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CENTRAL EUROPEAN REVIEW OF ECONOMICS & FINANCE Vol. 43. No 2 (2023) pp. 5-16 DOI https://doi.org/10.24136/ceref.2023.006

Ewa Falkiewicz¹

DIFFERENTIAL GEOMETRY APPROACH IN OPTIMIZATION OF THE BUSINESS PRODUCTION PROCESS

Abstract

In this work we show a new approach to the optimization of the production process - from a differential geometry point of view. It is known ([2]) analytical conditions of profit maximization and minimization of the cost in an enterprise. In the first part of this work, we show such a classical approach. In the second part of the work, we use geometrical methods to obtain a new geometrical approach to the production process.

Key words: production function, profit function, cost function, extremes of function, differential space, differential manifold

JEL codes: D20, D24, D29

1. Production process optimization

Let consider the long-term optimization issues of the business production process. The company wants to maximize profits or minimize production costs. Our purpose in this section is to find the answer to the question – which conditions should be filled?

1.1. Production function

We will denote by $x = (x_1, ..., x_n)$ n - dimensional vector of inputs, where $x_i \ge 0$ for i = 1, ..., n, by $y = (y_1, ..., y_n)$ n - dimensional vector of products, where $y_i \ge 0$ for i = 1, ..., n, $n \in \mathbb{N}$. By the production process

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we understand such set of activities as a result of which a given bundle of inputs is transformed into a specific bundle of products. The production process is described by not negative, 2n - dimensional vector $(x, y) \ge 0$, in which x is n - dimensional vector of inputs needed to produce n - dimensional vector of products y, $n \in \mathbb{N}$. Vectors x and y form a technologically acceptable production process. A set $Z \subset \mathbb{R}^{2n}$ of all technologically acceptable production processes with the norm defined by the formula:

$$||z|| = \max\{x_1, ..., x_n, y_1, ..., y_n\}$$
 for $z \in Z$

we call *p* **– production space**.

The production process $(x, y) \in Z$ we call **technologically effective**, if there is not exists another production process $(x, y') \in Z$ such that y' > y. ([1], s. 74)

With the technologically effective production process a vector – valued production function is associated. We define it in the following way:

Definition 1. If there exists a vector – valued function $f: \mathbb{R}^n_+ \to \mathbb{R}^n_+$, such that y = f(x), if and only if the production process $(x, y) \in \mathbb{Z}$ is technologically effective, then the function f is called vector – valued production function associated with p – production space \mathbb{Z} .

We will be concerned only with the case of production process in which manufacturer produce only one product using to this k inputs, $k \le n$. In such situation vector – valued production function defined above reduces to **the inner**, k - **arguments production function** $f: \mathbb{R}^k_+ \to \mathbb{R}$, $k \le n$, which is associated with the p – production space $Z \subset \mathbb{R}^{k+1}$. It is a function which maps each not negative vector of inputs $x = (x_1, \dots, x_k)$ to such result of production y = f(x), that the pair (x, y) makes technologically effective production process.

We will make the following assumptions about the inner, k - arguments production function $f: \mathbf{R}_{+}^{k} \rightarrow \mathbf{R}$:

- (F1) *f* is continue and second order differentiable on the interior of its domain int \mathbf{R}_{+}^{k} ;
- (F2) f(0,...,0) = 0 zero vector of inputs give zero production result;
- (F3) f is increasing function on int \mathbf{R}_{+}^{k} , i.e. each any small increase of inputs induces production increase;

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(F4) *f* is concave function on int \mathbf{R}_{+}^{k} , i.e. $\forall x^{1}, x^{2} \in \mathbb{R}_{+}^{k}, \forall \alpha, \beta \geq 0, \alpha + \beta = 1: (f(\alpha x^{1} + \beta x^{2}) \geq \alpha f(x^{1}) + \beta f(x^{2})),$ that is $\left(\frac{\partial^{2} f}{\partial x^{2}}\right)_{k \times k}$ is not positive matrix on \mathbf{R}_{+}^{k} ; (F5) function *f* is positive homogenous of rank $\theta > 0$, i.e. $\forall x \in \mathbb{R}_{+}^{k}, \forall \lambda \geq 0: (f(\lambda x) = \lambda^{\theta} f(x)).$

1.2. Profit maximization problem

In this section, we will be concerned with the problem of profit maximization in the enterprise. Suppose a company operates in the long run (long-term strategy). This postulate implies that it has unlimited freedom to determine the size and structure of the factors of production involved.

Let $x = (x_1, ..., x_k)$ be inputs vector of productive factors expressed in physical units, where each productive factor satisfies the condition $x_i \ge 0$ for i = 1, ..., k. Let further $w = (w_1, ..., w_k)$ be cost vector of productive factors. We will denote by $\langle w, x \rangle$ the inner product of vectors *x* and *w*:

$$\langle w, x \rangle = w \circ x = \sum_{i=1}^{k} w_i x_i = w_1 x_1 + \dots + w_k x_k.$$

Let us consider the function $f: \mathbb{R}^k_+ \to \mathbb{R}_+$ satisfying the conditions (F1)-(F5). We will denote by f(x) quantity of fabricated product (in physical units), by p – the price of this product.

Define profit function $Z: \mathbb{R}^k_+ \to \mathbb{R}_+$ of the company by the formula:

$$Z(x) = pf(x) - \langle w, x \rangle, \tag{1}$$

where pf(x) is product sale income, $\langle w, x \rangle$ denotes the cost of manufactured product.

Aur purpose is to maximize the company's profit when the production process is described by inner, k - arguments production function $f: \mathbb{R}^k_+ \to \mathbb{R}$ determined in the definition 1. We are looking for such a vector of inputs of production factors $x^* \ge 0$, for which profit function Z of the company, given by formula (1), riches its maximum.

A necessary and sufficient condition for the existence of an optimal solution $x = x^*$ is given by the following theorem:

Theorem 1. Let $f: \mathbb{R}_+^k \to \mathbb{R}_+$ be inner, k - arguments production function satisfying the conditions (F1)-(F5). Let further the product price p>0 and the production factor price vector w>0 satisfy the condition

$$\lim_{x \to \infty} p \frac{\partial f(x)}{\partial x} < w < p \frac{\partial f(x)}{\partial x} \Big|_{x=0}$$

Then the optimal solution to the problem of maximizing company's profit is the positive input vector of production factors $x^* > 0$, and a necessary and sufficient condition for the existence of an optimal solution is

$$p\frac{\partial f(x)}{\partial x}\Big|_{x=x^*}=w,$$

or otherwise

$$\frac{\partial Z(x)}{\partial x}\Big|_{x=x^*} = 0$$

(see [1]).

