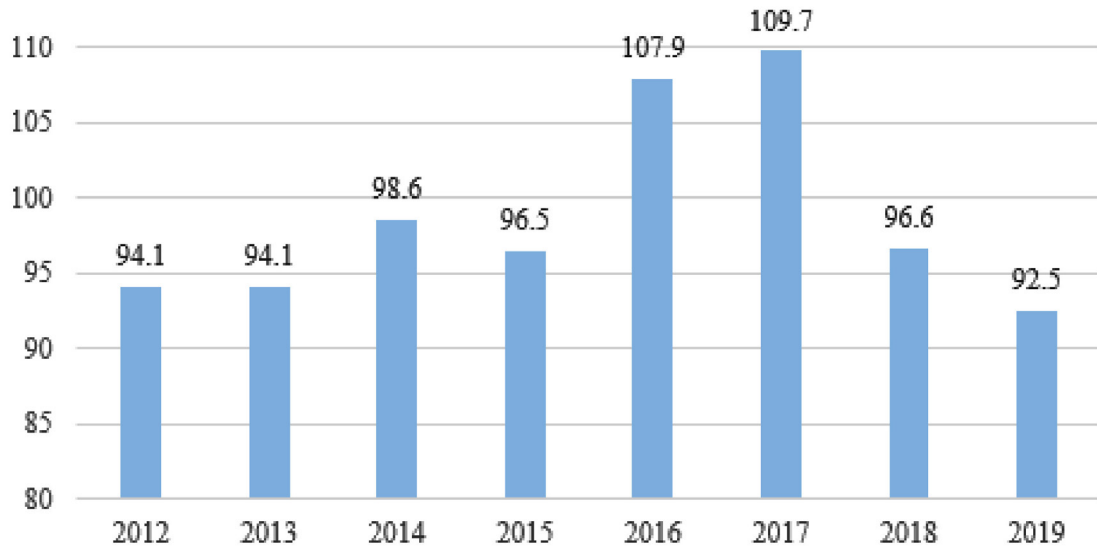


Figure 1. The Ukrainian Light Industry's Production Volume from 2012 to 2019

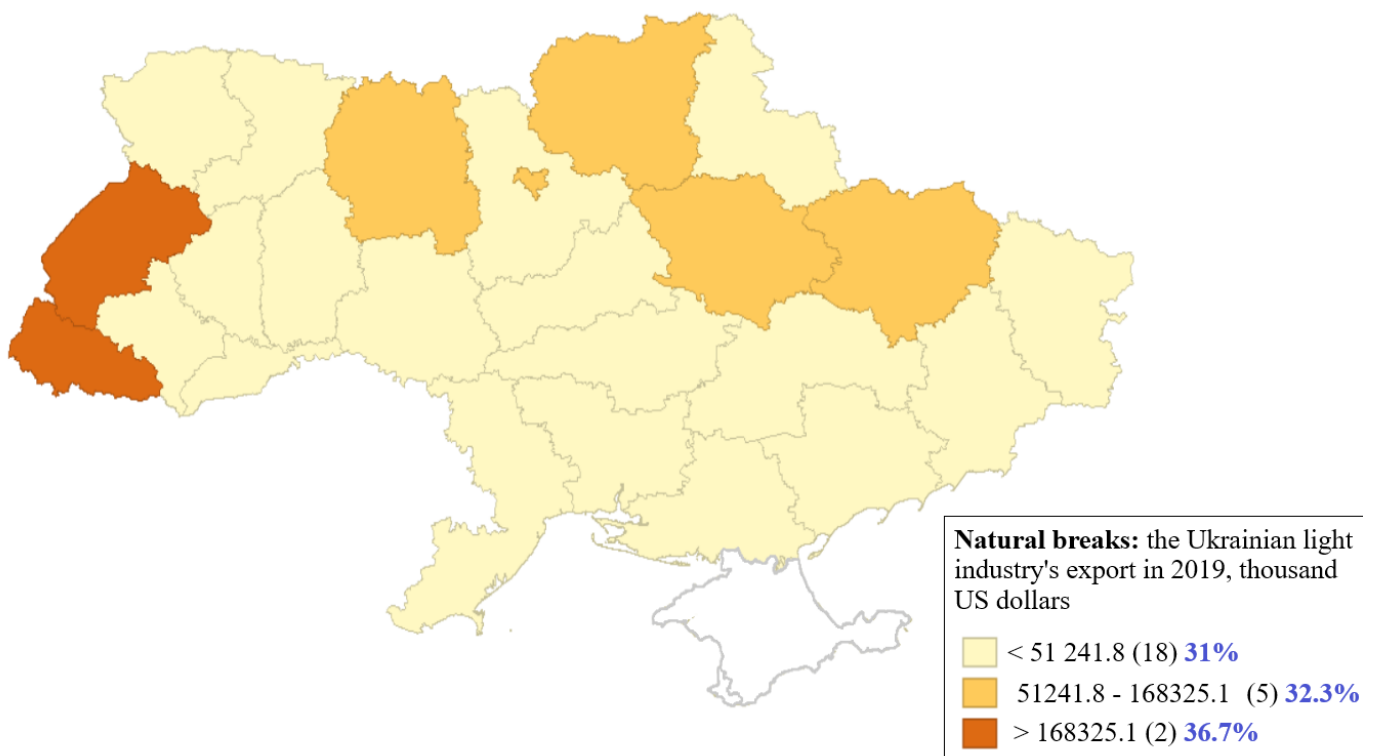


Figure 2. The Regional Distribution of the Light Industry's Export in 2019

The critical condition of the light industry in Ukraine draws the special attention of researchers

who emphasize the need for the urgent technological and innovative re-equipment of the industry as the

primary concern [5–12]. Also, the development path of the Ukrainian light industry remains an acute issue to the government and the Association of enterprises of textile and leather industry which cooperate to prepare a law “On promotion of digitalization and investment attractiveness of light industry enterprises” (N2508) [13]. First, the law involves establishing a zero value added tax (VAT) rate on equipment imported to Ukraine for production needs. Second, it exempts the light industry enterprises from the income tax referring to the main activities. The law came into force in April, 2020 and planned for 10 years. The released funds (tax amounts that are not paid to the budget and remain at the taxpayer’s disposal) are used to increase production volumes, capital investments, introduce innovative technical and technological transformations of production, smart technologies, or repay loans used for these purposes [14].

These circumstances provide the motivation for the current research which aims to verify the justification for a centralized national policy on digitalization and innovative transformations in the Ukrainian light industry. Hence, the research objective is to estimate the spatial dimensions of the Ukrainian light industry’s export and the intensity of its linkage to the regional technology development and innovation (RTDI).

2. Research Background

2.1. Impact of the Regional Technology Development and Innovation on the Ukrainian Light Industry’s Export

The impact of the technology and innovation development on the export and productivity is discussed in the empirical literature. For instance, Lai et al. [16] prove that new technologies and innovations promote the higher firms productivity within the research conducted in China. Also, Omer et al. [17] determine the significant positive relationship between the technology transfer and company performance which is mediated by innovation in Turkish export enterprises. In addition, Lecerf and Omrani [18] have found out that the developing innovation including the increasing

level of IT promotes the internalization of small and medium-sized enterprises in Germany, while those findings are characterized as country-specific. Additionally, Ferreira et al. [19] identify the impact of the technology transfer on the economic growth considering the cross-continent level and investigating Europe and Oceania. Ferreras-Méndez et al. [20] determine that the relationship between export performance and knowledge transfer is mediated by absorptive capacity in the context of Spain. Bezpalov et al. [21] develop a model for managing innovation-driven development within the regional industrial complex in Russia aiming to boost the competitiveness of products or service and ensure the economic growth. On the other hand, Sharma [22] identifies that technology transfer is not significant determinant of export in the context of Indian manufacturing. However, companies selling single product significantly benefit from both export and technology transfer.

Then, in the context of the light industry previous research indicates beneficial results of implementing technology and innovation. Thus, Blekanov et al. [23] identify the applicability of big data analysis of social media, namely, Twitter, in terms of revealing and ranking of supply chain risks in the footwear industry. Khvorostyanaya [24] proves the feasibility of technology transfer association industrial strategy development program to promote the competitiveness of the fashion, apparel and textile industries in Russia. In addition, Akter [25] develops an effective technology transfer mechanism for the textile and apparel industry in Bangladesh by utilizing innovative capacity analysis. Also, Pal & Yasar [26] design a blockchain-based architecture of distributed data management based on the Internet of Things aiming to support transaction services within a multilateral apparel industry supply chain network. Then, Küsters et al. [27] develop the plan of the Industry 4.0 application within setting up the textile factory in Germany.

In terms of the Ukrainian industry the problem of the technology development and innovation

remains acute and actively discussed. Atamanov et al. [28] determine the growth of the innovation activity during the production downturn as the mechanism of overcoming the crisis. Dzhezdzhula & Yepifanova [29] determine the relationship between the innovative activity and the growth of the and the company competitiveness in the context of the Ukrainian industry. Then, Grabovskaya [30] proposes a mechanism of the improvement for the innovative activity of business entities in Ukraine through the influence of the government. Also, Zilinevich & Galushchak [31] identify factors affecting the Ukrainian industry innovation development including the imbalance of the financial and credit policy, poor infrastructure, shortage of domestic raw materials, high environmental risks, inflation. Finally, Kravchuk [32] discuss the implementation of the concept Industry 4.0 within the Ukrainian industry. Regarding the Ukrainian light industry, the mechanism of its application is developed by Fedak [33].

Therefore, there is a lack of research concerning the practical implication of technology and innovation in terms of the Ukrainian light industry. Furthermore, the previous recommendations do not consider the current state of the regional industry development and existing technological resources.

2.2. Current State within the Ukrainian Light Industry

The Table 1 summarizes key issues determined by the empirical literature. First, the industry suffers from difficulties in attracting staff [6, 7, 34, 35]. It is also complicated by the external migration to countries of the European Union. Since 2017 the labor migration to Europe increased dramatically due to the visa-free regime and the open-door policy for the labor force from Ukraine in Poland, Czech Republic, Lithuania, Latvia, and Estonia. Second, the industry faces difficulties in obtaining funding to improve the technology and increase capacity [7, 34]. Third, it faces troubles within accessing external markets through the mismatch of standards, the lack of the experience and activity [34, 35].

Fourth, the domestic purchasing power is low that results in decreasing of the growth rate of light industry by 4.6% in 2019 [7, 34, 36]. Fifth, the light industry suffers from poor reputation of Ukraine as a place to invest or find suppliers due to corruption, mistrust of the legal system and war in the East [7, 34]. Sixth, the light industry is characterized with the low productivity due to lack of technical skills, the technology and infrastructure [6, 7, 34]. Seventh, the Ukrainian light industry is dependent on the import of raw materials [7, 34].

Table 1. – Key Issues and Directions for the Ukrainian Light Industry Development

Direction	Authors	Issue	Authors
1	2	3	4
Creating regional clusters	Dudko, 2019 Havrylenko and Brodiuk, 2018 Rubin and Tkachenko, 2017 Zheliuk and Berestetska, 2019	Lack of the qualified staff	Dudko, 2019 Havrylenko and Brodiuk, 2018 Rubin and Tkachenko, 2017 Selivestрова and Parhacka, 2018
Improving the tax and credit policy	Havrylenko and Brodiuk, 2018 Selivestрова and Parhacka, 2018	Lack of funding for the technological re-equipment	Olyinyk et al., 2019 Rubin and Tkachenko, 2017 Selivestрова and Parhacka, 2018
Supporting the national brand	Boiko and Tarasova, 2019 Zheliuk and Berestetska, 2019		
Implementing the foreign experience	Kasyan, 2016 Rubin and Tkachenko, 2017	Mismatch of the standards within	Havrylenko and Brodiuk, 2018 Rubin and Tkachenko, 2017

1	2	3	4
Strengthening the government control and the legal support	Boiko and Tarasova, 2019 Olyinyk et al., 2019	accessing the external market	
Enhancing the investment image	Kasyan, 2016 Olyinyk et al., 2019	Unfavorable investment climate	Rubin and Tkachenko, 2017 Selivestrova and Parhacka, 2018
Promoting the technology transfer and innovation	Kasyan, 2016 Olyinyk et al., 2019 Zheliuk and Berestetska, 2019	Low productivity	Boiko and Tarasova, 2019 Dudko, 2019 Rubin and Tkachenko, 2017 Selivestrova and Parhacka, 2018
Reasonable consumption and smart utilization	Olyinyk et al., 2019 Zheliuk and Berestetska, 2019	Import-dependence	Boiko and Tarasova, 2019 Olyinyk et al., 2019 Rubin and Tkachenko, 2017 Selivestrova and Parhacka, 2018 Zheliuk and Berestetska, 2019

Consequently, the Ukrainian light industry generates relatively low revenues and its position is far behind the world's top light industry exporters. On other hand, it cooperates with a large number of related industries and serves the entire economic complex of the country. Therefore, the researchers consider that it has a powerful production potential and capable of producing an extensive range of widely used industrial goods and it can be revived due to various measures (Dudko, 2019; Havrylenko and Brodiuk, 2018; Kasyan, 2016; Rubin and Tkachenko, 2017; Selivestrova and Parhacka, 2018).

Although, the idea of creating cluster prevails in the empirical literature, other measures to revive the Ukrainian light industry proposed by the literature are summarized in accordance with the problem which they might solve in the Table 1.

Herewith, the most cited directions to revive the Ukrainian light industry include the following measures. First, creating regional clusters is often considered as one of the direction to attract the qualified staff [6, 7, 10, 34, 35]. The idea of clustering the Ukrainian industry draws the attention of the government and scholars. Hence, the process of creating clusters in Ukraine is regulated by State

strategy for regional development for the period up to 2027 written by the Cabinet of Ministers in Ukraine [37].

Also, several textile industry clusters are already established, such as Ukrainian Fashion Cluster, Fashion Globus Ukraine, Kharkiv Fashion Cluster and West Ukrainian Fashion Cluster. The project of the clothing cluster in Khmelnytskyi region in West Ukraine is proposed [38].

3. Research Area and Methodology

3.1. Characteristics of Panel Data

After determining the research objective and tasks, the process of collecting data is initiated. The sample includes the panel data on the light industry's export and RTDI in the Ukrainian regions regarding the time period from 2012 to 2019. The Table 2 represents characteristics of the primary data.

Hereby, the value $Export_{in}$ is the average amount of the light industry's export in the region i in the year n . Then, the value of RTDI involves three dimensions. The first one is the technology and innovation activity A_{in} represented by the quotient of staff engaged in R&D and number of innovative enterprises in the region i in the year n .

Table 2. – Characteristics of Panel Data

Variable	Indicator	Formula	Measure
Dependent variable (Y):			
$Export_{in}$	The average amount of the light industry's export in the region i in the year n	–	10^3 hryvna
Explanatory variables (X):			
Determinants related with regional technology development and innovation (RTDI):			
A_{in}	The technology and innovation activity in the region i in the year n	$\frac{\text{Staff engaged in R \& D}}{\text{Number of innovation active enterprises}} \quad (3.1)$	Employees per enterprise
E_{in}	The expenditure on R&D and innovation in the region i in the year n	$\text{Expenditure on R \& D} + \text{Expenditure on innovation} \quad (3.2)$	10^3 hryvna
I_{in}	The implementation of R&D and innovation in the region i in the year n	$\frac{\text{Innovation products sold}}{\text{Enterprises implementing innovations}} \quad (3.3)$	10^3 hryvna per enterprise
Tax- related determinants:			
VAT	Value-added tax		%
IT	Income tax		%

The second component E_{in} is the sum of the expenditure on R&D and innovation in the region i in the year n . Finally, the implementation of R&D and innovation I_{in} refers to the quotient of the innovation products (goods, services) sold and the number of enterprises implementing innovations in the region i in the year n . The data concerning the regional export and RTDI is gathered from State Statistics Service of Ukraine (2020 b).

Finally, tax-related determinants include value-added tax (VAT_n) and income tax (IT_n) which are paid by enterprises. The primary data for these two variables consider annual tax rates.

3.2. OLS regression model

The dependent variable is the light industry's export. The independent variables include three measures of the RTDI such as technology and innovation activity, expenditure on R&D and innovation, implementation of R&D and innovation. The OLS regression model is presented below:

$$\ln Export_{in} = \beta_0 + \beta_1 \ln A_{in} + \beta_2 \ln E_{in} + \beta_3 \ln I_{in} + \beta_4 \ln VAT_n + \beta_5 \ln IT_n + \varepsilon \quad (3.4)$$

Where $Export_{in}$, A_{in} , E_{in} , I_{in} , (VAT_n), (IT_n) are described as above; β_0 identifies a constant; β_{1-5} is a slope coefficient for each independent variable; ε refers to the normally distributed error. The natural logarithm (\ln) is applied to normalize the values.

Meanwhile, if the spatial correlation (autocorrelation) exists, i.e. the values identified in one region are associated to observation in other regions, then the OLS model might be inappropriate tool to capture the spatial interdependence. However, the endogeneity problem is eliminated by extending the OLS model with spatially endogenous interaction. So the OLS is transformed into the spatial autoregressive model (SAR) which assesses the spatial dependence of the predicted values across regions. Also, omitting the relevant covariates in the OLS model, which are correlated with variables from other regions, causes

the spatial correlation in the error term. This problem might be solved by extending with the spatial interactions in residuals and modifying the OLS into the spatial error model (SEM).

3.3. Spatial analysis

The spatial analysis involves three models. It aims to test hypotheses about the spatial interactions for endogenous and exogenous variables. The relationships within those three modifications of the spatial model are represented in the Figure 3.

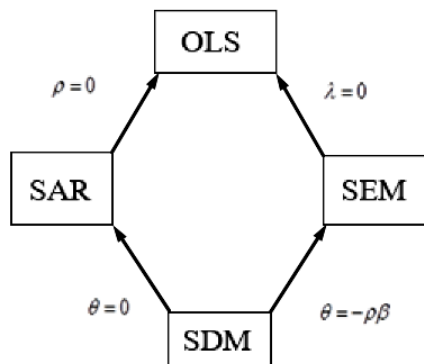


Figure 3. The Relationship Between Different Spatial Dependence Models

Based on the research background, the Hypothesis 1 is stated:

H1: *the regional technology development and innovation expressed by values of the technological and innovation activity, expenditure and implementation in a region impact (or are related to) the value of the light industry's export in neighboring regions in the context of Ukraine.*

The SDM is developed to test Hypothesis 1. It consists of the spatially lagged dependent variable and spatially lagged explanatory variables. The SDM is specified as follows:

$$Y_{in} = \rho WY + \alpha_{l_n} + \beta X_{in} + WX\theta + \varepsilon \quad (3.5)$$

Where Y_{in} , X_{in} are identified as above, β is slope coefficients for each explanatory variable; l_n is a vector associated with the constant term parameter α to be estimated; ρ refers to a spatial autoregressive parameter; WY is the spatially lagged Y calculated for various spatial dependencies with W defined as $(i \times i)$ spatial weight matrix; ρWY is an

endogenous interaction effect; $WX\theta$ is exogenous interaction effect.

Then, modifying the SDM into different spatial regression specifications is able to test the hypothesis about the existence of a spatial spillover (Le Sage and Kelley Pace, 2009). The second hypothesis is generated:

H2: *the value of the light industry's export in a region impact (or are related to) the value of the light industry's export in neighboring regions in the context of Ukraine.*

To test this hypothesis SDM might be simplified into the spatial autoregressive model (SAR), where $\theta = 0$, also called the spatial autoregressive model (SAR), which is presented below:

$$Y_{in} = \alpha_{l_n} + \beta X_{in} + WX\theta + \varepsilon \quad (3.6)$$

Finally, the third hypothesis is defined as follows.

H3: *other factors not included in the model might affect (or to be related to) the residuals in neighboring regions in the context of Ukraine.*

Thus, to test this hypothesis, the SDM degenerates into the spatial error model (SEM), where $\theta = -\rho\beta$, then $\lambda = \rho$, which is demonstrated as follows:

$$\begin{aligned} Y_{in} &= \alpha_{l_n} + \beta X_{in} + u \\ u &= \lambda \bar{W}u + \varepsilon \end{aligned} \quad (3.7)$$

Where u is used to model the disturbances.

The spatial weight matrix which defined as at Eilers (2019), it is calculated before running spatial models:

$$W = \begin{pmatrix} w_{11} & w_{12} & w_{13} & \cdots & w_{1m} \\ w_{21} & w_{22} & w_{23} & \cdots & w_{2m} \\ w_{31} & w_{32} & w_{33} & \cdots & w_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ w_{m1} & w_{m2} & w_{m3} & \cdots & w_{mm} \end{pmatrix} \quad (3.8)$$

Where m refers to the number of observation.

Meanwhile, the queen and the rook contiguity matrixes are the same due to the geographical location on the Ukrainian regions. Thus, only one spatial weight matrix is applied in the context of the research.

3.4 Hausman Test

First, the difference between random- and fixed-effects is clarified. As stated by Vaisey and Miles [41], the key difference between the fixed-effects and random-effects model infers in the correlation between the observed value and the unobserved time constant effects. Also, Bell et al. [42] claim about the incoherency of the fixed-effects model in regards to evaluating the parameters which are biased by violations of normality. Therefore, fixed effects remain unaltered within the sample, while random effects might change across cases omitting variables inconsistently.

A choice between the random- and fixed-effects models is feasible by the Hausman test applied when both models can be run for the panel data [43]. Here-with, the null (H_0) and alternative (H_A) hypotheses are examined.

H_0 : The random-effects model is rather consistent.

H_A : The fixed-effects model is rather consistent.

Basically, if the correlation between explanatory and control variables is absent, then both fixed- and random-effects model are valid, while fixed-effects model is inefficient. Thus, the Hausman test is the evaluation for the independence of the λ_i and the x_{kit} which are assumptions for the random-effects model. As a formula the Hausman test is presented as follows:

$$W = (\beta_{RE} - \beta_{FE})' \Sigma^{-1} (\beta_{RE} - \beta_{FE}) \sim \chi^2(k) \quad (3.9)$$

Where β_{FE} , β_{RE} are estimators for the fixed effects and random effects respectively. Then, the p-valued of the chi-square χ_2 is investigated. Since the p-value is less than 1%, then the null hypothesis might be rejected. By contrast, the random-effect model is considered as consistent if the p-value is more than 1%.

3.5 Difference-in-Differences Method for Policy Impact Evaluation

The DID method is frequently applied technique for policy impact evaluation which is also fully recognized and utilized by the European Commission [44] and the World Bank [45]. This technique incor-

porates concepts of the cross-sectional treatment-control comparison and then, before-after studies in order to achieve more robust identification. It includes an estimation of the policy impact (so-called, "treatment") by comparing results between the treatment and control groups with the outcomes after the policy implementation.

Basically, DID employs the data from two time periods for two groups. However, the data might be repeated as a panel or cross-sectional samples of population [46]. The DID estimation of the policy impact is formalized as follows:

$$DiD = (\bar{Y}_{i=Treatment, t=After} - \bar{Y}_{i=Treatment, t=Before}) - (\bar{Y}_{i=Control, t=After} - \bar{Y}_{i=Control, t=Before}) \quad (3.10)$$

Where Y with the bar refers to the average value of the outcome variable in the region i in the time period t .

It includes three parameters we estimate potential-outcome means (POM), the average treatment effect (ATE) in population and the average treatment effect on the treated (ATET). In particular, POM assesses the mean value of the outcome for two treated and control periods. ATE evaluates the difference in these two means. According to Lechner [47], ATET might be more reliable in predicting the treatment effect due to its focus on the control group. The formula of the ATET is defined as below:

$$ATET = E[(y_{1i} - y_{0i}) | D_i = 1] \quad (3.11)$$

Where E refers to the expectation operator, y_{1i} is the results of the observed value for the treated group, y_{0i} is the outcome of the control group. D is the target distribution. Thus, the ATE does not involve the target distribution. Meanwhile, the ATE and ATET often differ from each other, while they evaluate outcomes which are not affected from the impact in the same manner.

4. Data Analysis

4.1. OLS Model for the Light Industry's Export

The OLS model for the Ukrainian regional light industry's export is generated by the software IBM SPSS Statistics v.23. The results of the regression analysis are demonstrated in the Table 3 below.

Table 3. – Regression Analysis (Dependent Variable = Exp_{in})

Variables	B	Beta	t-value
<i>Constant</i>	1.536	–	3.200**
A_{in}	0.025	0.013	0.183
E_{in}	0.546	0.670	7.872**
I_{in}	0.173	0.183	2.891**
VAT	–0.120	–0.023	2.561*
IT	0.015	0.065	0.328
R		0.807	
R ²		0.651	
F		98.159**	

** $p < 0.01$, * $0.01 < p < 0.05$

Based on the results of the regression analysis, the model represents the high correlation between the observed and predicted values since the correlation coefficient is 0.807. Also, the model is able to predict the regional light industry export by 65.1%. Herewith, the significant results of the F-test prove that the model fits the sample data. The export is positively and significantly associated with the effect of the regional expenditure on the technology and innovation and its implementation. The Beta-coefficient obtained for the expenditure shows the highest effect on the export comparing to other variables. Meanwhile, the negative direct dependency between export and value added tax is obtained. Hence, the decrease of the tax rate promotes

increasing of export activity in the context of the Ukrainian light industry.

Consequently, the direct dependences between observed and predicted variables exist with regard to the expenditure and implementation of technologies and innovation. Also, tax burden influences the Ukrainian light industry's export activity.

4.2. Spatial Analysis

The spatial analysis is generated by Stata v.15. The SDM, SLM and, then, SEM are developed to investigate the spatial interrelations between the light industry's export and the RTDI.

The Table 4 reports results of building SDM with random effects and three dimensions of fixed effects including spatial, time and combined spatial-time effects.

Table 4. – SDM (Predicted Variable = *Export*)

	Random-effects	Spatial fixed-effects	Time fixed-effects	Spatial-time fixed-effects
1	2	3	4	5
<i>Constant</i>	1.66 [2.31*]	–	–	–
A_{in}	0.12 [0.86]	0.10 [0.70]	0.25 [1.63]	0.17 [0.98]
E_{in}	0.27 [5.63**]	0.28 [5.18**]	0.21 [2.25*]	0.26 [5.41**]
I_{in}	0.03 [0.76]	0.03 [0.6]	0.26 [2.12*]	0.02 [0.31]

1	2	3	4	5
VAT	0.29 [6.77**]	0.30 [6.49**]	0.19 [1.66]	0.29 [6.41**]
IT	0.04 [0.94]	0.03 [0.76]	0.25 [1.71]	0.01 [0.26]
WA	-0.06 [-0.32]	-0.07 [-0.36]	-0.18 [-0.76]	0.11 [0.76]
WE	0.04 [0.51]	0.09 [1.32]	-0.27 [-1.50]	0.10 [1.26]
WI	0.05 [1.55]	0.04 [1.05]	0.48 [3.26**]	0.004 [0.08]
WVAT	0.12 [0.86]	0.10 [0.70]	0.25 [1.63]	0.17 [0.98]
WIT	0.27 [5.63]	0.28 [5.18]	0.21 [2.25]	0.26 [5.41]
P	0.34 [2.84**]	0.24 [1.80]	0.49 [3.79**]	0.11 [0.90]
R ² (overall)	0.660	0.655	0.678	0.610
Log-pseudolikelihood	-143.24	-73.37	-250.06	-66.56
χ^2	20.94**			

** $p < 0.01$, * $0.01 \leq p < 0.05$

The outcomes of the Hausman test represents a significant value of chi-squared (χ^2) at p-value less than 1%. Hence, the null hypothesis about the random effect is not supported. Meanwhile, SDM with the time-fixed effects shows the highest overall coefficient of determination (R-squared) of 0.678 and the log-pseudolikelihood of -250.06. Also, results

for this model demonstrates a significant spatial interaction between the implementation and export in Ukrainian regions. However, the effect of spatially lagged technology and innovation activity (A) as well as expenditure (E) are statistically insignificant. Further, the Table 5 represents outcomes for the SAR with random and fixed effects.

Table 5. SAR (Predicted Variable = *Export*)

	Random-effects	Spatial fixed-effects	Time fixed-effects	Spatial-time fixed-effects
1	2	3	4	5
<i>Constant</i>	1.48 [2.10*]	–	–	–
A_{in}	0.08 [0.98]	0.07 [0.84]	0.25 [1.38]	0.19 [1.28]
E_{in}	0.29 [6.77**]	0.30 [6.49**]	0.19 [1.66]	0.29 [6.41**]
I_{in}	0.04 [0.94]	0.03 [0.76]	0.25 [1.71]	0.01 [0.26]

1	2	3	4	5
<i>VAT</i>	0.29 [6.77**]	0.30 [6.49**]	0.19 [1.66]	0.29 [6.41**]
<i>IT</i>	0.04 [0.94]	0.03 [0.76]	0.25 [1.71]	0.01 [0.26]
<i>P</i>	0.41 [4.31**]	0.38 [3.40**]	0.50 [5.26**]	0.29 [1.99*]
R ² (overall)	0.645	0.644	0.676	0.618
Log-likelihood	-145.24	-76.71	-263.05	-70.27
χ^2	6.84			

** $p < 0.01$, * $0.01 \leq p < 0.05$

Based on the findings, the null hypothesis about the random-effects model is appropriate since the value of chi-squared is insignificant in the context of the SLM. In regards to the random-effects SLM, its coefficient of the determination equals to 0.645 indicating the extent of the variance of the predicted variable which can be explained by the impact of explanatory variables. However, the highest coefficient of determination is identified for the time-fixed effects model which is able to explain more cases (67.6%) than other models. Herewith, the significant value of ρ is determined for both random and fixed-effects models.

The Table 6 illustrates outcomes for the random-effects and three dimensions of the fixed-effects SEM including spatial, time and spatial-time. Since the p-value of chi-squared exceeds 1%, the null hypothesis about the relevance of the random effect cannot be rejected. The random-effects SEM covers 64.3% of cases. However, the time fixed-effects model demonstrates the highest R-squared fitting 65.6% of cases. Also, the significant value of λ identifies the spatial dependence in the models error term within both random-effects and time fixed-effects SEM.

Table 6. – SEM (Predicted Variable = P_{in})

	Random-effects	Spatial fixed-effects	Time fixed-effects	Spatial-time fixed-effects
1	2	3	4	5
<i>Constant</i>	3.83 [4.18**]	–	–	–
A_{in}	0.08 [0.78]	0.09 [0.76]	0.26 [1.61]	0.24 [1.67]
E_{in}	0.42 [6.18*]	0.41 [5.67**]	0.37 [3.61**]	0.37 [6.79**]
I_{in}	0.04 [0.93]	0.03 [0.72]	0.16 [1.19]	0.01 [0.21]
<i>VAT</i>	0.29 [6.77**]	0.30 [6.49**]	0.19 [1.66]	0.29 [6.41**]
<i>IT</i>	0.04 [0.94]	0.03 [0.76]	0.25 [1.71]	0.01 [0.26]
λ	0.15 [0.67*]	0.19 [0.76]	0.60 [3.95**]	0.02 [0.14]

1	2	3	4	5
R ² (overall)	0.643	0.639	0.656	0.613
Log-likelihood	-161.81	-90.42	-265.48	-78.45
χ^2	4.67			

****** $p < 0.01$, $*0.01 \leq p < 0.05$

4.3. Policy Impact Evaluation

The policy impact evaluation is conducted by the DID technique which assesses the treatment effect of the policy comparing two periods before and after its implementation. Herewith, we control for two periods evaluating the year of 2019 as a starting point and the year of 2020 as the ending point. Thus, we estimate POM, ATE and ATET. The results of generating the regression PPML model adjusted with the treatment effect are presented at the Table 7 below.

Based on the results, the potential-outcome mean for the export before the policy implementation is smaller comparing to the time period after the policy implementation. Although, the policy on the light industry development is proclaimed, the difference between tax and tax-free result is about 3210.33 thousand dollars per region. Since the value of ATET provides more reliable result, it is still about 2180.5 thousand dollars per region. Therefore, these results prove that the policy on the poverty reduction in Ukraine might be not effective.

Table 7. – Treatment Effect Estimation

Indicator	Full sample
POM: Tax	28330.56 [25.82**]
Tax-free	31540.89 [21.63**]
ATE	3210.33 [4.28**]
ATET	2180.5 [3.30**]

****** $p < 0.01$, $*0.01 \leq p < 0.05$

5. Discussion

The regional expenditure on technology and innovation is linearly and positively related to the

light industry's export. These findings suggest a role of the expenditure in promoting the export. Then, the higher level of implementation of R&D and innovation positively associates with the higher volume of the light industry's export. Hence, the higher volume of the innovation products (goods, services) sold by an enterprise implemented innovations contributes to the export activity of the light industry. On the other hand, there is no evidence of the direct linear relationship between the technology and innovation activity and the light industry export. Thus, the export activity is not stimulated by the number of employees engaged in R&D per enterprise in the context of the Ukrainian light industry.

Next, regarding the spatial analysis the null hypothesis about the relevance of the random-effects model is supported in most calculations excepting the SDM. Additionally, the time fixed-effects models demonstrate the highest coefficients of determination within the study comparing to other model specifications. Meanwhile, the best model fitting the data is the time fixed-effects SDM which is able to explain the sample by 67.8%.

Then, in terms of the technology and innovation activity and the expenditure on R&D and innovation, their spatial impacts on the light industry's export are not identified. Thus, these values are distributed randomly across the Ukrainian regions and the export in the particular region is not associated with their values in the neighboring regions. However, the Hypothesis 1 is supported partly, since the values of the implementation of R&D and innovation might influence (or to be related to) the value of the light industry's export in a neighboring region within the time fixed effects. Also, the spatial dependence of the

light industry's export is diagnosed in the context of the Ukrainian regions and validated by both random and fixed effects. Finally, within the random and time fixed effects the spatial dependence in residual terms among neighboring Ukrainian regions is detected supporting the assumption that the residuals might affect (or to be related to) residuals in a neighboring area. Namely, the model captures impact of other unmeasured explanatory values.