Remark 1. The assumption of a strong concavity of the production function *f* does not guarantee the existence of an optimal solution to the problem of maximizing the company's profit. For if the production factor price vector satisfies the system of inequalities:

$$\frac{\partial Z(x)}{\partial x}\Big|_{x=x^*} \le 0,$$

then the optimal solution to our task is the zero input vector $x^* = 0$. On the other hand, when the system of inequalities is satisfied

$$0 \le \lim_{x \to \infty} \frac{\partial Z(x)}{\partial x} \Big|_{x = x^*},$$

the problem of maximizing the company's profit does not have a finite optimal solution.

1.3. Problem of minimizing production costs

Let $K: \mathbf{R}_{+}^{k} \rightarrow \mathbf{R}_{+}$ be linear function of enterprise costs given by the formula

$$K(x) = \langle \mathbf{w}, \mathbf{x} \rangle = \mathbf{w} \circ \mathbf{x} = w_1 x_1 + \dots + w_k x_k, \tag{2}$$

where $x = (x_1, ..., x_k)$ is the input vector of the factors of production of the enterprise, $w = (w_1, ..., w_k)$ is the production factor price vector. We are interested in minimizing production costs. Approaching the problem analytically we want to determine the minimum of the cost function *K* with the existing constraints:

$$f(x) = y = \text{const.} > 0, \tag{3}$$
$$x \ge 0,$$

where *y*=const.>0 is fixed production level, *f* is production function.

The condition for the existence of a minimum of the cost function K under constraints (3) is given by the following Theorem:

Theorem 2. Vector $x^* > 0$ is the optimal solution for the task of minimizing the costs of the company if and only if there exists a constant $\lambda^* > 0$ such that the pair (x^*, λ^*) satisfies the system of equations:

$$\left. \frac{\partial f(x)}{\partial x_i} \right|_{x=x^*} = \lambda^* w_i, \quad \text{where } i = 1, \dots, k.$$

The above Theorem implies that cost minimization of the company takes place when the marginal productivity of i – the factor of production x_i , expressed in the form of partial derivative $\frac{\partial f(x)}{\partial x_i}$ of production function f, is proportional to the price w_i of this factor.

2. Geometrical aspects of function extremes

Our starting point are Sikorski differential spaces [4, 5, 6], which are subsets of Cartesian space \mathbf{R}^n and differential manifolds, that is topological spaces locally homeomorphic to open subsets of \mathbf{R}^n . On such spaces we will develop the theory of geometrization of production process of the enterprise.

Sikorski differential space (Sikorski, 1972) is a ringed space (M, C), where *M* is set of points and *C* is **differential structure** on *M*, i.e. a set of real valued functions on *M*, $f: M \rightarrow R$ satisfying the following conditions:

- 1. *C* is closed with respect to localization, $C_M = C$, where C_M is the set of all local *C* functions in the weakest topology τ_C in which all function ffrom *C* are continous;
- 2. *C* is closed with respect to superpositions with smooth functions, scC = C, where

$$scC := \{\omega \circ (f_1, \dots, f_n) : n \in \mathbb{N}, \omega \in C^{\infty}(\mathbb{R}^n), f_1, \dots, f_n \in C\}.$$

A mapping $f: (M, C) \rightarrow (N, D)$ is **smooth**, if for any function $\alpha \in D$,

$$\alpha \circ f \in D$$
,

where (M, C) and (N, D) are Sikorski differential spaces.

Functions belonging to a differential structure *C* are by definition smooth $(C^{\infty} \text{ class})$ on *M*.

Differential manifolds of dimension *n* we call Hausdorff space *M* locally homeomorphic with \mathbb{R}^n , i.e. for any point $p \in M$ there exists surrounding $U \ni p$ and homeomorphism $x: U \to x(U)$ on the open subset of \mathbb{R}^n .

For any point $p \in M$, where M is differential space or differential manifold, by T_pM we will denote the set of all vectors tangent to M at a point p. We say that any mapping $v: C \to R$ is vector tangent to M if v is R – linear and satisfies the Leibniz rule:

$$v(f \cdot g) = v(f) \cdot g(p) + f(p) \cdot v(g) \text{ for } f, g \in C.$$
(4)

2.1. The problem of the extreme on a differential manifold

Let *M* be a differential manifold, $C^{\infty}(M)$ – let be an algebra of all smooth functions (i.e. functions having derivatives of any order, that are continuous functions) on *M*. Let's take a function $f \in C^{\infty}(M)$, $f: M \to \mathbb{R}$ and a point $p \in M$. By the symbol $(df)_p$ we will denote the differential of function *f* at a point $p \in M$:

$$(df)_p: T_p M \to \mathbf{R},$$

which is given by the formula:

$$(df)_{\mathfrak{p}}(\mathfrak{v}) = \mathfrak{v}(f),$$

where $v \in T_p M$ is a vector tangent to differentiable manifold M at a point p, i.e. \mathbf{R} – linear mapping which satisfies the Leibniz rule in formula (4).

Tangent vectors and differentials are related to a certain map. A collection of maps is called an atlas. Let $x = (x^1, ..., x^n)$ be a map in a surrounding of a point $p \in M$ and $x^1, ..., x^n$ let be coordinates of this map. Then the following equalities are true:

$$\frac{\partial}{\partial x^i}\Big|_p \in T_p M \text{ for } i = 1, \dots, n$$

And

$$\frac{\partial}{\partial x^{i}}\Big|_{p}(f) = (f \circ x^{-1})'_{i}(x(p)) = \partial_{i}(f \circ x^{-1})(x(p)) = \frac{\partial f}{\partial x^{i}}(p) = \frac{\partial f}{\partial x^{i}}\Big|_{p}.$$

The differentials $(dx^i)|_p$ are basis covectors for i = 1,...,n. Any differential of a function *f* a point *p* can be expressed by basis covectors:

$$(df)_p = \sum_{i=1}^n \frac{\partial}{\partial x^i} \Big|_p \cdot (dx^i) \Big|_p.$$
(5)

The coordinates $\frac{\partial}{\partial x^1}\Big|_p, \dots, \frac{\partial}{\partial x^n}\Big|_p$ form a gradient of a function *f* at a point *p*, i.e. vector of partial derivatives of function *f* at a point *p*:

grad
$$f_p = \left(\frac{\partial}{\partial x^1}\Big|_p, \dots, \frac{\partial}{\partial x^n}\Big|_p\right).$$

Theorem 3. If a function $f \in C^{\infty}(M)$ reaches an extreme at a point $p \in M$, then

$$(df)_p = 0, (6)$$

i.e. the differential of a function f disappears at that point.