Therefore, the results of this research support the idea of the unified policy regarding the digitalization and innovative transformations of the Ukrainian light industry announced by the government. However, it might focus not only on maintaining sustainable development of the light industry in the leading regions, but also promoting it across all Ukrainian regions. Further, a multi-scale spatial cooperation process is required to be implemented based on both geographical background and technological advancement of the Ukrainian regions.

6. Conclusion

The research attempts to verify the justification of the centralized policy on the digitalization and innovative transformations of the Ukrainian light industry proclaimed by the government. The empirical data involves the regional indicators of the technological and innovative development and the light industry's export of 27 Ukrainian regions from

2012. The indicators of technological development involve the regional technological and innovative activity, expenditure on R&D and innovation and the innovation implementation. The research methodology includes: 1) the regression analysis to investigate the linear relationship; 2) the spatial analysis to test the spatial interactions; 3) the Hausman test to verify the consistency of the random effect; 4) DiD technique to verify difference before and after policy implementation.

The research results demonstrate: 1) a positive linear effects of the regional expenditure and R&D implementation on the light industry's export; 2) a spatial relationship between implementation and export within time-fixed effect; 3) the spatial dependence of the light industry's export and in residuals within random-effects models; 4) the positive effect of the policy implementation.

The scope of the research concerns the Ukrainian regions and the light industry. It does not involve other regions or industries. Besides, the data referring Crimea and Sevastopol is not employed by the research since the data is not available.

The further research might include other regions and industries in order to compare the results with the outcomes of the current study. Then, other factors can be added to the research model such as GRP, educational level, labor cost and others.

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Section 6. Finance, money circulation and credit

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REGULATION OF INNOVATIVE ACTIVITY OF GEORGIAN NEO-BANKS IN THE CONTEXT OF THE DEVELOPMENT OF DIGITAL TECHNOLOGIES

Abstract. In the modern world, the life of society very quickly changed under the influence of various technological processes, which in turn created both enormous opportunities and colossal difficulties. The impact of technology on the world to the extent, it exists today has no historical counterpart. The technological revolution has further accelerated the transition to a digital economy. The digital economy refers to any economic activity carried out using digital technologies, which is inherently based on radical innovations – in technological, organizational, institutional, social and other areas. The role of digital technologies in the banking sector is also growing steadily. This article describes the processes and consequences of their transition to the fintech era, since today banking structures around the world are focusing on the implementation and development of innovative projects in the digital space.

Keywords: Digital Economy, innovations, digital banks, development of cashless payments.

Digitalization is a process that involves changing the classic business model of organizations. Banks widely use digital technologies in the process of customer service, which allows you to quickly and accurately identify a client, reduce the time for opening a bank account, improve the quality of electronic document management, and optimize internal processes. The leaders in banking innovations in the digital economy are Germany, Japan, the USA, South Korea and the UK. The opposite of this process is the growth of cyber fraud cases, which is one of the main modern banking risks.

One of the main factors for the successful development of banking is the policy of constant innovation. Currently, innovation is a key factor in the stability, competitiveness and sustainable economic

growth of banks. The goal of any commercial bank, especially in the context of the digitalization of the economy, is to maximize consumer satisfaction at lower cost, improve the quality of banking services for legal entities and expand the range, which is primarily possible through the development of the fintech industry and the active use of innovations in the banking sector. Financial innovations, as a method used by organizations to carry out transactions with new or existing assets, will make it possible to use the resources of credit institutions more efficiently.

The development of banking innovations and the digital economy as a whole has contributed to the emergence of virtual banks that do not have branches and physical offices. The active use of digital technologies has contributed to the deployment

of classic products in separate operations, their further integration into new structures and forms.

Digital banks are banks whose main activity is not confused with the digital environment. We also call them online banks, neobanks, direct banks. In the UK they are also called “Challenger” banks. “Banks of the future” – are formed as fully digital banks, where all banking operations are performed remotely. There is a huge demand among banks for fintech startups that are actively developing digital technologies, which can lead to faster customer service and lower transaction costs. It is for these purposes that neobanks are created, which are one of the main driving forces of the fintech industry.

There are about 250 digital banks in the world today. These include: Atom, Monza and Revolut (UK), Number26 and Fidor Bank (Germany), Saxo Bank (Denmark), Moven (USA), Nemea (Malta), We-Bank and MyBank (China), Tinkoff Bank (Russia), Morning (France). Atom Bank is considered the first digital bank in the world to be licensed in October 2016 in the UK. In just two months, he managed to reach 110 million. receiving a deposit in sterling.

Today, the most popular areas of fintech innovation in the banking sector are online payment technologies, biometric identification and robotics. Over the past few years, significant technological changes have taken place in the banking system in Georgia, which created legal and technological conditions for the launch of new payment services of the payment system, for the introduction of remote identification, and increased the availability of financial services for the population.

The National Bank of Georgia promotes the development of new technologies and innovative approaches in the financial sector to improve financial stability and customer engagement. To this end, the National Bank of Georgia is implementing a technology-neutral risk-taking approach and principles of open regulation. These principles are an integral part of the National Bank's supervisory strategy for 2020–2022.

By developing the model of digital banking, the National Bank is called upon to promote: the de-

velopment of innovative business models; Variety of financial products; better use of big data; Development of a customized, convenient, fast and affordable digital financial ecosystem based on the technological infrastructure around the customer; Efficient use of cloud services; Promote integration with technology companies and develop banking as a service in the whole sale market; The emergence of new technological players and increased competition in the financial sector. At the same time, the supervisory goals of the National Bank of Georgia are: to introduce new risk mitigation mechanisms in the process of developing a new digital banking model, to develop modern reliable standards for the security of personal data in cyberspace and to improve systemic risks and manage financial stability risks. It should be noted that the National Bank of Georgia considers the protection of the rights and interests of consumers to be systemic risks that can potentially have a negative impact on the development of the financial system and financial stability.

To generate interest in the development of digital banking models, in July 2020, the National Bank of Georgia published digital banking licensing principles for public consultation. The rules for entering the banking market have been simplified and benefits can be used in the licensing process. Possible benefits include: the issuance of a banking license if 10% of the minimum supervisory capital is met, as well as the so-called banking operations for doing business and finding additional investors. Providing a “build-up period”, a simplified liquidity reporting form, supervisory advice during the development of a business model, and, where appropriate, the targeted use of a regulatory laboratory to test the risk of certain technologies.

To obtain a full banking license, a bank must be able to demonstrate the sustainability of its business model and successfully operate in accordance with the requirements of a conventional bank. The National Bank of Georgia considers the banking business model as a digital bank with the potential to

expand access to finance, reduce the cost of financial intermediation, and at the same time meet the following technological criteria:

- Provides banking services mainly through electronic channels;
- Uses fundamentally new technologies and/or an innovative technological business model in the local market when providing banking services;
- Focused on open banking and development of the banking business as a service model in the wholesale market;
- Both external and internal banking modules are built on the basis of the API.
- Has electronic technological means of identification, user authentication and can apply to third parties for this service.

The first fully digital bank is SPACE, the first neo-bank in Georgia, which appeared on the Georgian market in May 2018, the project is being implemented with the support of TBC Bank. It can be said that the idea of creating a neo-bank belongs to TBC Bank, but Space and its employees are completely independent and its activities are not related to TBC Bank, moreover, the idea of creating a space means creating services and values that are different from a traditional bank. In mobile phones, through an app that can be downloaded for free for both Apple and Android users. It should be noted that Space is a bank that offers banking services to customers through the application, and not a mobile bank or Internet banking, which banks create for convenient delivery of services or products created for the client to the client in order to facilitate their use. Offers a fully digital service, all banking transactions are carried out through the application, which is an innovative banking service in the Georgian market. "Space" is not represented by branches, it is a completely digital bank. The idea of its creation is that the client can easily accept all banking transactions 24/7 without going to branches, without additional bureaucracy. Registration as a client is carried out through the ap-

plication, by the user, by taking a photo and selfie on an identity card. Unlike traditional banks, where you need to go to branches to register as a client. After registering in the application, you can order a space card, as well as open an account, the card is delivered by courier to the specified address. The company offers the buyer a debit card like "Visa classic". The card can be used at any ATM of the bank. When it comes to digital banking, the protection of security and personal data is important for the client, so the company devotes a lot of resources to this area, the project involves world-famous and experienced companies in the field of information security, which is considered one of the most secure environments in the world. The company is also focused on protecting the interests of consumers, actively complies and complies with the requirements of the National Bank and all other legislative norms.

The introduction of digital banking innovations in Georgia is accelerating. The population is gradually switching almost completely to digital channels. However, this process is accompanied by rather large disadvantages, in particular, in the long term, the number of employees in banks will inevitably decrease. Considering that today banks in the Georgian market offer the most jobs to the population, this fact will inevitably have a negative impact on the welfare of the country. The second negative effect can be considered dependence on technology, since all the projects discussed above require quite a lot of technical support, and when it comes to technology, no one is one hundred percent immune from shortcomings.

Banks and their customers follow the trend and master more and more innovative products that they like and then use. The great benefit of this process is considered to be the benefit of saving time, which is very valuable in the 21st century. Also, quite simple interfaces help to configure all types at the request of the user. The problems associated with the introduction of innovative products are real, it is difficult for people to get used to innovative products, although the digitalization trend is upward and the percentage

of online transactions is steadily increasing, it is still difficult for commercial banks to completely abandon traditional bankers. Provide services to customers for whom digital products are not available.

Constant monitoring and testing of processes is necessary, as Internet fraud creates serious problems for digital banking both in Georgia and in the world, losses from Internet fraud exceed millions of dollars. To prevent such cases, it is necessary to implement high standards of information security. The banking sector is one of the most highly regulated sectors, hence the

frequent regulations imposed by the regulator, which often lead to significant changes in business processes. Finally, it can be concluded that the various innovations introduced in Georgia over the past decade were aimed not only at the development of banking services, but also at the revitalization and renewal of the relationship between the client, employee and the banking system of the bank. the country. It can be said that the introduction of innovations in Georgia faces some problems, but the market will easily accept this if its participants see the benefits of this innovation.

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Section 7. Economics of recreation and tourism

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EMPIRICAL ANALYSIS OF THE RESULTS OF INVESTMENTS IN THE HOTEL AND RESTAURANT BUSINESS

Abstract. The economic reality in the tourism sector, which is reflected in the sharp increase in the investment factor for the implementation of tourism activities in the region, determines the most important and mandatory condition for its implementation at the level of territorial units – requires Scientifically substantiated approaches to efficient use of investment resources.

Tourism is a vulnerable sector, the development of which depends on the development of other sectors. The hotel and restaurant business is one of them. Well-maintained infrastructure, orderly sights, overnight stays and tasting of traditional dishes across the country help to increase the scale of tourism. This is impossible to achieve only with local resources, so the foreign investment is of great importance in the development of the sector. The aim of the paper is not to fully research the field, it focuses on determining the return on foreign investment in the hotel and restaurant business. The role of foreign investment in the hotel and restaurant business in the country's GDP, as well as the dependence of GDP on tourism flows and GDP per capita as a result of an assessment of the obtained information, results of regression analysis, analysis of t and F tests, forecasting by time series method. The analysis showed the adequacy of the regression model, confirmed the rejection of the null hypothesis, however, as a result of incomplete and flawed statistics, the dependency ratios changed the dependence of the share of revenues from hotel and restaurant business on the volume of foreign investment, number of tourists per capita. According to the above, problems were identified and proposals for their elimination were formed.

Keywords: investment, tourism, GDP, regression model, hotel and restaurant business.

Jel classification: Z32; F21; D22; E22

1. Introduction

Tourism is one of the most important sectors in the world economy, which is developing rapidly. The most important benefits of the tourism sector are the creation of many jobs, overcoming poverty,

involving the socially vulnerable in economic activity and self-employment, the inflow of foreign currency into the country, improving infrastructure, and so on. In addition, the development of tourism is a kind of incentive for the state to take

maximum care of and protect cultural heritage and tourist sites.

Each state is trying to present itself as the most attractive tourist destination and develop this sector, in which it spends millions of dollars. This, of course, guarantees only one result – attracting more tourists, who will make a small contribution to the development of the country's economy, which will ultimately be a huge profit.

The latest and most pressing challenge facing tourism today is Covid-19. No industry or business has not been affected by the coronavirus. However, while the effects of Covid-19 are unevenly distributed in other sectors, the tourism sector as a whole has faced major barriers. The number of tourists is declining in all countries and continents, which has put many of them in an economic crisis. First of all, the huge losses were suffered by the airlines, which experienced the largest percentage decrease in customers, as most of the countries closed their borders and tourists are no longer physically able to travel.

The paper focuses on the current state of the hotel and restaurant business in the field of tourism, the outcome of investments in them and the forecast of future investments. Investment projects are based on the needs of the tourism company and the condition for their viability is the compatibility between the investment policy and the strategic goals of the tourism enterprise.

The cash flow generated by the implementation of investment projects in the field of tourism usually takes place over several years, which makes it difficult to assess their effectiveness. Given that the implementation of investment projects over a long period affects the economic potential and economic activity of a tourism enterprise, the mistake of assessing their effectiveness ends with significant financial risks and losses. Selecting the most objective methods of evaluation will significantly help to avoid risks. To study the impact of foreign investment in the hotel and restaurant business, a hypothesis was developed: Foreign investment in the hotel and restaurant busi-

ness increases the share of tourism sector revenues in the country's GDP.

2. Literature review

Well-developed infrastructure is essential for attracting foreign capital and promoting economic growth. Also, providing good infrastructure reduces transaction costs, allowing investors to easily reach out to their suppliers and customers, improve market access, and thus contribute to the actual growth of the existing market (Susana Cró [24; 25]). This finding is particularly important for developing countries, where infrastructure is still disorganized and local investors have difficulty accessing costs. Prof. Dr S. S. Boora – in the work "Foreign Direct Investment and its impact upon the Indian Hospitality Industry" In addition to the use of foreign investment, the hotel business attaches great importance to investing in the construction of highways and airports. Of course, this approach is justified by the vulnerability of the tourism sector, especially since tourism is a sector related to movement, and the impact on economic development in this direction is also visible.

S. S. Boora calls all forms of tourism-related economic development the «tourism-driven growth hypothesis» (S. S. Boora [6]). Researcher Georgeta ILIE focuses on ecotourism in the development of the tourism sector and notes that this area can bring obvious benefits, but it does not lead to job creation (Georgeta ILIE [8]). The geographical location of the country, the social situation of the population, in particular, the development of ecotourism in Georgia should be taken into account, mainly by involving the unemployed rural population in this sector. Scientist at the University of Silesia (Pavĺina Pellešová [19]). University of Silesian scholar (Pavĺina Pellešová [19]) estimates the share of tourism in the country's share of GDP not only in the role of direct tourism in economic development but also concerning other sectors and notes that although tourists do not use the products of all industries indirectly They still have an impact on the development of the tourism sector. At the same time, however, it

emphasizes the differences between other manufacturing industries and tourism production. We agree with the author on the influence of other sectors in the development of the tourism sector, but for this paper, the research is built solely on the development of the hotel and restaurant business. At the next stage of the research, the interaction analysis with other fields will be performed.

3. Methods

To assess the impact of investments in the hotel and restaurant business on the country's economy, the revenues of the tourism sector are determined as a share of the country's GDP, corresponding, were selected as factors: investments in hotels and restaurants; Number of tourists visiting by years; Expenditure incurred by the state in tourism; Inflation rate,%; GDP per capita.

The main focus of the research was to determine the growth of the share of this sector in the GDP from

investments in the tourism sector – a correlation–regression analysis was conducted based on the information obtained for the assessment. To conduct the analysis, first of all, the defining parameters for the development of the tourism sector were identified:

1. X_1 – Investments in hotel and restaurant facilities (million GEL);
2. X_2 – the number of tourists (thousand people);
3. X_3 – Expenditure incurred by the state in tourism, in thousands of GEL;
4. X_4 – inflation rate, %;
5. X_5 – GDP per capita, GEL.

The selected parameters were considered as independent variables and 15 years of information was obtained; y – Hotel and restaurant business revenues in GDP (million GEL) were taken as a dependent variable. In our opinion, the selected independent variables significantly determine the growth of the share of the tourism sector in GDP.

Table 1. – Statistical data of analytical variables

Years	Hotel and restaurant business revenues in GDP (million GEL)	Investments in hotel and restaurant facilities (million GEL)	Number of tourists (thousand people)	Expenditure incurred by the state in tourism, in thousands of GEL	Inflation rate, %	GDP per capita, GEL
2006	179.00	18.30	217.10	1147.60	8.78	3553.78
2007	192.80	81.10	282.40	4709.80	10.97	4402.35
2008	224.60	54.70	266.30	6062.00	5.55	4956.50
2009	280.00	141.70	350.00	2854.70	2.99	4715.25
2010	383.90	54.80	596.90	8638.70	11.24	5762.70
2011	573.80	45.80	853.00	52996.40	2.04	6782.68
2012	730.00	47.50	1185.10	80156.40	-1.37	7301.76
2013	787.40	112.30	1255.50	58608.00	2.37	7691.13
2014	843.60	103.40	1391.40	16671.70	1.95	8368.01
2015	1069.80	204.00	1854.50	25808.70	4.88	9109.40
2016	1307.00	227.60	2539.80	33948.20	1.83	9613.94
2017	1562.30	323.70	3381.50	76137.10	6.72	10933.91
2018	1811.70	513.20	3666.10	100936.90	1.52	11968.00
2019	2089.10	288.70	4014.00	77749.60	7.00	13239.39
2020	1232.40	112.30	1344.70	77527.90	2.40	13234.09

Source: National Statistics Office of Georgia, geostats.ge

3.1 Regression analysis

The approximate multifactorial regression equation was formed as follows:

$$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5$$

To construct a model with fewer errors, the multicollinearity of the independent variables was first determined:

Table 2. – Correlation analysis

	y	x_1	x_2	x_3	x_4	x_5
y	1					
x_1	0.82718468	1				
x_2	0.97429717	0.880267	1			
x_3	0.78780957	0.603696	0.732567822	1		
x_4	-0.27362358	-0.16326	-0.197238135	-0.50390722	1	
x_5	0.94565981	0.696075	0.855151639	0.802904	-0.33833425	1

Source: Author's calculations

As the correlation data show, multicollinearity is evident between the independent variables. In the next stage of the research, the primary data processing was performed, the scattered data was detected and a model was built with adequate data. Based on

the formatting of scattered (incorrect) data and the construction of diagrams, the data for 2018, 2019, and 2020 were subtracted from the database and regression analysis was performed.

Table 3. – Coefficient analysis

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.606133702	200.411965	0.0130039	03900463	-487.7843	492.9965459	-487.78428	492.99655
X Variable 1	0.440873081	0.617068101	0.7144642	03017775	-1.069038	1.950784329	-1.0690382	1.9507843
X Variable 2	0.199273969	0.117811065	1.6914707	0.1416981	-0.088999	0.48754726	-0.0889993	0.4875473
X Variable 3	0.000159283	0.001245595	0.1278768	0.9024248	-0.002889	0.003207145	-0.0028886	0.0032071
X Variable 4	1.913803955	7392347919	03588899	0.804373	-16.17462	20.00222769	-16.17462	20.002228
X Variable 5	0.05266825	0.038213553	1378261	0317312	-0.040837	0.146173446	-0.0408369	0.1461734

Source: Author's calculations

Table 4. – Filtered data for variables

Years	Hotel and restaurant business revenues in GDP (million GEL)	Investments in hotel and restaurant facilities (million GEL)	Number of tourists (thousand people)	Expenditure incurred by the state in tourism, in thousands of GEL	GDP per capita, GEL
1	2	3	4	5	6
2006	179.00	18.30	217.10	1147.60	3553.78
2007	192.80	81.10	282.40	4709.80	4402.35
2008	224.60	54.70	266.30	6062.00	4956.50
2009	280.00	141.70	350.00	2854.70	4715.25
2010	383.90	54.80	596.90	8638.70	5762.70
2011	573.80	45.80	853.00	52996.40	6782.68

1	2	3	4	5	6
2012	730.00	47.50	1185.10	80156.40	7301.76
2013	787.40	112.30	1255.50	58608.00	7691.13
2014	843.60	103.40	1391.40	16671.70	8368.01
2015	1069.80	204.00	1854.50	25808.70	9109.40
2016	1307.00	227.60	2539.80	33948.20	9613.94
2017	1562.30	323.70	3381.50	76137.10	10933.91

Source: National Statistics Office of Georgia, geostats. Ge

The following inaccuracies were revealed in the data of the regression analysis:

1. X_3 (expenditure incurred by the state in tourism, in thousands of GEL) and X_4 (inflation rate,%) with high probability (P -value) is not related to the y variable. Accordingly, they were excluded from the analysis and the analysis table took the following form:

The more reliable the results of the analysis, the larger the database, although it has become very difficult to obtain investment and related data in the tourism sector, adding to the fact that statistically, accurate data is questionable. Therefore, to verify the already corrected data, the information was checked with descriptive statistics.

Table 5. – Descriptive statistics

Variables	Minimum	average	Maximum	Standard deviation
Investments in hotel and restaurant facilities	18.3	94.63398665	323.7	94.63398665
Number of tourists visiting	217.1	995.652095	3381.5	995.652095
GDP per capita	3553.78398	2310.88056	10933.9123	2310.88056

Source: Author's calculations

Virtually all parameters vary considerably. For example, investments in hotels and restaurants, the number of tourists visiting, and GDP per capita show a large fluctuation between the maximum and minimum marks, as well as between the standard deviation figures.

Data analysis for 2018, 2019 and 2020 revealed variable – investments in hotel and restaurant facilities – a negative benchmark. This is related to incomplete accounting, at the same time to the decline in the quality of work of all structures as a result of the Covid pandemic in 2019 and 2020. Graphs were built to test the stationarity of the data, which also clearly showed the deviations in the table.

Eventually the regression equation took the form:

$$Y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3$$

Table 6. – Results of the regression model

	Coefficients	Standard Error	tStat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	26.7015771	132.709204	0.201203656	0.846261	-287.105825	340.508979	-287.105825	340.508979
X Variable 1	0.30014599	0.47544106	0.631300092	0.5478965	-0.82409348	1.42438545	-0.82409348	1.42438545
X Variable 2	0.20941597	0.08751361	2.39295323	0.0479602	0.002479171	0.41635276	0.00247917	0.41635276
X Variable 3	0.0527103	0.02943688	1.79062126	0.1164718	-0.01689686	0.12231745	-0.01689686	0.12231745

Source: Author's calculations

Table 7. – Results of the regression model and F test (2006–2017 years)

Dispersion analysis					
	df	SS	R ²	F	Significance F
Regression	3	1342498	0.97	121.052675	2.14927E-06
Residua	7	25877.12			
Total	10	1368375			

Source: Author's calculations

The normalized $R^2 = 0.97$ is adequate and reflects the reality, $T_{ststist}$ was conducted to ensure the adequacy of the model. And the Fisher (F) test. The result was obtained:

$T_{Critical} = 2.365$. accordingly $T_{ststist} > T_{Critical}$.
 $0.201 < 2.365$ (y for a variable);
 $0.631 < 2.365$ (x_1 for a variable);
 $2.393 > 2.365$ (x_2 for a variable).
 $1.791 < 2.365$ (x_3 for a variable).

Ie The number of tourists (x_2) visiting tourist facilities is a statistically significant variable, which means that investing in restaurant and hotel business pays off in terms of the number of tourists, while the statistical significance of the variables x_1 and x_3 has not been confirmed, but due to the adequacy of the model, it was considered that the t-test shows an acceptable value in the case of obtaining reliable information. Analysis of the Fisher test showed that $F_{Critical} = 3.71$ e.g. $F > F_{Critical}$ ($121.05 > 3.71$) e.g. The null hypothesis is not complete and there is a linear relationship between the variables.

Although the regression analysis showed that investments in the tourism business have the largest impact on revenue growth in the hotel and restaurant business, the number of tourists coming, and the relatively weak impact of investment, the reality confirms that economic development in Georgia, especially the tourism sector, is directly dependent on foreign On investments. As for the impact of the number of tourists coming here, the amount spent by each tourist is important, which shows the income instantly, and the return on investment requires time. The aim was not to fully study the tourism sector and therefore the use of more variables was not considered necessary.

The research was also conducted on the nonlinear regression model to develop the correct model, although, except for inadequate parameters, the model still moved to the linear model. The impact of GDP per capita on the hotel and restaurant business is explained by the fact that there is no direct connection and this data reflects the result obtained by the local population only through restaurant services, so the connection is depicted with a weak parameter.

Based on the data obtained from the regression analysis, we drew the following conclusions:

1. The normalized $R^2=0.97$ has been improved, indicating model adequacy;
2. The dependency ratios, in particular the fact that the volume of investment in the tourism business directly contributes to the growth of tourism sector revenues in GDP, were negative before the model was developed. The correct attitude was observed as a result of the processing;
3. The value of P, which indicates the probability of error, has improved dramatically compared to the previous analysis.

It was considered necessary to be convinced of the adequacy of the obtained results by Checking the model for the autocorrelation of balances, for which the data and graphs of the balances given in the regression analysis were used, according to the Darbin Whiston criterion

$$DW = \sum [e_t - (e_{t-1})]^2 / \sum e_t^2 = 2.068$$

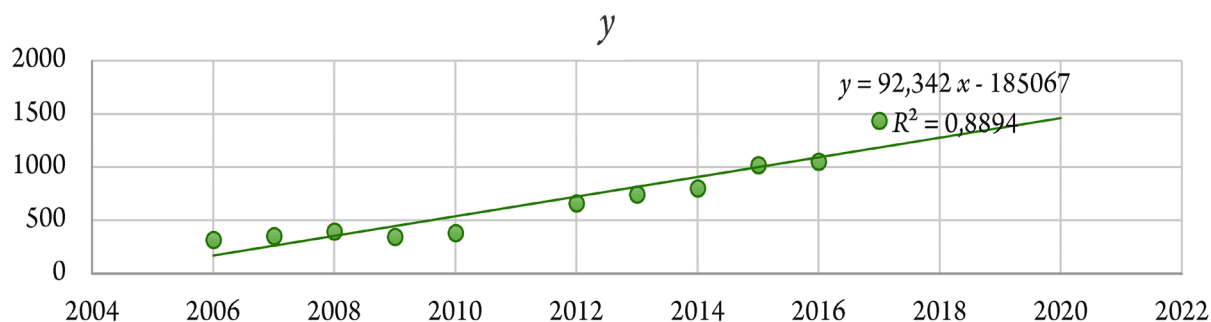
Compared to Durbin Whiston's recommended criteria, it was found that there is no autocorrelation between balances, which in turn proves that the compiled model determines the relationships between variables, i.e. hotel and restaurant business

revenues in GDP are determined by investments in hotel and restaurant facilities, several tourists arriving And GDP per capita.

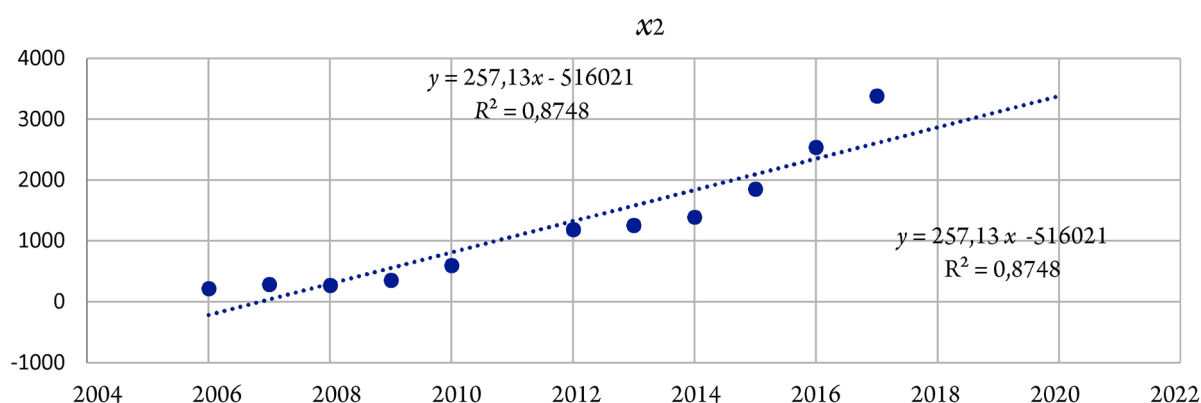
3.2 Timeline analysis

Because the study is based on the change of data over time, a time cycle analysis was performed, us-

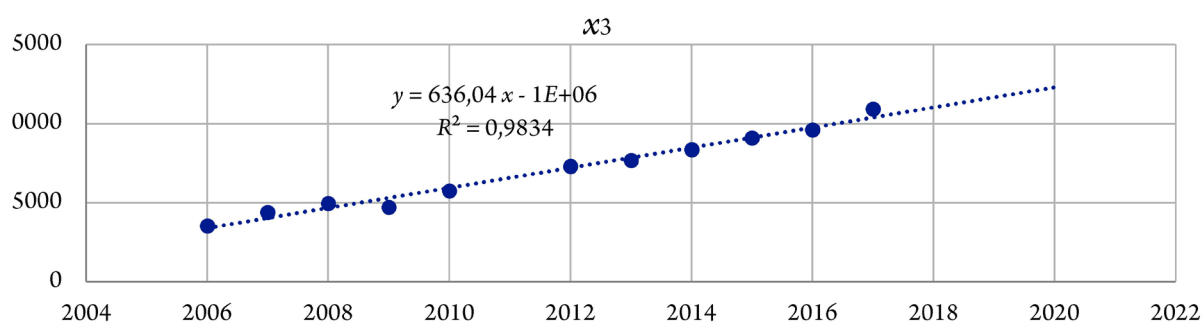
ing which the forecast for the growth of hotel and restaurant business revenues in GDP over the next 3 years was fulfilled. For this, a time series graph was constructed for the variable y :



Graph 1. Time series



Graph 2. Time series



Graph 3. Time series

As can be seen from the graphs, the data are adequate in the case of a linear regression model. As for the forecast, in case of any changes in the data in the next three years, there will be an increase in

the defined parameter. As noted while working on the model, the 2018–19–20 data were excluded as a result of the scatter check, now we can identify the data that should have taken place in those years.

The 2018 year

$$Y = 36.5900033 + 0.423292337 * 513.2 + 0.212111424 * 3666.1 + 0.047915309 * 3553.78 = 1201.725$$

The 2019 year

$$Y = 36.5900033 + 0.423292337 * 288.7 + 0.212111424 * 4014.00 + 0.047915309 * 13239.39 = 1644.579$$

The 2020 year

$$Y = 36.5900033 + 0.423292337 * 112.3 + 0.212111424 * 1344.70 + 0.04791509 * 13234.09 = 1003.467$$

There seems to be an error in recent years in statistics that have shown the model to be inadequate. Obtaining accurate and reliable information is considered to be one of the major problems that distort the results of research and affect the planning and forecasting of economic processes.

4. Conclusion

Thus, investments in the tourism sector lead to an increase in the share of the country's GDP and consequently the tourism sector. Investing in tourism is investing capital in the tourism business to make a profit. For tourism investments, as well as for other investments, it is necessary to take into account that the invested capital must be profitable. Since capital is one of the main components of tourism production, the ability of the tourism economy to produce tourism products largely depends on the amount of capital invested in the tourism economy. With the growth of capital, the productivity of the tourism economy increases. By reducing investment in the tourism economy, production capacity is reduced accordingly.

Investments in the tourism economy increase only when the return on investment exceeds the amount of capital invested. When a tourism investment equals payback, a tourism investment return equals zero. This means that the tourism economy produces an amount of capital equal to the investment spent.

In this case, capital and production remain constant in the tourism economy. If the profit is less than the tourism investment, e.g. The difference between invested and received capital is negative, the tourism economy is losing sources of capital renewal and reducing production capacity. The development of new methods and technologies for the production of tourism products leads to the need for new investments.

The state policy to increase investment in the tourism economy should consist of the imposition of preferential taxes on profits in the tourism industry and various incentives. The cost of acquiring and using new investments affects the return on investment. Low cost means a big return on investment and a big return on investment.

1. To predict the reliability of the research and the high quality of future processes, it is necessary to describe statistics on inflows of foreign investments and returns, as well as the tourist services consumed by a particular tourist and the expenses incurred by them.

2. Although the analysis of 10–12 years is less reliable, the rejection of the null hypothesis allows us to confirm that the share of return on foreign investment in GDP depends on the volume of investments, their use by tourists and ultimately GDP per capita. On the increase in share

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Section 8. Economic theory

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THE IMPACT OF PRODUCTION LOSSES ON THE STRUCTURE OF V. V. LEONTIEV'S "INPUT-OUTPUT" TABLES

Abstract. In the article, based on the principle of constructing open input-output tables by V. Leontiev, a method is given for recalculating the coefficients of the tables and the final results in the presence of defects or previously known inevitable (or average) product losses. The influence of losses on the prices and costs of raw materials is shown. Formulas for modifying the coefficients of "open" tables with known average losses at all levels of production and distribution of products are given. It is shown by a numerical example that, in contrast to the assumption of the linearity of the Leontiev tables, with increasing losses, resource consumption does not grow linearly, and when losses reach a certain value, the balance of production and distribution becomes impossible.

Keywords: Tables «input – output», product losses, own consumption.

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ВЛИЯНИЕ ПОТЕРЬ ПРОДУКЦИИ НА СТРУКТУРУ ТАБЛИЦ В. В. ЛЕОНТЬЕВА «ЗАТРАТЫ-ВЫПУСК»

Аннотация. В статье на основе принципа построения открытых таблиц «затраты-выпуск» В. Леонтьева, дан метод пересчёта коэффициентов таблиц и итоговых результатов при наличии брака или заранее известных неизбежных (или средних) потерь продукции. Показано влияние потерь на цены и затраты сырья. Даны формулы модификации коэффициентов «открытых» таблиц при известных средних потерях на всех уровнях производства и распределения продукции. Показано на численном примере, что, в отличие от допущения о *линейности* таблиц Леонтьева, с ростом потерь, потребление ресурсов растёт *не линейно*, а при приближении потерь к определённой величине баланс производства и распределения становится невозможным.