Proof: Let's take the manifold $M = \mathbb{R}^n$, on which the atlas in a surrounding of a point $p \in \mathbb{R}^n$ is in the form of single map $x = (x^1, \dots, x^n) = \operatorname{id}_{\mathbb{R}^n}$. Let $f: \mathbb{R}^n \to \mathbb{R}$ be a smooth function on \mathbb{R}^n , i.e. $f \in C^{\infty}(\mathbb{R}^n)$. If a function f possesses a local extreme at a point p, then it is well known that the necessary condition for the existence of an extremum of a function f at a point p is that the partial derivatives of a function f at this point are equal to zero:

$$\frac{\partial f}{\partial x^i}(p) = 0, \ i = 1, \dots, n.$$
(7)

The condition (7) implies

$$\sum_{i=1}^{n} \frac{\partial}{\partial x^{i}} \Big|_{p} \cdot (dx^{i}) \Big|_{p} = 0, \tag{8}$$

From the formulas (8) and (5) we obtain

$$(df)_p = 0.$$

We have proved that the Theorem 3 is true for the manifold being a Cartesian space $M = \mathbf{R}^n$.

Now let's consider the case where *M* is any differential manifold. Let $f: M \to \mathbf{R}$ be smooth function on *M*, $f \in C^{\infty}(M)$. If $x = (x^1, ..., x^n)$ is a map on *M*, then $f \circ x^{-1}$ is smooth function on the open submanifold $(x(U), \{id_{x(U)}\})$. From this fact we obtain that

$$\partial_i(f \circ x^{-1})(x(p)) = 0 \text{ for } i = 1, \dots, n.$$
 (9)

The condition (9) is equivalent to the fact that for = 1, ..., n:

$$\frac{\partial}{\partial x^i}\Big|_p (f) = 0. \tag{10}$$

From the equality (10) finally we have:

$$(df)_p = 0,$$

which means that the differential of the function f at a point p disappears.

Corollary 1. The vanishing of the differential of the function f at a point $p \in M$ means the perpendicularity of the gradient of the function f at a point $p \in M$ to the manifold M on the Cartesian space \mathbb{R}^n , and thus the perpendicularity of the gradient to the tangent vector $v \in T_pM$, what can be expressed:

$$(\operatorname{grad} f)(p) \perp v.$$
 (11)

In other words, the formula (11) means that the scalar product of gradient of the function f at a point $p \in M$ and tangent vector $v \in T_pM$ is equal to zero:

$$(\operatorname{grad} f)(p) \circ v = 0.$$

2.2. Maximization the company's profit in geometric terms

Let $x = (x_1, ..., x_k)$ be an input vector of the factors of production of the enterprise, $w = (w_1, ..., w_k)$ let be a vector of factor prices. Let $f: \mathbb{R}^k_+ \to \mathbb{R}_+$ be the production function which satisfies the assumptions (F1)-(F5).

Our aim is to find a geometric condition for a company to maximize its profit. The Theorem 1 gives the condition which must be fulfilled for the profit function Z defined by the formula (1) to reach a maximum. However, this theorem is formulated in the language of mathematical analysis. Our task is to solve the profit maximization problem in the language of differential geometry. This is described by the following theorem:

Theorem 4. If $f: \mathbb{R}^k_+ \to \mathbb{R}_+$ is inner, k – arguments production function, continuous, twice differentiable and strongly concave, $Z: \mathbf{R}_{+}^{k} \rightarrow \mathbf{R}_{+}$ is inner, k – arguments profit function given by (1), that is continuous, twice differentiable and strongly concave, p is a price of a product, p>0, $w = (w_1, \dots, w_k)$ is positive vector of factor prices, then the optimal solution of the task of profit maximization of a company is positive input vector of the factors of production $x^* > 0$, and the necessary and sufficient condition of the existence of optimal solution is that the gradient of the function f is parallel to the vector of factor prices:

grad
$$f \parallel w$$
.

The condition of parallelism of the gradient of the production function to the vector of factor prices also means that the gradient of the profit function Z is zero:

grad
$$Z = 0$$
,

which follows directly from the form of the profit function (1). The profit function Z is strongly concave (because the production function f is strongly concave and the costs function $\langle w, x \rangle$ is strongly concave). Therefore, the profit function Z has exactly one global maximum at a point $x^* > 0$.

2.2.1. Minimization of production costs of a company in geometric terms

The theorem 2 gives an analytical condition for minimizing costs in the enterprise.

We now turn on to the formulation of an analogous condition in the language of differential geometry.

Let $K: \mathbf{R}_+^k \to \mathbf{R}_+$ be linear function of enterprise costs given by the formula (2). We want to find the minimum of the function K defined on a differential space *M*, which is subspace of Cartesian space. $M \subseteq \mathbf{R}_{+}^{k}$

and is given by constraint:

$$M: f(x) = y = \text{const.} > 0,$$
 (12)

where $x \ge 0$ is not negative input vector, y=const.>0 is fixed production level and *f* is production function.

The following theorem gives geometric condition for minimizing the company's production costs under constraint (12):

Theorem 5. The cost function K given by the formula (2) has a minimum at point $x = p \ge 0$ on differential space M defined by condition (12), if the gradient of f is perpendicular to the tangent vector v at point p, i.e.:

$$\operatorname{grad} f \perp v \text{ for } v \in T_p M,$$

where T_pM is space tangent to differential space M at point $p \in M$.

Proof: Differential space given by condition (12) can be expressed as:

$$M = f^{-1}(y).$$

From the condition (12) we know that f is constant function, so the gradient of this function is zero vector:

grad *f*=0.

From the above also differential of gradient of function f is equal to zero:

d (grad f) = 0

and differential of function *f* at point $p \in M$ is equal to zero:

$$d_p f = 0.$$

From the above we obtain that the value of the differential of function f at point $p \in M$ at vector v tangent to M is also the zero:

$$(d_p f)(v) = 0$$
 dla $v \in T_p M$,

what can be expressed as follows:

$$\sum_{i=1}^{k} \left(\frac{\partial f}{\partial x_{i}}\right|_{p} \cdot dx_{i}|_{p}\right)(v) = 0.$$
(13)

On the other hand, we have:

$$(dx_i|_p)(v) = v(x_i),$$

So, from equation (13) we get:

$$\sum_{i=1}^{k} \frac{\partial f}{\partial x_i} \Big|_p \cdot v(x_i) = 0.$$
(14)

Equation (13) denotes that the inner product of the vector of partial derivatives of the function f at point p (i.e. the gradient of the function f at point p) and the vector tangent to the differential space M at point p is zero:

$$\left(\frac{\partial f}{\partial x_1}\Big|_p, \dots, \frac{\partial f}{\partial x_k}\Big|_p\right) \circ (v_1, \dots, v_k) = (\operatorname{grad} f)(p) \circ v = 0,$$

which is equivalent to the fact that the gradient of the function *f* at point *p* is perpendicular to the vector tangent to *M* at this point:

grad
$$f \perp v$$
 for $v \in T_p M$.

3. Conclusions

The considerations in the paper show that the production function theory can be presented in the language of differential geometry. Moreover, it turns out that the geometric approach simplifies the proofs of profit maximization and costs minimization theorems. Replacing analitical concepts with geoemetric ones makes that it is possible to prove the conditions sufficient for existence of the extremum of the production function in a simple and brief way.