Ключевые слова: Таблицы «затраты – выпуск», потери продукции, собственное потребление.

Постановка проблемы. Использование в экономике таблиц «затраты-выпуск» В. Леонтьева приобрело популярность в середине XX века,

однако в настоящее время их применение для целей прогноза ограничено в силу ряда их особенностей, среди которых следует указать:

Во-первых, их применимость лишь в условиях плановой экономики.

Во-вторых, разработанные на основе таблиц долгосрочные прогнозы экономического роста отличаются низкой точностью.

В-третьих, отсутствие методического подхода для обоснования выбора между видами таблиц Леонтьева («открытого» и «закрытого» типа).

В-четвёртых это неоднозначность в выборе зависимых и независимых переменных, ибо у В. Леонтьева: «Вопрос о том, какие переменные должны трактоваться как зависимые, а какие определяемы экзогенно, по существу является тактическим» [3, 25]. Не однозначность таблиц ещё в том, что: «с помощью введения дополнительных уравнений экзогенные переменные можно превратить в эндогенные» [3, 27]. А эти условия, при которых такие превращения становятся необходимыми Леонтьевым не разъяснены. Число таких уравнений – тоже. Неоднозначность таблиц и в том, что в них автором допускается, что: «... Некоторые переменные являются «вспомогательными». Их значение и употребление требуют разъяснения» [3, 88]. Критерия же для ввода в таблицы «вспомогательных» переменных – не приводится.

И пятая особенность таблиц та, что метод их построения основан на соблюдении принципа «рыночного равновесия» как *строгого* баланса между уровнем производства и потребления, баланса, которого просто быть не может ввиду фактов «перепроизводства» или потерь в сельскохозяйственной сфере, которые нельзя заранее учесть. Аналогично дело обстоит и с браком-потерями продукции. Учитывая вышеизложенные особенности, решения по таблицам Леонтьева можно уподобить решениям физических задач без учёта «сил трения» или диссипации энергии. В целом, такие решения дают лишь общее приближение к итоговому результату объекта или процесса, но не всегда отвечают критериям требуемой необходимой практической точности.

Анализ публикаций. Большинство (если не все) публикаций по данной теме ограничиваются приложениями применения метода Леонтьева, а сама теоретическая часть метода, изложенная в оригинальных работах автора [1–4], не подверглась существенной переработке ни самим автором, ни его последователями, на что указывает и примечание от редакции: «Неточности и прямые ошибки в формулах, в изобилии имеющиеся в оригинале (полностью не устраненные... в английском переводе), исправлены по умолчанию... в отдельных местах делались соответствующие ссылки» [3, 83].

Но и в «оригиналах» кроме ошибок имеем разночтения. Например, по теме экономического равновесия редакция указывает: «предшественником... исследований В. В. Леонтьева надо считать Вальраса, сформулировавшего принципы экономического равновесия» [1, 8]. А относительно рыночного *равновесия* сам же В. Леонтьев отмечает следующее: «Разумеется, экономика совсем не обязательно достигает состояния равновесия. Такого состояния может не быть вовсе, или их может быть несколько» [1, 179]. Или учёный берёт за основу своих построений «принцип», которого может *не быть вовсе*.

Далее им отмечается, что: «Хотя некоторые из составляющих систему общего равновесия уравнений... базируются на выполнении определенных условий... эта система не может считаться верной» [1, 56], что вообще за гранью научной методики. Кроме того, он указывает, что в его таблицах зачастую: «Возникает несоответствие, противоречащее условиям всеобщего равновесия» [1, 114]. И совсем парадоксальное заявление, что: «в контексте экономического роста, придется признать, что в экономике вообще не может быть устойчивых или неустойчивых состояний равновесия» [1, 183].

Но, несмотря на все противоречивые заявления, многие экономисты признают: «теория общего равновесия в настоящее время является

стержнем экономического образования в США (как для студентов старших курсов, так и для аспирантов)» [4, 161]. В целом же, и Леонтьев считает, что: «Теория общего равновесия... является стержнем современной экономической теории» [4, 122]. Вместе с тем, в одном из своих интервью он указывает на главный недостаток этой теории равновесия: «теория общего равновесия не объясняет, как использовать фактические данные, и я специально разработал метод «затраты-выпуск», чтобы... сделать механизм функционирования системы более понятным» [5, см. «Интервью Фоули»]. Имеется ещё целый ряд разночтений, но уже в принципах построения самой его теории.

Основой таблиц Леонтьева является квадратная матрица **A** взаимных поставок товаров между фирмами, коэффициенты которой означают сколько единиц товаров сторонних фирм использует фирма для выпуска единицы своей продукции. С одной стороны, В. Леонтьев указывает: «достаточные условия... требуют, чтобы ни у одного из столбцов (или строк) сумма технологических коэффициентов в **A**... не превышала **1** и по крайней мере одна из этих сумм была меньше единицы» [1, 284]. А с другой стороны в примере-иллюстрации, автор формулирует: «Если, например, в производстве **6**... единиц товара № **1** используется... **10** единиц товара № **3**...» [4, 34], или в его собственном примере даже один элемент матрицы $A_{31} = 10/6 > 1$.

В. В. Леонтьев не разъясняет почему его: «Таблицы затраты-выпуск обычно не содержат... данных о добыче полезных ископаемых и стоимости, добавляемой первичной обработкой ресурсов» [3, 108]. Но в другой работе он постулирует, что: «С затратами первичных ресурсов, таких, как... природные ресурсы... можно обращаться так, как если бы они были продуктом отдельной отрасли» [1, 285], или он же: «Добыча полезных ископаемых... подробно описывается матрицей технологических коэффициентов» [2, 73].

Автор отмечает, что в его таблице: «матрица **A** является квадратной неотрицательной матрицей всех коэффициентов затрат» [1, 68], но, учитывая загрязнение, он предлагает иное: ««Выпуски» всех загрязняющих веществ будут представлены отрицательными величинами» [1, 348] в его же матрицах.

Аналогично вызывает возражение и следующее его примечание: «загрязнение, связанное с деятельностью домашних хозяйств и других конечных потребителей, не учитывается» [1, 322], хотя подобные загрязнения (например, мусорные полигоны бытовых и строительных отходов, сбросы в реки неочищенных сточных вод и пр.) и представляют основную проблему.

В работе Леонтьева имеются многие спорные утверждения, с которыми просто нельзя согласиться, напр.: «Показатель общего выпуска... товаров... является... суммой объемов выпуска хлеба, ботинок, мужских костюмов, телевизоров» [1, 82], где суммируются объёмы товаров, различающихся не только по виду, но и по срокам пользования, как, например, хлеб – товар одноразового пользования, а ботинки – товар длительного пользования. С одной стороны Леонтьев указывает: «Одним из самых полезных свойств... системы «затраты-выпуск»... является линейная аддитивность решений системы относительно любых изменений конечного спроса» [1, 299], а с другой он же: «Взаимосвязи отраслей представляют собой что угодно, но только не простую вертикальную последовательность» [1, с. 104].

Противоречивыми представляются и такие утверждения Леонтьева: «в открытой системе... домашние хозяйства считаются сектором конечного спроса, т.е. экзогенным сектором» [2, 60], и сравните с тем, где: «Домашние хозяйства не обязательно рассматривать как часть экзогенных секторов, каковыми они являются» [2, 60]. Основания для «необязательности» – не указаны, что провоцирует известный произвол и в его экономической теории.

Отметим и прямо противоположные заявления Леонтьева, например: «США располагают большей суммой производительного капитала ... чем любая другая страна» [2, 233]. В другом месте он отмечает: «сравнительный недостаток капитала и избыток трудовых ресурсов в США» [2, 268], или о том же: «США богаты трудовыми ресурсами и бедны капиталом» [2, 265].

Есть у Леонтьева и явные «антиэкономические» мысли: «все регионы, по-видимому, выиграли бы ... если бы регионы-покупатели продолжали сокращать свою зависимость от импорта ... товаров путем наращивания внутреннего производства» [3, 387–8], где он косвенно ратует за региональное самообеспечение вне международного обмена, хотя прекрасно осведомлен о наличии и «неконкурентного» импорта, который безальтернативен: «В эту «неконкурирующую» категорию можно с уверенностью включить кофе ...» [2, 261], и зависимость от которого неустранима. Или его аналогичный «совет»: «... развивающимся регионам придётся значительно увеличить свою долю тяжелой промышленности в экономике, чтобы резко сократить свою зависимость от импорта машин и оборудования» [3, 134], который вообще отрицает выгоду международного разделения труда. Или такая оригинальная «мысль», что: «Главный упор в снабжении продовольствием развивающихся регионов должен быть сделан на увеличении их собственного производства сельскохозяйственной продукции» [3, 49], которая в формальном толковании означает «производство риса, кукурузы и цитрусовых в Заполярье».

Есть и непонятная фраза: «устойчивый рост цен на минеральное сырье и сельскохозяйственные товары... по сравнению с ценами на промышленные изделия – один из путей...» [3, 49], где *рост* цен, а это [%/год] *сравнивается* непосредственно с *ценами* [\$ / кг]. Если здесь имелось в виду сравнение темпов роста цен сырья и изделий, то тоже неувязка. Получается, что цены на

сырье растут большими темпами, чем цены на ... изделия из этого сырья.

Отмеченные выше и многие другие неоднозначности и противоречия побуждают проанализировать (и по возможности откорректировать) как те положения, на которых базируется общая теория экономического равновесия, так и некоторые положения в теории равновесия системы В. В. Леонтьева «затраты-выпуск».

Цель статьи. Оставаясь в рамках исходной парадигмы Леонтьева о *возможности* экономического равновесия и о *наличии* экзогенного сектора экономики, безвозвратно и безвозмездно поглощающего часть производимой продукции производителей – разработать метод модификации зависимости имеющихся коэффициентов «открытых» таблиц В. Леонтьева от известных средних производственных или иных потерь, показать влияние потерь на цены и уровни потребления-затрат сырья, ибо, хотя В. Леонтьев и отмечал: «периодическое списание запасов ... во всей экономической системе» [4, 355], но изучения последствий подобного «списания» запасов (потерь) у него нет.

Изложение основного материала. При построении таблиц «затраты-выпуск» Леонтьев сформулировал основное условие, а именно, что каждый участник его «обменного» рынка производит некую продукцию и взаимно обменивается своей продукцией, параллельно поставляя её как внешним экзогенным (экспорт), так и конечным потребителям. Иными словами, все фирмы-производители поставляют свою продукцию в некий общий «пул», из которого затем берут всё необходимое для дальнейшего воспроизводства. Задача заключается в том, чтобы, зная вектор конечного потребления Y , найти вектор общего производства X . Итак, базовое уравнение В. Леонтьева

$$X = A \cdot X + Y, \quad (1)$$

где: $X = \{X_1, X_2, \dots, X_N\}$ – *искомый* вектор-столбец выпуска товаров N отраслями, *фирмами*, который нужно найти (X_L – полный объём выпуска товара L -й фирмой в любой его размерности), зная кото-

рый, потом будет не сложно распределять «пул» общего выпуска X по потребителям.

A – матрица $\{N \times N\}$ коэффициентов «обмена» продукцией между всеми N фирмами рынка обмена на единицу выпуска каждой:

$$A = \{[A_{11}, A_{12}, \dots, A_{1N}] / [A_{21}, A_{22}, \dots, A_{2N}] / \dots / [A_{N1}, A_{N2}, \dots, A_{NN}]\};$$

A_{KL} – (элемент матрицы A) объём поставок (сколько единиц) продукции K -й фирмы идёт для L -й фирмы, чтобы последняя смогла выпустить единицу («штуку», тонну, баррель и т.п.) своей продукции;

A_{KK} – объём поставок продукции K -й фирмы для себя, чтобы выпустить единицу своей же продукции. Естественно, должно выполняться $A_{KK} < 1$;

$A_{KL} \cdot X_L$ – весь объём поставок K -й фирмой продукции для L -й фирмы. Матрица A – будет «диагональная», когда все фирмы работают только на производство продукции для конечного потребления и для себя, без «перекрёстных» обменов поставок меж собой. Матрица A – нулевая, когда все фирмы работают только на поставки населению и/или имеют некие производственные потери. У Леонтьева есть и более «продвинутые» варианты построения его «таблиц», например, с учётом загрязнений, динамические таблицы экономического развития, таблицы расчёта цен, но мы ограничимся только анализом принятого им базового варианта таблиц.

$Y = \{Y_1, Y_2, \dots, Y_N\}$ – это вектор-столбец т.н. «безвозвратного», или конечного потребления, это тот объём продукции каждой фирмы в натуральном его выражении, который безвозвратно потребляется населением или «теряется», либо то и другое вместе. Здесь автором вводится понятие **потерь**, ибо таблица Леонтьева не учитывает потери, хотя **потери** бывают иногда весьма значительные, особенно в аграрном секторе, либо **потери** представляют зачастую технологически неизбежный брак и пр. Почему-то к безвозвратным потерям В. Леонтьев также отнес и экспортно-импортные операции, объявив, что: «экспорт

порт может быть представлен положительными, а импорт – отрицательными компонентами конечного спроса» [2, 61].

В результате, введя единичную матрицу I размерностью $\{N \times N\}$ (с «единицами» вдоль главной её диагонали и с «нулями» для остальных компонент), Леонтьев последовательно преобразовывает базовое уравнение системы «затраты-выпуск» следующим образом

$X = A \cdot X + Y$; $I \cdot X = A \cdot X + Y$; $(I - A) \cdot X = Y$, откуда получает красивое решение для искомого вектора выпуска X открытой системы «затраты-выпуск», для которой характерно, что $Y \neq 0$

$$X = (I - A)^{-1} \cdot Y. \quad (2)$$

Открытая таблица. Открытая таблица Леонтьева характеризуется ненулевым вектором Y потребления и свойствами, где: «в открытой системе межотраслевых связей домашние хозяйства считаются сектором конечного спроса, т.е. экзогенным сектором» [2, 60], или: «ассортимент товаров Y_1, Y_2, \dots открытой системы... включает... только спрос со стороны домашних хозяйств» [2, 102], где, зная их конечный спрос Y , можно найти весь выпуск продукции X , с учётом, что часть товаров «поглощают» сами производители.

Однако здесь не учтены важные моменты. Не вся произведенная продукция поставляется на рынок, ибо всегда объём производства товара *превышает* объём продаж. Причинами этого служат или брак производства, или потери при хранении продукции, или же потребление произведенных своих товаров для собственных нужд, например, в сельскохозяйственном производстве. Как указывает сам В. Леонтьев: «очень большая часть затрат сельскохозяйственного труда практически теряется, так как используется лишь для обеспечения прожиточного минимума работников» [2, 263], или: «Сельское хозяйство продает... небольшую часть своих произведений; большая часть их потребляется в домашнем хозяйстве» [1, 248], однако в его таблицах *все производимые товары*, в т.ч. и используемые для собственных

нужд, учитываются в операциях через обменный рынок, что должно дать завышенные результаты, например, в расчете вектора цен.

Уравнение баланса для совокупного производства K -й фирмы, как и потребления её продукции другими N фирмами и конечными потребителями можно представить как

$$X_K = A_{K1} \cdot X_1 + A_{K2} \cdot X_2 + \dots + A_{KK} \cdot X_K + \dots + A_{KN} \cdot X_N + Y_K, \quad (3)$$

где: X_K – весь объем производства K -й фирмы для своих нужд и для поставок товара на рынок обмена остальным потребителям.

Следует отметить, что при потреблении фирмой *своей* продукции для *своих* нужд, объем производства должен обеспечивать объем поставок товара как на рынок, так и учитывать компенсацию возможных технологических форс-мажорных или же иных потерь. Как можно показать, K -я фирма должна производить в $\eta_K = 1/(1 - A_{KK})$ раз больше товаров, чем поставлять на рынок, и приобретать на рынке во столько же раз больше «чужой» продукции для нужд собственного воспроизводства, поэтому уравнение баланса обмена K -й фирмы для реального рынка обмена должно быть следующим $X_K/\eta_K = A_{K1} \cdot X_1 + A_{K2} \cdot X_2 + \dots + 0.0_{KK} + \dots + A_{KN} \cdot X_N + Y_K$, (4)

где: X_K – полный объем производства K -й фирмы; X_K/η_K – поставки на обменный рынок продукции K -й фирмы;

$A_{KL} \cdot X_L$ – потребление продукции K -й фирмы L -й фирмой.

И сам В. Леонтьев отмечал, что должен быть некий: ««Минимальный запас» не принадлежит хозяйственному кругообороту» [4, 71], а потребление собственной продукции и попадает под определение подобного «запаса».

При этом может показаться, что, если привести подобные члены, то уравнения (3) и (4) баланса станут тождественными. Но это верно лишь при отсутствии потерь продукции, как у производителя, так и у остальных его потребителей. При наличии потерь соотношения иные.

Если доля брака (или иных потерь) у K -й фирмы-производителя равна r_K , то, как несложно показать, параметр η_K будет уже иным

$$\eta_K = 1/(1 - A_{KK})/(1 - r_K), \quad (5)$$

но это при условии, что весь брак остаётся у производителя. Если же видов брака несколько: $r_{K1}, r_{K2}, r_{K3} \dots$ тогда имеет место подобное соотношение

$$\eta_K = 1/(1 - A_{KK})/(1 - r_{K1})/(1 - r_{K2})/(1 - r_{K3}) \quad (5')$$

В свою очередь у производителя (L) продукции возможна порча в процессе производства даже качественной продукции, взятой из «пула» от фирмы (K). Если вероятность такой порчи s_{KL} , то в таблице вместо элемента A_{KL} следует подставлять элемент

$$S_{KL} = A_{KL}/(1 - s_{KL}), \quad (6)$$

где: S_{KL} – элемент, отражающий требование повышения объема приобретения продукции K -й фирмы со стороны L -й фирмы из-за браковки именно « K -изделий» уже в производстве « L -изделий». То же относится и к компонентам Y_K вектора Y , которые нужно увеличить в $1/(1 - y_K)$ раз при доле y_K потерь поставленной продукции K -й фирмы у конечных (безвозвратных) потребителей. В итоге имеем уравнение реального «баланса»

$$H \cdot X = S \cdot X + Z, \quad (7)$$

где реальная **обменная** матрица (S) Леонтьева приведена в Таблице 3.

Таблица 3. – Реальная обменная матрица (S) Леонтьева

X	Обменная матрица (S)				Z
X_1/η_1	0.0	S_{12}	...	S_{1N}	Z_1
X_2/η_2	S_{21}	0.0	...	S_{2N}	Z_2
...
X_N/η_N	S_{N1}	S_{N2}	...	0.0	Z_N

В Таблице 3 даны элементы матрицы некоего бартерного обмена, где:

$Z_K = Y_K/(1 - y_K)$ – полное потребление конечными потребителями продукции фирмы K , с учётом потерь и у самих конечных потребителей.

$S_{KL} = A_{KL}/(1 - s_{KL})$, и $S_{KK} = 0.0$, когда производимые товары, кроме товара на собственные нужды

складываются в общий «пул», откуда участники выбирают нужные им товары в нужном количестве;

H – диагональная матрица, где: $H_{KK} = 1/\eta_K$ и $H_{KL} = 0$ для $K \neq L$;

Окончательно вектор полного производства для всех фирм будет

$$X = (H - S)^{-1} \cdot Z. \quad (8)$$

Отсюда можно заключить, что брак одной фирмы, даже не попадая на обменный рынок, вызывает цепную мультипликативную реакцию роста её спроса на товары остальных поставщиков (для компенсации брака) и на свою собственную продукцию, провоцируя и всеобщий рост пустого потребления.

Ниже дан пример расчёта выпуска X для четырёх фирм по методике Леонтьева и по предложенному методу, где вектор Y и все коэффициенты матрицы A взяты произвольно, при условии $A_{KK} < 1$.

Таблица 4. – Пример расчёта выпуска X для четырёх фирм по таблице Леонтьева

X_0	матрица Леонтьева A				Y
603.3	0.0	0.1	0.2	0.1	100
938.7	0.3	0.3	0.1	0.1	200
1333.3	0.2	0.1	0.4	0.2	300
1427.4	0.1	0.3	0.3	0.2	400

На Рис. 1 показаны графики относительно-го роста выпуска фирм как функции процента брака (X_0 – выпуск фирмы без брака). Слева на (Рис. 1) все фирмы, кроме первой, работают без брака, а брак (r_1) первой фирмы меняется по величине. Вследствие браковки части своей продукции первая фирма должна увеличивать объем своего выпуска, вдвое больше, чем «объем» её бракованного товара, что при этом вызывает рост выпуска у всех фирм на чуть меньшую величину.

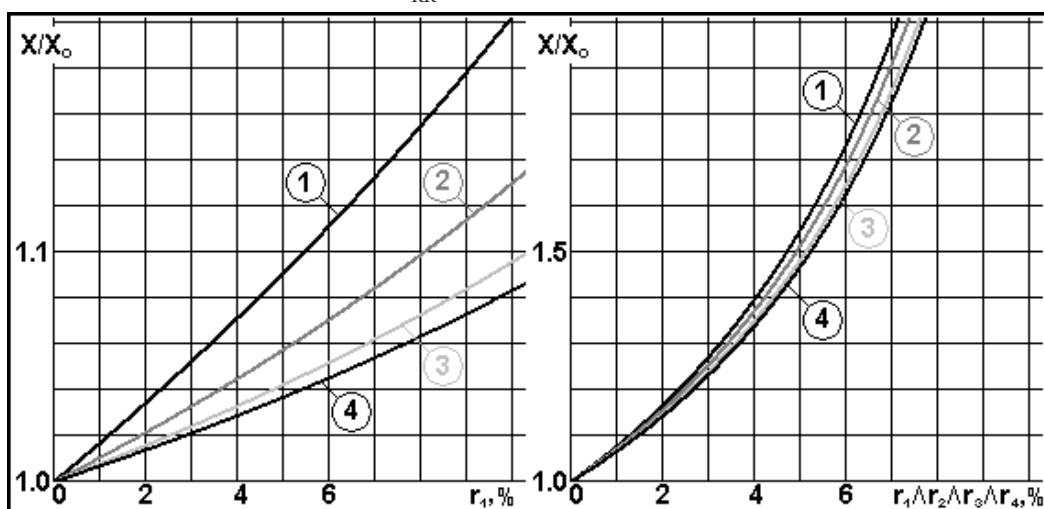


Рисунок 1. Увеличение выпуска, как функция доли брака

На Рис. 1 (справа) показана ситуация, когда все фирмы работают с одинаковым уровнем брака ($r_1 = r_2 = r_3 = r_4$), и их выпуск существенно нелинейно растёт с браком. Моделирование показало, что зависимость роста выпуска как функция брака носит *гиперболический* характер, когда при некотором предельном уровне брака выпуск гиперболически стремится к 8 (обратите внимание на разницу масштабов графиков по оси ординат).

При рассмотрении баланса цен P_A и добавленных стоимостей V базовое уравнение Леонтьева имело вид $P_A = A' \cdot P_A + V$, однако, допуская гипотезу наличия уже известных-заданных «добавленных стоимостей», и учитывая всё же необходимость компенсации потребления фирмой собственной продукции и её потерь за счет рыночной прибыли, получаем следующее уточненное уравнение для «расчёта» цен

$$P_S = S' \cdot H \cdot P_S + V, \quad (9)$$

где: A' и S' – транспонированные относительно главной диагонали матрицы A и S (или поэлементно $A_{KL} = A'_{LK}$ и $S_{KL} = S'_{LK}$).

Откуда искомый вектор цен будет

$$P_s = (I - S' \cdot H)^{-1} \cdot V. \quad (10)$$

Можно показать, что рассчитанные по методу Леонтьева цены P_A будут завышенными по сравнению с ценами P_s , рассчитанными по предложенному методу. Численный пример сравнительного расчёта цен по обоим вариантам приведен ниже в Таблице 5.

Таблица 5. – Численный пример сравнительного расчёта цен

P_A	P_s	матрица Леонтьева A'				V
85.28	85.28	0.0	0.3	0.2	0.1	10
111.04	77.73	0.1	0.3	0.1	0.3	20
153.37	92.02	0.2	0.1	0.4	0.3	30
112.88	90.31	0.1	0.1	0.2	0.2	40

Аналогичные графики прироста цен как функции роста доли брака продукции иллюстрирует Рис. 2.

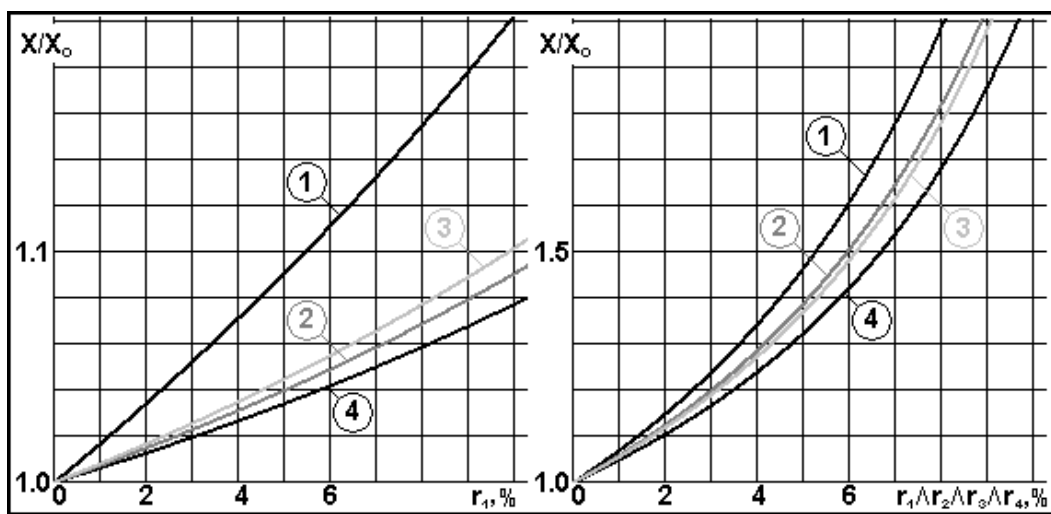


Рисунок 2 Рост цен, как функция доли брака

На Рис. 2 (слева) все фирмы, кроме первой, работают без брака; (справа) фирмы работают с относительно одинаковым (процентным), и синхронно изменяющимся уровнем брака.

Анализ публикаций говорит о том, что акцент в экономических исследованиях делается на неэффективности монополий или конкуренции в плане разбазаривания ресурсов, но проблема влияния брака на расходование ресурсов не получила должного внимания. Приведенные выше рисунки иллюстрируют, однако, что при снижении брака (производственных потерь) с 10% до 5% (в два раза) только одной фирмой приводит к двойной экономии ресурсов и у этой фирмы и у ее контрагентов. Однако, возникновение брака 5% у всех фирм, ранее работавших без брака, приведет каждую фирму к росту потребления ресурсов до уровня ~ 40%.

Отметим, что приведенные численные примеры, иллюстрируют только общую тенденцию нелинейного влияния потерь на суммарное расходование ресурсов, которое носит гиперболический характер, указывающей на наличие некоего предельного уровня потерь, выше которого «баланс» производства и потребления становится просто невозможным.

Выводы. Показано влияние производственных и иных потерь фирм на затрат сырья и на уровни цен. Предложен методический подход, уточнения известных классических таблиц В. Леонтьева, составленных без учёта потерь. Разработаны принципы, позволяющие модифицировать «открытые» таблицы Леонтьева при данных средних потерях. Даны формулы для корректировки коэффициентов исходных классических

таблиц В. Леонтьева. Показано на численном примере, что, несмотря на структурную *линейность* таблиц Леонтьева, в которых: «Взаимозависимость между секторами... экономики описывается системой линейных уравнений, выражающих балансы между совокупными затратами и... вы-

пуском каждого продукта» [2, 51], по мере роста брака и иных потерь, реальное потребление ресурсов растёт *нелинейно*, гиперболически, причём, при приближении любой из потерь к определённой величине общее существование рынка становится вообще невозможным.

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MONOPOLY, COMPETITION AND "CARTELS" IN THE MARKETS, OPTIMAL PRICES AND QUOTAS OF PARTICIPANTS

Abstract. The analysis of pricing features in different types of markets is given: monopolistic, competitive and with the "collusion" of producers. Formulas for calculating monopoly and competitive prices and optimal quotas of producers are given, based on the principle of maximum profit for each.

Keywords: monopoly, competition, collusion, prices, quotas.

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МОНОПОЛИЯ, КОНКУРЕНЦИЯ И «КАРТЕЛЬНЫЙ СГОВОР» НА РЫНКАХ, ОПТИМАЛЬНЫЕ ЦЕНЫ И КВОТЫ УЧАСТНИКОВ

Аннотация. Дан анализ особенностей ценообразования на рынках разного вида: монопольных, конкурентных и при «сговоре» производителей. Даны формулы расчёта монопольных и конкурентных цен и оптимальных квот производителей, исходя из принципа максимальной прибыли каждого.

Ключевые слова: монополия, конкуренция, сговор, цены, квоты.

Постановка проблемы. В экономической литературе наличествуют разночтения в отношении оценок рыночных отношений, причём доминируют только описательные иногда эмоциональные высказывания без обоснования последних какими-либо моделями и расчётами. Проблема неоднозначности оценок может быть решена только в плоскости конкретных расчётов, тогда и субъективные оценки-«комментарии» рыночных явлений станут ненужными.

Анализ публикаций. Что касается публикаций по монопольным рынкам, то основной акцент авторы делают на их якобы неэффективности и даже на прямой «порочности», всячески «поощряя» любые антимонопольные меры. Фридрих фон-Хайек: «правительство следует лишить монополии на эмиссию денег». Он же: «порок рыночного порядка... – есть следствие многолетней правительственной монополии на эмис-

сию денег». Отметим, что кроме этой денежной монополии правительства имеют монополии на налогообложение, безнаказанное насилие, «законотворчество» в худшем смысле этого слова, которые Хайек не упоминает. А вот мысль Пола Самуэльсона: «существуют «несостоятельности рынка»... Одна из несостоятельств рынка связана с монополиями». Человек *несостоятелен*, если он не может выполнять то, что он выполнял ранее. О какой *несостоятельности* монополий можно говорить, если они успешно-прибыльно функционируют на рынках? Он же: «там, где распространены монополии, загрязнение окружающей среды». Как будто при конкуренции среда не загрязняется, а очищается. Ещё у него монополия как *ошибка* рынка: «государство старается исправлять ошибки рынка, такие как монополии». И в том же *государстве*: «Имеются три основных источника монополии... прямая или косвенная

государственная поддержка и частный сговор». Читай, левой рукой государство *«исправляет»* монополии, а правой их *поддерживает*, как в этой фразе нашего героя: «На практике монополия... возникает вследствие государственной поддержки или сговора между отдельными лицами». Если под *сговором* понимать нечто противозаконное, то получается, что государство *поддерживает* нарушителей закона. Если *сговор* это нечто в рамках закона, то почему бы его не именовать соглашением или контрактом? Попутно отметим, что тот же *сговор* между отдельными лицами именуют картелем. Он же: «один продавец (монополист) взвинтит цены... для того, чтобы получить дополнительную прибыль». А у лауреата Ж. Тироля: «выручка монополиста... убывает с... увеличением цены» [2, 99]. Есть два лауреата и два противоположных заявления. У одного *взвинчивание* цен даёт дополнительную прибыль, у другого – выручка падает. Кому верить, если они оба «освящены» Нобелевскими премиями? Так растёт или падает прибыль монополий с ростом цены? А *взвинчивание* цен это до бесконечности или до какого-то уровня? А где расчёт этого уровня? Но расчёта нет. А в ином месте Пол *умерил* недовольство, и его мнение: «Мешать работе экономики, пытаясь умерить аппетиты горстки монополистов – это все равно, что отравлять ядохимикатами целый сад, чтобы уничтожить несколько жуков». Экономика работает, фирмы имеют прибыли, народ – продукцию фирм и рабочие места, потому *мешать работе экономики* – это значит только *снижать* указанные показатели. А кому такое надо? Да и *вмешательство* означает воздействие на объект и вовсе со стороны. А с какой? А ведь экономике противостоит только политика. Первая – производит а вторая – паразитирует на первой... Поэтому *вмешательство* в экономику может быть только со стороны государства со всеми вытекающими негативными последствиями для экономики... А это – перл: «Немонопольная прибыль является величайшим социальным злом монопо-

лии. Неэтичной... является тенденция монополий устанавливать слишком высокие цены» [3, 118], где у монополии есть... *немонопольная* прибыль. Монополист при цене товара 9.99 получил прибыль миллион. Как определить, что эта цена *слишком* высока, и сколько в миллионе «сидит» *немонопольной* прибыли – загадка века. Ещё Пол: «Государство вынуждено создавать антимонопольное законодательство и тем самым урезонивать тех, кто пытается завысить цены», и иная его т.з., где: «они [монополии] обычно могут существовать лишь при том или ином покровительстве государства». *Антимонопольные* законы и *покровительство* монополий – в одной тарелке.