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Anna Odrobina

THE INTERNATIONALISATION OF PLATFORM-BASED BUSINESSES – THE CASE OF GAFAM¹

Abstract

The platform-based business model is indicated as the 'winning' one in the days of the digitisation of businesses. Such a platform constitutes a digital infrastructure bringing together various groups of users, whereas the platform owner provides facilities for establishing multi-sided relationships and interactions through the platform both within and between such groups. The platform generates the formation of a network of interactions between users and the operator of the business model seeks methods for and ways of monetising such interactions and data by organising the processing of data and the use of interactions. It has stimulated the spectacular development of the GAFAM corporations, the global IT giants and leaders. The paper aims to examine the process of the internationalisation of corporations relying on platformisation and to determine whether platformisation influence the internationalisation of economic activities. As demonstrated by the research carried out, despite their global operations, the digital corporations in guestion, GAFAM, have not internationalised as the process is traditionally understood; instead, they have been able to effectively operate on a global scale without expanding their foreign assets or foreign employment. It has created entirely new drivers towards decelerating globalisation as businesses relying on platforms and digitisation continue to grow.

JEL classification codes: F23, M21, L20

Keywords: platformisation, Google, Apple, Facebook, Amazon, Microsoft, TNI, internationalisation.

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Introduction

The 2010s witnessed buoyant growth of enterprises relying on digitisation, particularly on platform development. There are reasons why platformisation is believed to be the 'winning' business model in the nearest future. It is reflected in the spectacular global rise of the five IT giants, among the world's largest firm in terms of market value, known as GAFAM. The acronym is formed from the initial letters of the business names of Google (Alphabet)², Apple, Facebook (Meta)³, Amazon and Microsoft, US corporations operating as multi-sided platforms with wide and extensive ecosystems of products, applications, services, content and users.

The objective of the study is to examine the process of the internationalisation of corporations relying on platformisation and to determine whether platformisation influence the internationalisation of economic activities based on the example of GAFAM. The point is that digital technologies underlying the business model of an undertaking transform its internationalisation path (international footprint) as well. Thus, as the digitisation of enterprises continues, one may expect hindering effects on the globalisation process. The paper puts forward the following hypothesis: the platformisation of economic activities transforms how corporations internationalise (their international footprints).

The study is composed of three parts. The first part focuses on the essential elements of the platform-based business models used in the corporations in question. The second part describes the development potential and dynamics of GAFAM. Finally, the third part presents the results of research on the course of the internationalisation of the corporations under review, allowing to draw conclusions on the specific characteristics of the internationalisation of present-day enterprises relying on digitisation and platformisation and, consequently, also to conclude on the future of globalisation.

² In 2015, Google set up a holding company operating under the business name Alphabet Inc., to take over the Google's subsidiaries, whereas Google itself became a subsidiary of Alphabet. However, it must be emphasised that Google is an undertaking of key importance to the activities of Alphabet. This study uses the name Google to maintain consistency with the acronym GAFAM, but the data presented still concern Alphabet.

³ As regards Facebook, the company was renamed to Meta (Meta Platforms) at the end of 2021; the rebranding was combined with changing the logo and visual identity of the corporation. As in the case of Google, the previous business name is used in this paper.

The essential elements of the platform-based business model as illustrated by the example of GAFAM

A key element of the business model based on platformisation is a platform bringing together various groups of users. Such a platform constitutes a technical infrastructure (architecture) facilitating interaction and service provision (UNCTAD 2019, pp. 25-27; Nieborg & Poell 2017, pp. 4275-4292), intermediating the creation of multi-sided networks between multiple users (Evans & Schmalensee 2016; McIntyre & Srinivasan 2017). Therefore, it includes IT hardware (e.g. devices such as smartphones, laptops, other accessories), operating systems and software for interactions between users and machines (interfaces) (Deshayes 2019, pp. 36-44). A platform is a sort of 'core' of an entire ecosystem with various user groups gravitating around it (Gautier & Lamesch 2021, pp. 1-15):

- consumers use digital devices to navigate the Internet and its content via search engines, web browsers, social media, instant messengers, map services, etc.;
- businesses use products and services offered by the platform to increase their efficiency and productivity as well as for boosting creative processes, relying on cloud services, productivity software, collaboration tools, analytics software, data analytics, sales programs, etc.;
- merchants use the platform as an online distribution system, relying on shopping websites, price analysis tools, delivery services or online payment services;
- content editors create digital content and use the platform to make it accessible to users, relying on development tools for applications, videos, music, games, music streaming, etc.;
- advertisers use the platform to place online advertising in order to reach potential customers, relying on advertising networks, auctions, serving technology, targeting services.

In the platform-based model, it is essential that the relations, relationships and interactions on the platform should be managed, processed and used in such a manner as to enable the company – the platform owner – to effectively monetise those interactions and data. It is worth pointing out that all interactions will not generate revenue for the platform owner, but all of them are indispensable to the effective monetisation of the platform. As one example of such a user group, consumers do not pay for using products and services provided by the platform (e.g. the Google search engine), but they do leave information on what the consumers search for, what services they use, etc., which allows showing them customised ads paid for by advertisers as well as presenting to consumers products and services offered by firms that will also pay the platform owner for interaction with specific consumers. Therefore, the platform becomes enormously profitable, provided that the management of platform-based data, relationships and interactions is efficient and creative.

In their respective business models, all the GAFAM corporations rely on a platform; however, as their functioning varies, they bring together different user groups in their ecosystems, as summarised in Table 1. All the firms have content editors in their ecosystems. Consumers constitute another popular user group (only Amazon is not active in this segment of users). In their models, three firms target advertisers (Google, Facebook and Microsoft) and businesses (Apple, Amazon and Microsoft). The structures of the ecosystems created are firm-specific as each of the GAFAM firms relies on its own model of monetisation by creating and capturing value from the data it has and processes (UNCTAD 2019, pp. 29-45).

	Google	Apple	Facebook	Amazon	Microsoft
Platform	'Android' mobile operating system, 'Nexus/Pixel' phones, 'YouTube' software and infrastructure	'iPhone' phones, 'iPad' tablets, 'Mac' laptops and other devices (watches, keyboards, etc.), 'IOS' operating systems	software and infrastructure of social media and messengers	'Kindle' e- readers, 'Fire' TVs, 'Echo' Speakers	'Windows' operating system, 'Surface' laptops, 'Lumia' phones, 'Xbox' gaming console
Users					
Consumers	'Google' search engine and vertical search engines, 'Google Maps' mapping and navigation services, 'Chrome' browser	'Safari' browser, 'Facetime', 'Message' communication tools, 'Map' navigation services	'Facebook' and 'Instagram' social media, 'WhatsApp' and 'Messenger' messengers	-	'Bing' search engine

Table 1. Characteristics of GAFAM's ecosystems

Businesses	-	'iWork' productivity suite	-	'AWS' Cloud offerings, 'WorkDocs' productivity suite, 'WorkMail' collaboration tools	'Azure', 'Office 365' Cloud services, 'Excel', 'Word', 'PowerPoint' productivity software, others business solutions: ERM, CRM
Merchants	-	'ApplePay' mobile payment system	Online distribution via social media	Shopping websites: amazon.com, amazon.de, etc., 'Marketplace' online resale platform, 'Fulfillment' delivery services	-
Content editors	'YouTube' video platform, 'PlayStore' platform for books, games and applications	'AppStore' for mobile applications, 'iTunes' for music, 'iBooks' for digital books	Digital content such as games through social media	Access to TV shows and films through 'Prime', digital books sold through 'Kindle Store'	Tools for content and game creators
Advertisers	'AdSense' advertising network, 'AdWords' auctions	-	'Audience Network' advertising network, 'Atlas', 'LiveRail'	-	Advertising services

Continued table 1.

Source: prepared by the author based on: Gautier & Lamesch 2021, pp. 4-5; UNCTAD 2019, pp. 25-31; Fontanel & Sushcheva 2019, pp. 5-12; Miguel de Buston & Izquierdo-Castillo 2019; Miguel de Buston 2017, pp. 43-46.

Although their activities vary in nature, one common characteristic for GAFAM is value creation by offering a platform enabling interactions between and within multiple user groups. GAFAM are also referred to as the Big Tech (the Big Five, the Tech Giants) as they are believed to control operating systems, data centres and knowledge (Ricap & Lundvall 2020, pp. 10-17). They enjoy very strong, even dominant positions in various areas of the digital sector, also in terms of economic and financial power (Smyrnaios 2016, pp. 61-83). Apple dominates the smartphone market;

Amazon has dominated the e-book market; Microsoft is a quasi-monopolist in the market in operating systems for personal computers; Google is the market leader in cloud services (ahead of Microsoft and Amazon) and search engines; Facebook dominates social media (Miguel de Buston 2017). Even in markets where GAFAM are not the strongest players the corporations in question are still able to have some control. In the computer hardware market, dominated by Samsung, Lenovo, Sony, Dell and Huawei, GAFAM have remote (mobile) access to their offers and telecommunication connections. Examples include Microsoft with its operating system and Skype instant messenger or the Google search engine. In any case, Google has remote access to other manufacturers' devices under its Mobile Virtual Network Operator (MVNO) licence, whereas Microsoft and Facebook own new transatlantic communication cables, the most powerful and efficient at present (Fontanel 2020, pp. 3-6). As pointed out by researchers, GAFAM's great success also involves threats arising from those corporations' technological advantages and monopolising the digital space (Miguel de Buston & Izquierdo-Castillo 2019), which allows them to make business use of users' private data, influence political choices, apply censorship procedures, disrespect freedom of expression or create demand (Fontanel 2020, pp. 8-12). Other controversial issues include fiscal matters related to tax optimisation or intellectual property rights (Fontanel & Sushcheva 2019).

GAFAM's potential analysis

The main information on the business activities of the GAFAM corporations, including data for 2022, is summarised in the table 2. It contained in the official annual reports on Form 10-K filed by the companies and published by the United States Securities and Exchange Commission. As at the end of 2022, GAFAM's market value was approx. USD 7.9 trillion, an upsurge on the end of 2019, from USD 4.93 trillion. It was driven by the spectacular acceleration of digitisation in the period of the COVID-19 pandemic. But the market value of GAFAM exceeded Japan's GDP as early as 2019; only the USA and China had GDP higher than the total capitalisation of the Big Five. In 2020, the market value of a single corporation exceeded USD 2 trillion for the first time – in the case of Apple. In 2022, Apple was joined by Microsoft in surpassing the amount of USD 2 trillion.

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Tuble 2. Business delivity data of OAI Am in 2022						
	Google	Apple	Facebook	Amazon	Microsoft	
Market value (USD	1,340.53	2,746.21	599.82	1,084.06	2,309.84	
billion), as at 30						
August 2023						
Revenue (USD	282.83	394.33	116.61	513.98	198.27	
billion)						
Revenue from	52.5%	60.7%	57.8%	38.5%	49.5%	
outside the US (%)						
Sources of revenue	Advertising:	Product	Advertising:	Product	Cloud services:	
	88.8%	sales: 80.4%	98.3%	sales: 55.9%	42.7%	
	Other: 11.2%	Service	Other: 1.7%	Service	Business	
		sales: 19.6%		sales: 44.1%	services: 23.5%	
					Personal	
					computer	
					services: 33.8%	
Employment	190.2	164.0	86.5	1541.0	221.0	
(thousand)						
R&D (USD billion)	39.5	27.7	35.3	73.2*	26.6	
R&D intensity (%)	14.0	7.1	30.3	14.2*	13.1	

Table 2. Business activity data of GAFAM in 2022

* applies to the technology and content category as Amazon does not otherwise specify R&D spending in its annual reports.

Source: prepared and calculated by the author based on: Alphabet Inc. Annual Report, 2023; Microsoft Inc. Annual Report, 2023; Amazon Annual Report, 2023; Apple Inc. Annual Report, 2023; Meta Inc. Annual Report, 2023; Top 100 global innovation leaders, https://www.fdiintelligence.com/content/feature/global-innovation-leaders-2022-edition-82527 [accessed: 4 September 2023].

GAFAM generate hundreds of billions of US dollars per year. It is worth pointing out that the 2010s saw GAFAM's revenues soaring around 5.5 times; in the crisis year of 2020 alone, they went up by 19% against 2019 (*GAFAMs' market capitalization*... 2021), in connection with the pandemic-driven development of digital technologies. Altogether, the 2010s witnessed most impressive increases in revenues recorded by GAFAM, especially for Facebook (by a factor of 43.5), Amazon (by a factor of 11.3), Google (by a factor of 6.2), whereas the revenues of Microsoft rose over 4 times and those of Apple more than doubled⁴. It is also worth highlighting that further spectacular increases in revenues were also observed in 2020–2022, with the revenue of each of the GAFAM corporations going up by 65% to 75%. Detailed information on the dynamics of GAFAM's revenues is presented in Figure 1.

⁴ Revenues generated in 2020 as compared to 2010.