Не чужд противоречий лауреат Жан Тироля. С одной стороны: «фирмы объединяются... только для того, чтобы законно проявлять монопольную власть на продуктовом рынке» [2, 23], и парой строк ниже – иное: «Мотивы эффективности... Они не предопределяют существования монопольной власти на продуктовом рынке» [2, 23]. Есть или нет *власть* на *продуктовых* рынках – решайте сами. У Тироля: «Фирма, которая обладает *монопольной властью*... всегда может лишиться монопольной власти повышением... цены» [2, 262]. А у Пола, как мы наблюдали выше: «(монополист) взвинтит цены», и тем... сам себя лишает «*власти*». Кстати о власти. Наличие власти подразумевает факт отъёма чего-то у кого-то с угрозой применения силы. В противном случае власти нет. На рынке происходит торговля и добровольный товарообмен. О какой *власти монополий* идёт речь если всё добровольно? Лауреат Милтон Фридмен полагает, что: «Перед нами стоит выбор из трех зол: частная нерегулируемая монополия; частная монополия, регулируемая государством; и монополия, непосредственно управляемая государством». Кругом только «зло», и реального выбора для реализации «добра» нет. Да и на слух слова: *регулировка* и *управление* звучат как синонимы, потому реальное «зло» Милтона лишь в двух экземплярах частной и государственной монопо-

лий. Если под «*злом*» (в экономическом смысле) понимать убытки, то откуда вообще получается прибыль – остаётся неясным. А вот Жан Тироль о «*долгах*» правительства: «правительство должны начать исследовать причины монополизации». И с каких же это пор правительства, имеющие монополию власти на всё, что-то кому-то *должны*, тем более в научно-исследовательской сфере? Если только перечислить всё то, что (по высказываниям экономистов-теоретиков) правительства *должны* делать для своих народов, то получится неплохая докторская диссертация. Приведенные здесь фразы о монополии и её «*грехах*» взяты из разных работ лауреатов, но аналогичные высказывания о монополиях типичны для большинства публикаций по данной тематике.

Относительно конкурентных рынков – та же разногласия: как по видам конкуренции, так и по её «свойствам». Конкуренции бывают несовершенные, совершенные, ценовые, количественные, мощностные и монополистические. Слово-сочетание «монополистическая конкуренция» для трезвого уха сродни: «уродливой красавицы» или «гуманного маньяка», где прилагательное явно противоречит существительному. О совершенной конкуренции говорят, когда добавочный производитель на рынке *не влияет* на рыночную цену, и лауреат В. Леонтьев «иллюстрирует» это так: «Когда фермер Джонс определяет, какое количество... свиней даст наибольшую прибыль, он принимает во внимание рыночную цену, по которой они могут быть проданы. Поступая таким образом, он... полагает, что цена является заданной, то есть практически не зависимой от его конкретного решения». О какой же *наибольшей прибыли* можно говорить, когда цена задана? Ведь чем *больше* вырастишь свиней, тем *больше* будет прибыль. В условиях совершенной конкуренции максимизация прибыли *невозможна*. Конкуренция подразумевает борьбу между фирмами. Здесь же цена задана рынком, и рынок поглотит любой выпуск по этой цене. Получается, что со-

вершенная конкуренция – это отсутствие борьбы вообще, и словосочетание: «конкурентная борьба за ...» – вообще теряет смысл. Ещё у Пола: «совершенная конкуренция может привести к сильно выраженному неравенству, к недоеданию детей». А почему Пол не указал, *когда* такая же конкуренция *может не привести* к голоданию детей? Если голодают дети, то почему ничего не говорится о состоянии их родителей? Если и они голодают, то недоедает всё население. А поскольку массового голода мы не наблюдаем, то возникает большое сомнение в существовании такой конкуренции. Да и откуда *неравенству* взяться, если рыночные цены заданы и одни для всех?

Но в условии *несовершенной* конкуренции *борьба* есть. Пол: «Субъекты несовершенной конкуренции часто... борются за увеличение своей доли рынка». Как *часто* они борются – не уточняется. Откуда следует, что и этому виду (*несовершенной*) конкуренции *не всегда* присуща *борьба*. Увеличение своей доли возможно только путём роста своего предложения, что приводит к падению цен, причём до уровня «низших затрат», когда на рынке останется только один производитель и, по словам Жана Тироля, в т.н.: «конкуренции Бертрана... Фирма, имея низшие затраты и назначая цену, равную «вторым низшим затратам»... захватывает весь рынок... и получает положительную прибыль» [2, 346]. Или очевидный вывод. Попытка захватить большую долю рынка в итоге ведёт к монополии, причём, такой хитрой, при которой цена товара на уровне «вторых низших затрат» ближнего конкурента, т.е. реально – на уровне второй себестоимости. Как тогда монополии могут *взвинчивать* цены – остаётся загадкой века. Подобного вида «конкуренция» приводит к падению как прибыли, так и нормы прибыли почти до нулевого уровня. Что тогда мешает вывести капитал из «промышленности» и внести деньги на банковский депозит, где норма прибыли всё-таки ненулевая? Ответ Жана поражает: «...ценовая конкуренция – очень

сложное явление» [2, 382]. Если оно *сложное* для лауреатов, то что творится в экономической науке на уровне экономической профессуры, простых преподавателей и бедных студентов?

Что же касается картельного *сговора*, то, например, у Пола читаем: «Зло *олигополии*... В отраслях, производящих идентичную продукцию... большие накладные расходы... конкуренция разорительна... фирмы... стремятся достигнуть общего соглашения о ценах, которое обеспечило бы всем максимальные прибыли». О методике расчёта уровня этих «*цен соглашения*» – ничего не говорится. Или: «Угроза монополизации посредством слияний... всегда тревожила антимонопольные органы». Ну, *тревожит*. И что дальше? Или лауреат Жан Тироль: «Многие фирмы отрасли, конечно, обдумывают то, какие результаты принесет возможность сговора» [2, 382]. Методика такого *обдумывания* результатов не указана. Он же: «существуют факторы, которые могут воспрепятствовать сговору. Мы выделяем два таких фактора – лаги обнаружения и асимметрия фирм... Попытки формализовать второй фактор, к сожалению, не были... успешными» [2, 375]. И это слова нобелевского лауреата. Причины такой *не успешности* обойдены молчанием. Асимметрия лица – это понятно. А что суть *асимметрия* фирм – не ясно. А это просто перл: «... возможность поддержания сговора или иного исхода зависит от подразумеваемого типа безумия» [2, 406]. Обратите внимание, что имеется в виду не *реальный*, а *подразумеваемый* тип безумия. Ещё: «конкурирующие розничные торговцы могут предоставлять слишком малый или слишком большой объем услуг» [2, 282], – в *конкуренции* спрос не равен предложению! Ещё Пол Самуэльсон, о видах «*зла*»: «Вмешательство монополии в действие предложения и спроса, вероятно, является злом» [3, 17]. Монополия – она на рынке действует одна. *Вмешаться* в её имманентные действия может нечто *стороннее* рынку: государство, рэкетеры, форс-мажор и пр.. Монополия во взаимодействии с рынком формирует предложение

спрос с целью получения своей максимальной прибыли. Монопольный рынок без монополии – это нонсенс. Где здесь *вмешательство*? Ещё он же: «вред экономике приносят монополии и другие виды несовершенной конкуренции» [3, 118], или его вопрос: «как свести к минимуму зло и расточительство, связанное с этими несовершенствами конкуренции?» [3, 104], или ещё в тему: «закон запрещает картелям устанавливать цены путем бесстыдного сговора с целью увеличения до максимума взаимных прибылей» [3, 117]. И вряд ли последнее из зол: «Зло *олигополии*... фирмы... тайно стремятся достигнуть общего соглашения о ценах, которое обеспечило бы всем максимальные прибыли... налагать санкции на обманщиков, которые делают тайные скидки с цен» [3, 121]. В итоге приходим к выводу, что монополии и несовершенные конкуренты, что бы они ни делали: *взвинчивали* цены или делали бы *тайные* (?) с них *скидки*, стремились бы к максимуму прибыли или продавали всё по себестоимости – в итоге творят только зло, но не указано... кому и по каким причинам. Такова экономическая наука. В той степени в какой экономическая наука находится на государственной подпитке, – до тех пор государственное *вмешательство* в действия рынков будет провозглашаться благом, а все неурядицы и проколы в экономике будут «списывать» на монополии, конкуренцию, сговоры фирм, на что угодно, только бы вывести из под позитивной критики «руку дающего». Создаётся впечатление, что экономическая наука в лице её элиты – лауреатов престижных премий, присвоила себе и *монополию* на основы экономических знаний и, ввиду отсутствия конкуренции на этом «рынке», позволяет себе под видом качественной продукции заваливать рынок «китайским ширпотребом», нимало не смущаясь противоречиями рекламы и рекламируемой продукции.

Вот ещё пара скороспелых фраз Пола: «прибыль исчисляется как общая сумма доходов корпораций и некорпорированных предприятий» [3, 236]. Как известно, *прибыль* есть разность *дохо-*

дов и затрат, но не *сумма доходов*. Или странное: «В условиях совершенной конкуренции человек может успешно осуществлять свои операции... если он делает такие вещи, которые имеют ценность для него и для других» [3, 235]. Получается, что все, принимающие участие в табачной промышленности, обязаны курить, а о ликёрово-водочной «индустрии» – и подумать страшно. Или вот заглавия разделов из его книги: «НЕВОЗМОЖНОСТЬ ИЗМЕРЕНИЯ ПРИБЫЛИ» [3, 229]. А в Писании, там сказано: «Неизмерим песок морской (33:22 Иеремия)». Или ещё название: «ПРОПОВЕДЬ О ПРИБЫЛИ» [3, 233], а ведь *проповеди* читают *верующей* толпе, которой не нужны доказательства. А в экономике потому и существует так много школ и течений, что каждая из них и *проповедует* свои положения, нимало не интересуясь *проповедями* «соседей». С этой т.з. экономические школы сродни религиозным конфессиям, вербующим себе сторонников. Вот в подтверждение слова (тоже лауреата) Ауманна: «экономика... используют несопоставимые модели для анализа монополий, олигополий, совершенной конкуренции, общественных благ, выборов, формирования коалиций и т.п.». Или там на каждый тип рынка – свои «теории», не согласованные меж собой.

Цель статьи. Принимая за истину слова Гегеля: «всё действительное – разумно», постараемся показать на примерах действительную сущность и необходимость существования рынков указанных видов; несостоятельность противоречивых, односторонних или эмоциональных их оценок, типа: «зло», «порочность», «неэффективность», ибо по диалектике Гегеля «порочность» видна только на фоне добродетели, а «зло» для вас – всегда есть «добро» для того, кто вам это «зло» причиняет. «Изучать» и постулировать только зло и *порочность* – значит видеть и «изучать» только половину реального мира.

Изложение основного материала. Прежде всего определимся, что в данной статье понимает-

ся под функцией спроса и какова её общая структура. Как известно, при прочих равных условиях, спрос на товар зависит только от его цены: чем выше цена, тем ниже спрос. Но в экономической литературе часто цену определяют как функцию спроса, что и ведёт к серии парадоксов [1, 67–70]. Кроме того, спрос зависит, причём линейно, от «объёма» рынка: чем больше на рынке *поток* покупателей, тем выше будет и спрос. Но спрос на товар зависит от его «потребительских» свойств. Чем большую *прибыль* имеет *потребитель* от использования купленной вещи, тем больше будет и спрос на неё (это при заданной цене товара). Бесполезные товары, которые не приносят прибыли при их эксплуатации, спросом не пользуются. На рынке продавец имеет т.н. «денежную» прибыль как разность цены товара и его себестоимости (для продавца). Прибыль покупателя равна разности дохода от полного потребления купленной вещи и ранее уплаченной за неё ценой (но с учётом возможных «эксплуатационных затрат» на сроке потребления). На бартерном рынке меняются не эквивалентными по «стоимости» товарами, а эквивалентами прибыли от *будущего* потребления уже обменённых вещей. Каждый меняет свою вещь, которую он прибыльно уже использовать почему-то не может на любую другую (или конкретную) вещь, уже прибыльную в её потреблении. Принцип *прибыльности* любого потребления также проработан в [1, 56] на анализе как бартерного, так и денежного рынков. Отсюда вывод, что *предметом* экономической науки должны быть все виды коллективной или индивидуальной деятельности, приносящие *прибыль*. Убыточная же «деятельность» (войны на уничтожение, санкции, таможенные барьеры и пр.) характерна для политики, и там «выигрывает» тот, кто понесёт меньший ущерб... Итак, общий вид формулы для функции спроса следующий:

$$m = M \cdot F(P/C), \quad (1)$$

где: m – собственно спрос на товар, с размерностью [шт./день];

M – максимально возможный спрос на товар при *бесплатной* раздаче его (и его субститутов) на заданном рынке, с размерностью [шт./день];

P – цена товара, с размерностью [\$/шт.];

C – *прибыль*, полученная потребителем после «уничтожения» единицы товара в результате полного его потребления, с размерностью [\$/шт.];

F – монотонно убывающая функция её аргумента, для которой площадь между нею и осью абсцисс на интервале изменения аргумента $[0 \dots \infty)$ или на некотором ограниченном интервале – есть конечная величина. Например, экспоненциальная функция $F(P/C) = \text{Exp}(-P/C)$ на бесконечном интервале, или линейная функция $F(P/C) = (1 - P/C)$, уже на интервале цен $(0 \leq P \leq C)$, или квазилинейная функция $F(P/C) = \text{Exp}[-P/(C - P)]$, – эти функции можно брать для *аппроксимации* реальных, но не известных точно функций спроса, тогда как «гипербола» $F(P/C) = 1/(1 + P/C)$ – применяться как функция спроса не может, поскольку для неё указанная выше площадь – бесконечна.

В монографии [1, 514] показано, что линейный спрос $m = M \cdot (1 - P/C)$ характерен для товаров длительного пользования, и здесь параметр C равен полученному потребителем *доходу* от эксплуатации вещи до выхода её из строя (естественно, что с учётом всех эксплуатационных затрат на полном сроке), а экспоненциальный спрос $m = M \cdot \text{Exp}(-P/C)$, характерен для товаров одноразового потребления (пища, энергоресурсы и пр.), и здесь параметр C равен полученной *прибыли* от одноразового употребления вещи. Параметр C пропорционален и «качеству» товара, в том смысле, что отношение P/C от качества никак не зависит (чем выше качество, тем выше C , тем выше и цена товара P). Поэтому безразмерное соотношение P/C – это инвариант любого товара вне зависимости от качества (надёжности, производительности и пр.). В ряде случаев качество ассоциируют с долговечностью эксплуатации вещи, её производительностью (инструменты, бытовая

техника), внешним её видом или, при незнании, ориентируются на репутации производителей (бренды).

Как видим, функция (1) двупараметрическая и, зная функцию точно или только *вид её аппроксимации*, параметры функции можно найти по «двум точкам». Например, для сезонных товаров, зная цену P_1 и спрос m_1 в «сезон» и, соответственно, в «межсезонье» P_2 и m_2 , для расчёта значения C получаем неявное уравнение $m_1 \cdot F(P_2/C) = m_2 \cdot F(P_1/C)$, решив которое, уже для расчёта параметра M имеем $M = m_1 / F(P_1/C)$ или же $M = m_2 / F(P_2/C)$. В иных случаях эмпирическое определение параметров также возможно, но более трудоёмко.

Под нормой прибыли будем понимать долю прибыли в *цене* товара, или при себестоимости товара (S) и *цене* (P) норма прибыли будет $\eta = (P - S)/P \equiv 1 - S/P$. По определению нормы, поскольку цена всегда выше себестоимости, имеем $(0 \leq \eta < 1)$. Ниже под себестоимостью S понимаются *минимально* необходимые затраты на производство единицы *товара*. Накладные расходы любого вида (затраты на аппарат управления, бухгалтерию, охрану, и пр.) в себестоимость не входят и их оплачивают из будущих прибылей. Из них же выплачиваются налоги, акцизы, проценты по кредитам, аренда и пр. затраты. Причём, себестоимость *товара* она выше себестоимости его *производства*. И дело даже не в транспортных и иных видах торговых издержек. Ведь если производитель зерна половину его расходует «на хозяйство», то для поставки тонны на рынок надо реально произвести две тонны, поэтому себестоимость зерна-*товара* S будет вдвое выше себестоимости его *производства* S_0 . Если доля собственного потребления r_0 , доля брака r_1 , доля иных потерь r_2 , то можно доказать верность равенства $S = S_0 / (1 - r_0) / (1 - r_1) / (1 - r_2)$. Или $S > S_0$.

Монопольный рынок. Рассмотрим ценообразование на монопольном рынке, при отсутствии товаров-субститутов к товару монополиста. Для

его прибыли имеем очевидное выражение: $Q_M = M \cdot (P - S) \cdot F(P/C)$, где: S – это себестоимость товара. Из: $\partial Q_M / \partial P = 0$, имеем выражение для цены $P \equiv P_M$, дающей монополисту *наибольшую* прибыль: $F(P/C) + F'(P/C) \cdot (P - S)/C = 0$. Здесь обозначение $F'(P/C)$ – производная функции $F(P/C)$ по её аргументу (P/C) , но не по цене P . Или $F'(P/C) = (dF/dP) / [\partial(P/C)/\partial P] \equiv (\partial F/\partial P) \cdot C$.

Как легко показать, для экспоненциального спроса монополия цена: $P_M = C + S$ и, соответственно, прибыль монополии $Q_M = M \cdot C \cdot \text{Exp}(-1 - S/C)$. Оптимальная рыночная квота для монополиста $\pi_1 = 1$, как единственного владельца-продавца товара, а норма прибыли (монопольной и максимальной) $\eta_M = C/(C + S)$. Как видим, для случая экспоненциальной функции спроса максимальной прибыли монополиста отвечает конечная (оптимальная) норма прибыли. Поэтому-то стремление к максимуму прибыли не эквивалентно стремлению к максимуму её нормы, и знаменитая фраза Маркса о презрении капиталиста-монополиста к виселице при норме прибыли в 300% – ложная.