Figure 1. Dynamics of GAFAM's revenues (USD billion) Source: as in Table 2; www.statista.com [accessed: 18 August 2023]

In 2022, the highest revenues of USD 514 billion were reported by Amazon, with a mere 38.5% generated outside the US (Table 2). The second best performer in terms of revenue was Apple, reporting USD 394 billion and nearly 61% from foreign markets, outperforming other GAFAM corporations in that regard. It was followed by Google, with 2022 revenues of USD 283 billion, 53% of which from outside the US. Further, Microsoft generated nearly half of its revenues of USD 198 billion from foreign markets. Lastly, with revenues of USD 117 billion, Facebook had almost 58% of foreign sales. As regards sources of revenue, for Facebook and Google advertising services generate the most sales, at around 98% and 84% of the revenues of the two firms respectively in the year in question. Apple and Amazon mainly sell products (approx. 80% and 56% respectively) and services (about 20% and 44% respectively). At the same time, revenues of Microsoft are generated by the sale of IT services, nearly evenly distributed between business services, cloud services and services provided to individual users.

In terms of employment, Amazon definitely leads the way (with approx. 1.5 million employees) as the corporation needs to develop its distribution entities, which is directly related to the specific characteristics of retail trade (e-commerce) activities. The other firms declare 86,500 (Facebook) to 221,000 (Microsoft) persons employed.

Characteristically, GAFAM spend enormous amounts on R&D activities, with a very dynamic upward trend in the 2010s. In 2020, the world's top three

R&D spenders were Amazon, Google and Facebook, whereas Microsoft and Apple were ranked sixth and seventh respectively (Strategy & 2023). It is related to the characteristics of the business model those firms rely on in their operations, based on digitisation and platformisation. Digitisation poses a major challenge of continuous investment in technology development as well as - in the case of GAFAM - setting trends and directions of technological advancement in the IT sector and pursuing knowledge monopolisation (Ricap & Lundvall 2020). Therefore, the industry requires high R&D intensity, typically around a dozen per cent of GAFAM's revenues, but the share ranges from 7% for Apple to 30% for Facebook (Table 2). The speeding up of the digitisation process requires digital companies to continuously increase R&D investment. A comparison of GAFAM's R&D expenditure between 2012 and 2022 shows sky-rocketing investments. The most impressive growth concerned Facebook, having increased its R&D spending as many as 88 times in the period in guestion (from USD 0.4 billion in 2012). Amazon's expenditure on research and development rose nearly 25 times (from USD 2.9 billion in 2012). R&D spending went up nearly 12 times at Apple (from USD 2.4 billion in 2012). In the period under analysis, Google increased its R&D spending more than eight times (from USD 5.2 billion in 2012). At the same time, R&D expenditure by Microsoft nearly doubled, but it must be emphasised that in 2012 the firm was one of the top R&D spenders as well, the world's second best performer (Strategy &, 2023).

It is worth stressing that the buoyant growth of GAFAM has also resulted from the significant scale of their activities or, rather, simply from their corporate strategies based on acquisitions of other entities, usually technological start-ups. From 1987 to 2020, GAFAM made a total of 825 acquisitions, of which Google accounted for 249 acquisitions (from 2001), Microsoft - for 239 acquisitions, Apple - for 128 acquisitions (from 1988), Amazon – for 107 such deals from 1998 and Facebook – for 102 acquisitions from 2005 (Parker, Petropoulos & van Alstyn 2021). In 2015–2017 alone, 175 companies were acquired by GAFAM, mostly by Microsoft (52) and Google (40) (Gautier & Lamesch 2021, pp. 7-8). Such deals usually concern US or European enterprises, mainly from the user groups of businesses and content editors. Acquisitions play various roles for GAFAM, from offering opportunities for corporate development in the area acquired and effective competition (e.g. the acquisition of YouTube by Google) to increasing the attractiveness of the acquirer's products and enhancing its services offered to users, as reflected in acquisition deals made by Facebook, Apple and Google. Further, as demonstrated by recent studies, a major share (approx. 60%) of GAFAM's acquisitions result in the discontinuation of products previously supplied by the acquirees (Gautier & Lamesch 2021, p. 10). It frequently involves upgrading such products and integrating them into the corporation's own products under the acquirer's brand name. Sometimes, such a product is sold under a different brand, to boost growth potential. Other drivers of such acquisitions include adding technology and high-quality employees to the acquiring company. Certainly, some of GAFAM's acquisitions are motivated by strategies to monopolise the market, thus to eliminate competition (Miguel de Buston J.C. & Izquierdo-Castillo J., 2019), which is subject to examination by the competent competition or anti-trust authorities of the countries concerned (Argentesi et al., 2019).

GAFAM's international footprint analysis

In 2017, the internationalisation of digital corporations was assessed by UNCTAD in its annual World Investment Report containing a new top 100, ranking digital MNEs (UNCTAD 2017). One problem is that – despite their global operations - those corporations carry out international activities in ways specific to digitalisation. Whereas the share of foreign sales in total sales shows the actual scale of internationalisation, their foreign assets seem to be relatively modest, with no information on foreign employment. Therefore, the widely accepted Transnationality Index (TNI) becomes an unreliable tool in most cases. UNCTAD created a ranking based on total sales and the share of foreign sales and on total assets and the share of foreign assets, additionally showing the ratio of the share of foreign sales to the share of foreign assets⁵. Clearly, although digital corporations have no significant foreign assets, they are still able to generate global sales as they can reach customers through their digital infrastructures, without the need to make heavy foreign direct investments to grow globally. Another issue is the fact that digital corporations tend to have strong links with their home markets, generating the vast majority of their sales, particularly that those are mostly very large outlets (the USA, China).

The information shown in Table 3 concerns GAFAM's performance in 2015 with the use of the relevant metrics and categories from the UNCTAD ranking. The highest sales as well as assets were then noted by Apple, selling most of its products and services outside its home country (65%). As compared to the other enterprises in question, the company also had the second highest (behind Microsoft) share of foreign assets, at 39%. The second largest seller, Amazon (USD 107 billion), only reported 36% of sales outside the USA, with roughly the same share of foreign assets (32%). Slightly more than half of Microsoft's sales were generated in foreign markets, but the share of foreign assets was markedly lower (43%). But the most significant differences in foreign sales and assets were observed for Google and Facebook; both firms sold more than half of their products and services abroad, whereas their foreign assets only accounted for slightly

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⁵ One such ranking had appeared before, presenting data for digital corporations for 2015.

above 20% of total assets. In the case of the two corporations, their respective shares of foreign sales were more than double those of foreign assets (the ratio was 2.25 for Google and 2.51 for Facebook).

It is clear, therefore, that a company relying on digitisation and platformisation may expand internationally without necessarily increasing its foreign assets. Such a digital company is able to reach its customers through Internet infrastructure wherever such online infrastructure exists and to remain physically based in its home country at the same time. Obviously, it is also of relevance that GAFAM have excellent development conditions in their country of incorporation due to the size of the economy, the market and the technological leadership of the USA. Therefore, the US market generates a significant share of sales for the five MNEs.

	classification	Total sales (USD billion)	Share of foreign sales (%)	Total assets (USD billion)	Share of foreign assets (%)	Ratio of the share of foreign sales to the share of foreign assets (<i>FDI</i> <i>lighteness</i> <i>indicator</i>)
Google	Internet platforms/ Search engines	75.0	54	147.5	24	2.25
Amazon	e- commerce/Internet retailers	107.0	36	65.4	32	1.13
Facebook	Internet platforms/ social networks	17.9	53	49.4	21	2.51
Apple	IT devices and components	215.6	65	321.7	39	1.65
Microsoft	IT software and services	85.3	52	193.7	43	1.22

Table 3. Internationalisation of GAFAM in 2015

Source: prepared by the author based on: UNCTAD 2017, pp. 8-11.

Therefore, the ongoing digitisation and platformisation of businesses seems to require revising existing views on corporate internationalisation, based on expanding foreign sales accompanied by rising foreign assets and foreign employment. The rankings of the largest MNEs prepared by UNCTAD as annexes to its *World Investment Report* treat foreign assets as an essential criterion. That is why Google (Alphabet), Apple and Microsoft were first included in the ranking in 2013, Amazon – as late as 2016, whereas Facebook (Meta) has never been ranked yet. The highest ranks among the world's largest 100 MNEs were occupied by Apple (from 10th place in 2015 to 37th in 2022). Microsoft's positions ranged from the top 20 to the top 50 (20th in 2022, 49th in 2013). Google climbed to 34th place in 2022, but

it was ranked very low before. Amazon occupied positions in the top 50, 60 and 90; it only reached 26th position in 2018.

Figures 2, 3, 4 and 5 characterise the internationalisation (international footprints) of Google, Apple, Microsoft and Amazon based on the aforementioned rankings prepared by UNCTAD, based on the TNI and its components in relative and absolute terms. For all the four MNEs in question, the TNI showed a downward trend, apparently contrary to the buoyant growth of GAFAM's activities described above. However, as indicated before, it is characteristic of digital corporations to internationalise by expanding their operations in the international market without relatively increasing their foreign assets.

The most distinct downward trend of the TNI was observed for Apple, from 59.6% in 2013 to 43.2% in 2019 to 38.2% in 2022. Such a situation was primarily caused by the company's declining foreign assets, in both nominal and relative terms. At the same time, while nominal foreign sales were on the rise, they remained stagnant in relative terms, slightly above 60%.

As regards Google, a marked fall in the TNI was recorded in 2013-2015 (from 42% to 34% respectively); afterwards, the index remained stagnant, slightly exceeding 33%, then it ranged from 35% to 37% in 2020-2022. Whereas in nominal terms foreign assets, sales and employment showed an upward trend from 2015, they remained relatively stagnant after 2015; in prior years, foreign assets and sales had fallen distinctly, with a stagnant share of foreign sales in total sales throughout in period in question.

At the same time, Microsoft was characterised by the most stable situation in terms of internationalisation; its TNI ranged from 42.8% in 2013 to 43.6% in 2019, with a peak (49.9%) in 2015. Afterwards, Microsoft's TNI showed a downward trend to 2022. Whereas foreign assets increased nominally, they were stagnant in relative terms. Foreign sales and employment remained roughly similar, in both nominal and relative terms, throughout the period covered.

The most significant fluctuations were observed for Amazon, characterised by rapid annual changes in the TNI (62.7% in 2016, 33.1% in 2017, followed by 60.4% and 30%), due to major changes in its foreign assets and employment with differences of several per cent in relative foreign sales.



Source: prepared and calculated by the author based on: UNCTAD 2014-2023



Source: prepared and calculated by the author based on: UNCTAD 2014-2023



Source: prepared and calculated by the author based on: UNCTAD 2014-2023



World Investment Report Source: prepared and calculated by the author based on: UNCTAD 2014-2023

It clearly follows from analysing GAFAM's case that digitisation and platformisation affect how corporations increase their international footprints; while expanding global sales, they do not proportionally internationalise their assets or employment. As exemplified by GAFAM, under the new conditions of digitisation and platformisation companies may grow internationally even with decreasing transnationality indices, which is somewhat paradoxical, considering the dynamic growth of those enterprises, including in the international market. But the observation can be explained by the rapid development of platform-based ecosystems, with the GAFAM corporations leading the way. The point is that the more a company relies on a digital ecosystem and a platform in its activities, the lesser relative foreign involvement (foreign assets and employment) is necessary. As shown by the example of GAFAM, impressive corporate growth, also pursued internationally, may be accompanied by stagnant or even falling transnationality indices. It means that an enterprise can effectively expand abroad under conditions of a rising share of operations in its home market, while selling its products or services in foreign markets as well. Certainly, the internationalisation of sales by digital corporations will also require having foreign assets, even if for more efficient adaptation of their products and services to their markets of operation; thus, they may confine themselves to opening foreign offices or branches, mostly responsible for communicating with users in their respective languages. Simultaneously, the company's key business processes will be supported in its home market. For example, at its official website Facebook declares having more than 80 offices worldwide and 17 global data centres (Meta 2023).

Conclusion

To recapitulate the above, it must be highlighted that digital firms relying on platform-based business models follow different international expansion paths from those of traditional corporations. Despite their buoyant growth, also on a global scale, GAFAM are characterised by stagnant or even declining internationalisation indices (TNI). It primarily concerns foreign assets but also foreign employment. While supporting a major share of their business processes in their home country, the GAFAM corporations have been impressively successful in increasing their foreign sales. Hence the paradox of falling TNIs accompanied by rising foreign sales. The key driver of such international expansion is a specific business model, based on IT infrastructure in the form of platforms enabling global operations with low shares of foreign assets and foreign employment.

The example of GAFAM, the world's technological leaders (Tech Giants), allows to assume that the trends set by the five largest digital corporations will soon be followed by many other multinational enterprises. As the digitisation and platformisation pathway seems to be particularly appealing, it may attract further companies modelling their operations on those of GAFAM. In any case, those trends seem to be the present-day challenge as well as necessity to businesses. Therefore, one likely scenario is a shift in corporate internationalisation on a larger scale. It may also call into question the relevance of the currently used internationalisation indicators and require developing new approaches.

Given that the GAFAM group encompasses enterprises with the highest market values worldwide, thus global giants, it is surprising to find the relatively insignificant shares of foreign operations in their business activities. Therefore, one may venture to reflect that, as those are the leading representatives of the new era of global digital corporations, drivers towards decelerating globalisation, thus hindering the internationalisation of economic activities, have at least two sources here:

- digital corporations, likely to increase in number and to operate globally by obtaining revenues from the global market, will show a low degree of internationalisation of their operations in terms of foreign assets, thus slowing down globalisation, particularly with regard to foreign direct investment flows;
- corporations operating in other sectors will implement digital solutions in efforts to modernise their business models and to benefit from digitisation, which will also enable them to function internationally and to disinvest, at least in part, in foreign operations, which will hamper or even reverse globalisation with regard to flows of goods, services and direct investment.