Для линейного спроса аналогичные расчёты приводят к соотношениям $P_M = 1/2 \cdot (C + S)$; $Q_M = 1/4 \cdot M \cdot (C - S)^2/C$; и $\pi_1 = 1$, а норма $\eta_M = (C - S)/(C + S)$, где норма – тоже конечная величина, и отклонение от неё *в любую сторону* вызывает потери в прибылях. Аналогичное рассмотрение линейного спроса есть и у Жана Тироля: «Монополия цена, p ... максимизирует $(p - c)D(p)$, где $D(p)$ – совокупный спрос: $D(p) = 1 - p/\theta$, таким образом, монополия цена $p = (c + \theta)/2$ и монополия прибыль $\Pi = (\theta - c)^2/4\theta$. Предостережение. Эти расчёты предполагают...» [2, 221], где он, описав правильный метод расчёта оптимальных монопольных цен, почему-то дальше не пошёл, а ограничился только линейным спросом и с некими *предостережениями*. И теряет смысл, точнее, является полностью ложной фраза лауреата Пола Самуэльсона, что: «(монополист) взвинтит цены... для того, чтобы получить дополнительную прибыль», ибо отклонение от *монопольной* цены в ту или другую сторону

прибыль монополиста только снижает, но никак не «дополняет».

А вот не подкреплённое расчётами голословное утверждение лауреата В. В. Леонтьева, разработчика его всемирно знаменитых таблиц «затраты – выпуск»: «система ступенчатых цен... могла бы быть разработана в каждом случае таким образом, чтобы гарантировать и даже увеличить монопольную прибыль» [4, 212]. Да, *гарантировать* монопольную прибыль можно. Но эта прибыль, как мы показали выше, *максимальная*, а *увеличить* нечто уже *максимальное*, по самому определению максимального, – невозможно.

Итак, на монопольном рынке существует *оптимальная* рыночная цена P_M , дающая *наибольшую* прибыль Q_M , поэтому рассуждения о монопольном *взвинчивании* цен, о неких *сверхприбылях* монополий – лишь болтовня, не утруждающих себя расчётами «теоретиков». Государственные «монополии» в любой отрасли хоть и позволяют «снижать» розничные цены, но такие «монополии» зачастую нерентабельны, требуют бюджетных дотаций, добрая треть из которых «оседает» в карманах госуправленцев и их «контролёров». Итак, монополия, её цены P_M и прибыли Q_M однозначны и закономерны.

Конкурентный рынок. Здесь будет рассмотрена конкуренция между продавцами или прямыми производителями товара (без накруток транспорта и торговли), каждый из которых стремится максимизировать свою прибыль.

Рассмотрим ценообразование на конкурентном рынке, при отсутствии товаров-субститутов к «конкурентному» товару. Пусть на рынке имеется N продавцов одного товара, равного у всех качества, но *разной* себестоимости S_j ($1 \leq j \leq N$). Тогда при одинаковой для всех рыночной цене P , должен выполняться баланс общего предложения $\sum_j t_j$ и спроса $t = M \cdot F(P/C)$, или:

$$\sum_j t_j = M \cdot F(P/C). \quad (2)$$

Откуда выражение для рыночной цены P будет: $P = C \cdot \Phi(\sum_j t_j/M)$, где: Φ – обратная функ-

ция функции F , для которой верно тождество $y \equiv F[\Phi(y)]$.

Поскольку общая рыночная цена P устанавливается автоматически т.н. «невидимой рукой рынка» и *одинакова* для всех продавцов, то единственный «параметр», который может изменять продавец, – это объём предложения m_j своего товара на рынке. К примеру, прибыль L -го продавца запишется как:

$$Q_L = m_L \cdot (P - S_L) \equiv m_L \cdot [C \cdot \Phi(\sum_j m_j / M) - S_L]. \quad (3)$$

Оптимальное предложение m_L для L -го продавца, максимизирующее (при постоянных предложениях прочих производителей) только его прибыль Q_L , найдём из тривиального соотношения $\partial Q_L / \partial m_L = 0$, которое примет вид:

$$C \cdot \Phi(\sum_j m_j / M) - S_L + C \cdot (m_L / M) \cdot \Phi'(\sum_j m_j / M) = 0.$$

С учётом того, что $\Phi'(\sum_j m_j / M) \cdot F'(P/C) \equiv 1$, и $P = C \cdot \Phi(\sum_j m_j / M)$, имеем:

$$P - S_L + C \cdot (m_L / M) / F'(P/C) = 0. \quad (4)$$

Для всех участников рынка получается система из N уравнений вида (4). Сложив вышеприведенные уравнения, с учётом спроса и предложения (2), получим для определения конкурентной цены $P \equiv P_K$ уравнение:

$$P_K = S_A - (C/N) \cdot [F(P_K/C) / F'(P_K/C)] \equiv S_A - (C/N) / W(P_K/C), \quad (5)$$

где: $S_A = (\sum_j m_j) / N$ – это **среднеарифметическая себестоимость** товара для всех N участников рынка;

$W(P_K/C) < 0$ – это логарифмическая производная функции спроса по её безразмерному аргументу (P_K/C) . Так для экспоненциального спроса имеем: $F = \text{Exp}(-X)$ и $W(X) = -1$. Для линейного – $F = (1 - X)$ и $W(X) = -1/(1 - X)$, а для квазилинейного $F = \text{Exp}[-X/(1 - X)]$ и $W(X) = -1/(1 - X)^2$.

При «сложной» функции спроса $F(P/C)$ решение уравнения (5) можно находить итерациями. Положив $P_K = 0$ и подставив его в правую часть (5), найдём первое приближение для P_K , которое подставляем снова в правую часть и т.д.. Квоту L -го участника находим из (2–5), она будет:

$$\pi_L = m_L / (\sum_j m_j) = m_L / [M \cdot F(P/C)].$$

Из (4) имеем $P - S_L + C \cdot \{m_L / [M \cdot F(P/C)]\} / W(P_K/C) = 0$.

Или $P - S_L + C \cdot \pi_L / W(P_K/C) = 0$. Откуда с учётом (5) окончательно:

$$\pi_L = (1/N) \cdot (P_K - S_L) / (P_K - S_A) \equiv 1/N - (S_L - S_A) / C. \quad (6)$$

Следует отметить, что если оптимальная конкурентная цена P_K зависит от *вида* функции спроса (5), то те же квоты $\pi_L = 1/N - (S_L - S_A) / C$ – зависят лишь от себестоимости производителей и прибыли C от потребления товара.

Как видим, при торговле на почти оптимальном рынке, по количеству конкурентов $(N - 1)$, сложившейся там цене P_K , по своей себестоимости S_L и среднеарифметической S_A себестоимости всех участников можно однозначно оценить – скорректировать и своё на нём *оптимальное* долевое участие π_L . Вот что по поводу формулы (6) говорил Леонтьев: «объём производства фирмы в ходе конкурентной борьбы рассматривается как функция господствующей на рынке цены» [4, 110]. У него формулы (6) для определения квот фирм нет, поэтому абсурдность такого заявления не видна. А ведь если оно верное, то возникает вопрос: *как может только одна функция от цены (P_K) объяснить такие разные объёмы производства у фирм-производителей?*

Вот примеры. Для линейного спроса имеем $P_K = (C + N \cdot S_A) / (N + 1)$; и норма $\eta_L = 1 - S_L \cdot (N + 1) / (C + N \cdot S_A)$.

У экспоненциальной функции спроса оптимальная цена

$$P_K = C/N + S_A; \text{ при норме } \eta_L = 1 - N \cdot S_L / (C + N \cdot S_A).$$

При $N = 1$ мы приходим к монопольным ценам и квотам. Если на рынке монополиста (с себестоимостью S_M) известны его оптимальная монопольная цена P_M то параметр $C = (P_M - S_M)$ определяем однозначно, и с появлением конкурентов трудности расчёта сокращаются (ибо параметр C уже известен).

Отметим, что себестоимость S_L товара каждого конкурента может быть неизвестна и произво-

дителю, а если она ему известна, то суть информация конфиденциальная. Потому-то расчёт цен и квот по предложенным формулам затруднителен, но их ценность, однако, в том, что они *доказывают* наличие оптимальной конкурентной цены P_K и квот π_L участников, к каковым и ведёт конкурентный рынок его «невидимая рука». И как практически прав был Пол Самуэльсон, когда отмечал, что: «издержки производства [все себестоимости S_L участников рынка – В.Ш.] определяют конкурентную цену, лишь влияя на предложение [а это квоты π_L участников рынка – В.Ш.]» [3, 19], но формул для расчётов цены $P_K(S)$ и предложений товаров $\pi_L(6)$ лауреат почему-то не привёл. А мы показали, что издержки производства *определяют* предложение товаров, а на конкурентную цену *влияет* (кроме них) и *вид* функции спроса.

Достаточно просто решается «проблема» входа на рынок новой фирмы. Для неё должны выполняться два неравенства. Расчётная квота должна быть положительной и норма прибыли должна быть выше банковского процента r по депозиту. Пусть на рынке имеется N фирм с их среднеарифметической себестоимостью S_A , и туда желает войти фирма X с себестоимостью S_X . Для экспоненциального спроса (после преобразований) имеем ограничение по себестоимости $S_X < S_A + C/N$ – это из условия для квоты, и более «жесткое» ограничение по себестоимости S_X из требований к норме прибыли на рынке $S_X < (1 - r) \cdot (S_A + C/N)$. Для функции линейного спроса имеем соответственно $S_X < (N \cdot S_A + C)/(N + 1)$ и $S_X < (1 - r) \cdot (N \cdot S_A + C)/(N + 1)$. Или в общем виде условие вхождения «новой» фирмы X с себестоимостью S_X на рынок с уже конкурентной на нём ценой P_K имеет тривиальный вид $S_X < (1 - r) \cdot P_K$.

Картельный сговор. имеется несколько проблем объединения фирм в картель, или при реализации ими т.н. «тайного» сговора. Поскольку сговор осуществляют бывшие конкуренты, то первая проблема – это обеспечение «устойчивости» системы, чтобы никому не было *выгодно*

выйти из сговора. Поскольку сговор подразумевает повышение цен, то спрос должен упасть и при этом участники сговора должны сократить своё производство каждый. А как это сделать, чтобы никто не «чувствовал» себя ущемлённым? И третья проблема – чисто «колхозная», а состоит она в том, что при работе на «общий котёл», каждый норовит положить туда поменьше, а получить – побольше. В последнем случае проблема обычно решается административными мерами.

Рассмотрим «тайный» сговор, когда N производителей конкурентного рынка неформально договариваются повысить цену, снизить соответственно общий выпуск, возможно изменив *прежние квоты* участников. Прежде всего надо решить возможно ли вообще организовать картель? Ведь если после его образования прибыль *хотя бы одного* участника станет меньше, то сговор не осуществим. Этот участник выйдет из сговора и рынок примет, как минимум, олигопольный вид. Здесь для примера положим *экспоненциальный* спрос на товар. В этом случае оптимальная конкурентная цена $P_K = C/N + S_A$, а квота J -го участника $\pi_J = 1/N - (S_J - S_A)/C$ (6). Для прибыли J -го участника имеем выражение $Q_J = M \cdot C \cdot [1/N - (S_J - S_A)/C]^2 / \text{Exp}(1/N + S_A/C)$. После сговора для общей прибыли участников рынка имеем $Q^C = M \cdot \sum_J (P_C - S_J) \cdot \rho_J \cdot \text{Exp}(-P_C/C)$, где: ρ_J – новая квота J -го участника, вместо бывшей конкурентной квоты. Из условия максимума прибыли $\partial Q^C / \partial P_C = 0$ после несложных преобразований с учётом того, что $\sum_J \rho_J = 1$, получим оптимальную цену $P_C = S_C + C$, где: $S_C = \sum_J \rho_J \cdot S_J$ – *средневзвешенная* по квотам себестоимость «заговорщиков». Для оптимальной прибыли J -го участника после несложных вычислений имеем $Q_J^C = M \cdot C \cdot [1 - (S_J - S_C)/C] \cdot \rho_J / \text{Exp}(1 + S_C/C)$. Сговор в принципе возможен, если для каждого из его участников выполняется соотношение $Q_J^C > Q_J$, или в развёрнутом виде после сокращений и несложных преобразований получим необходимые условия для реализации устойчивого сговора

$$\rho_j > \text{Exp}(Y) \cdot (X_j - Y)^2 / X_j \quad (7)$$

где обозначено: $X_j = 1 - (S_j - S_c)/C$; $Y = 1 - 1/N - (S_A - S_c)/C$. Отметим, что если квоты участников сговора остаются теми же как в конкурентной среде, то справедливо соотношение $S_A - S_c = (N/C) \cdot D_A$, где: $D_A = (1/N) \cdot \sum_j (S_j)^2 - S_A^2$ – это **среднеарифметическая** дисперсия себестоимостей «заговорщиков». И если $(S_A - S_c \ll C)$, то справедливо примерное соотношение $Y \approx 1 - 1/N$.

Просуммировав уравнения (7) с учётом того, что $\sum_j \rho_j = 1$, получим достаточное условие возможности реализации тайного или прямого сговора

$$\sum_j \text{Exp}(X_j - 1/N) \cdot (1/N - 1 + X_j)^2 / X_j = 1, \quad (8)$$

Если для условия (8) окажется $\sum_j [\dots] > 1$, то сговор *невозможен*. Если окажется, что $\sum_j [\dots] < 1$,

то, просчитав для всех участников сговора *общий* множитель $\lambda = 1/\sum_j [\dots]$, получим точное выражение для квот участников

$$\rho_j = \lambda \cdot \text{Exp}(Y_j) \cdot (X_j - Y_j)^2 / X_j. \quad (7')$$

Замечание. При расчёте $S_c = \sum_j \rho_j \cdot S_j$ в качестве ρ_j следует брать квоты конкурентного рынка ($\rho_j = \pi_j$), или вообще *вначале* можно принять $\rho_j = 1/N$. После уточнения квот по формуле (7') нужно всю процедуру расчёта *средних* S_c повторить уже с новыми квотами ($\rho_j \neq \pi_j$), возможно несколько раз, пока результаты перестанут меняться и не сойдутся к их оптимальному значению.

Пример оптимизации квот по данному алгоритму для $N = 7$ участников сговора приведен в ниже следующей Таблице 1 (для $C = 20, M = 1$ и $\rho^0 = \pi$).

Таблица 1 (расчёт оптимальных квот участников сговора)

№ J	S	π	Q^K	ρ^1	ρ^2	ρ^3	ρ^4	ρ^5	ρ^6	ρ^7	Q^c
1	1	0.218	1.056	0.358	0.429	0.459	0.470	0.475	0.475	0.475	3.321
2	1.5	0.193	0.871	0.255	0.257	0.249	0.243	0.240	0.240	0.240	1.637
3	2	0.169	0.703	0.171	0.148	0.136	0.132	0.131	0.131	0.131	0.871
4	2.5	0.143	0.551	0.108	0.083	0.076	0.075	0.075	0.075	0.075	0.485
5	3	0.118	0.416	0.062	0.046	0.043	0.043	0.043	0.043	0.043	0.273
6	3.5	0.093	0.297	0.032	0.025	0.024	0.024	0.024	0.024	0.024	0.149
7	4	0.068	0.195	0.014	0.012	0.012	0.012	0.012	0.012	0.012	0.074

В этом примере конкурентная цена $P_K = C/N + S_A = 8.36$. Для прибыли J-го производителя конкурентного рынка $Q_j^K = M \cdot \pi_j \cdot (P_K - S_j) \cdot \text{Exp}(-P_K/C)$, откуда имеем общую рыночную прибыль $Q^K = \sum_j Q_j^K = 4.09$.

Соответственно, для рынка сговора $P_c = S_c + C = 21.55$, прибыль J-го производителя $Q_j^c = M \cdot \rho_j \cdot (P_c - S_j) \cdot \text{Exp}(-P_c/C)$, общая прибыль $\sum_j Q_j^c = 6.81$. Как видим, на конкурентном рынке дисперсия оптимальных квот и прибылей участников меньше, чем при сговоре, но ниже прибыль каждого и общая рыночная прибыль производителей. Хотя при сговоре квоты и объёмы производства у низко эффективных (относительно высокая себестоимость) производителей падают, тем не менее, их прибыли «от сговора» возрастают.

Если под рынком понимать весь мировой рынок, например, пшеницы, нефти, то предложенный метод расчёта применим для оценки последствия (это прибыли, квоты и объёмы производства) *возможного* объединения *всех* национальных производителей в единую транснациональную корпорацию.

Выводы. Показано, что для любого типа рынков имеется оптимальный «алгоритм поведения» производителей, обеспечивающий им *максимальную* прибыль для каждого. Потому, вмешательство в деятельность рынка прибыль может только *снизить*, возможно при этом повысив прибыль у покупателей, но, зачастую, образуя безвозвратные потери прибыли вообще. Даны простые формулы расчёта квот, цен, прибылей для конкурентного рынка и участников

возможного картельного сговора на конкурентном рынке. Сформулированы необходимые и достаточные условия существования и устойчивости картеля.

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