It is worth noting that, as the trend of digitisation, platformisation and automation is indicated as an emerging process, although with a great impetus gained due to the pandemic crisis, it is possible to conclude on ever-stronger and permanent drivers towards globalisation slowdown, arising from the digitalisation and platformisation of corporations. It is not particularly relevant here that the pandemic has ended as the digitisation of business activities will continue to speed up.

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BUDGETARY OPERATING BALANCES IN THE ASSESSMENT OF THE FINANCIAL ASPECTS OF EUROPEAN INTEGRATION

Abstract:

The aim of the study was to assess whether the presentation of financial flows between states and the EU budget provides constructive information, since the literature on the subject emphasizes that the assessment of the benefits and costs of integration has a much broader and more complex scope resulting from the free movement of people, services, goods and capital.

In the paper it was used data from 2019 taking into consideration the last year of the UK's full membership in the European Union and a year before COVID-19 pandemic which also has influenced EU finance. In addition, the current operating balances of the member states are presented based on the latest data from 2022 referring to the author's modified algorithm for calculating operating budgetary balances according to the guidelines of the European Commission.

Findings resulting from the conducted research are as follows: referring to the formulated hypotheses it should be stated that there are no grounds to reject them. Correction mechanisms on the revenue side of the European Union budget affect the operating balance of a given country, although they do not have to cause a change in the operating balance from negative to positive or vice versa. In addition operating budgetary balances do not provide a true picture of the benefits and costs of European integration.

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Providing the value of budget balances for member states in relation to the EU budget should be considered a strictly accounting procedure. The wider use of operating budgetary balances can be considered a denial of the essence of European added value, because they refer to the idea of "fair return" as the expectation of a certain adequacy between the amounts paid and the funds received from the budget.

Keywords: operating budgetary balances, European Union budget, correction mechanism. financial solidarity.

JEL codes: F15, H30, H77.

Introduction

The results of analyzes concerning payments and withdrawals to and from the European Union budget has been controversial since the beginning of the European Communities. As new areas were covered by joint expenditure and new members were admitted, the problem of budget balances increased, and the division into net payers and beneficiaries led to many misunderstandings between member states and an often misleading interpretation of this accounting concept.

The aim of the article is to assess whether the presentation of financial flows between states and the EU budget provides constructive information, since the literature on the subject emphasizes that the assessment of the benefits and costs of integration has a much broader and more complex scope resulting from the free movement of people, services, goods and capital. The following hypotheses were adopted for the study:

- 1) Correction mechanisms on the revenue side of the European Union budget affect the operating balance of a given country.
- 2) Operating budget balances do not provide a true picture of the benefits and costs of European integration.

To examine the impact of transfers from and to the European Union budget in individual member states, data from 2019 was used due to the last year of the UK's full membership in the EU and a year before COVID-19 pandemic which also has influenced EU finance. In addition, the current operating balances of the member states are presented based on the latest data from 2022 according to the proprietary adjusted budget operating balances method used by the European Commission,

The study was divided into four main parts. The first one presented the essence of the division of EU countries into net contributors and net recipients and the importance for the perception of the benefits and costs of European integration. The second part was devoted to the evolution of the correction mechanisms existing on the revenue side of the EU budget.

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The third part presents the methodology for calculating budget operating balances and research results, while the fourth part contains discussion and conclusions. The research used the European Commission's database dedicated to the revenues and expenditure of the EU budget.

1. The essence of budget operating balances

When publishing data on operational budget balances, the European Commission emphasized that they were of a strictly financial nature and therefore no conclusions could be drawn on their basis about the benefits and costs of membership in the European Union. However, despite the clear position of the European Commission, data on operating balances are used by member states for or against further deepening of integration. Such different views on financial flows often result from the conscious use of this data for specific, particular purposes of political parties. As a result, currently, i.e. referring to the multiannual financial framework for 2021-2027, the European Commission has stopped providing information on budget balances, although this data can be obtained based on payments and withdrawals in relation to the EU budget.

The budget balance calculated according to the European Commission's methodology is called the operational budget balance and is calculated according to the formula (European Commission, 2019):

$$OBB_i = TAE_i - AE_i - ANC_i \times \frac{TAE_{UE} - AE_{EU}}{ANC_{EU}}$$
(1)

where:

OBB_i operating budgetary balance of the state *i*, where i = 27 or 28^2 ;

TAE_i total allocated expenditure from the EU budget for the state *i*, where i = 27 or 28, or i = EU for EU as the whole organisation;

 AE_i administrative expenditure) for the state *i*, where i = 27 or 28, or i = EU for EU as the whole organisation;

ANC_i adjusted national contribution of the state *i*, where i = 27 or 28, or i = EU for EU as the whole organization.

The assumptions adopted by the European Commission do not include:

- on the side of expenditure from the EU budget, funds for EU administration, as expenditure for the common functioning of the European Union, and not for the benefit of a specific member state, and expenditure for third countries (those remaining outside the European Union, including candidate countries) are not taken into account; as a result, other expenses are called operational,

² Number of member states before or after British withdrawal from the European Union.

 on the side of revenues to the EU budget - traditional own revenues, currently in the form of customs duties, as a levy resulting from the functioning of the customs union, and therefore resulting from the import of goods into the European Union.

The European Commission's methodology for calculating budget operating balances is based on the assumption that it is a zero-sum game for the entire European Union (Asatryan et al., 2020a) i.e. how much a given member country could receive from the EU budget, taking into account the same percentage share as in payments to the EU budget. The value calculated in this way is then subtracted from the actual expenditure from the EU budget for the given country (Stabryła-Chudzio, 2022).

The presentation of budgetary operating balances is treated with great caution in drawing conclusions about the benefits and costs of integration on this basis alone. The net benefits go beyond operating balances and include wider economic and social impacts in terms of trade opportunities, employment and productivity, including spillover effects on other members. Furthermore, data on operating balances are only indicative from an economic point of view.

Therefore, a broader aspect of integration should be taken into account, relying on the following arguments (Asatryan et al., 2020b; Asatryan et al., 2020c):

- the existence of economies of scale of spending at EU level compared to spending at member state level,
- threshold effects of projects that, from a financial point of view, a single country would not be able to implement,
- cross-border effects, including: in the form of foreign direct investments, trade, environmental protection, scientific research results,
- effects of freedoms guaranteed by the European single market (movement of people, goods, services and capital),
- the existence of external expenditure from the EU budget not included in budget balances and intended for economic and social cooperation of third countries with the European Union, supporting democracy, protecting human rights and stability in a given region,
- the existence of other funds outside the EU budget that are not taken into account when calculating operating balances.

2. The importance of financial correction mechanisms in the European Union budget

The correction mechanisms existing in the European Union budget are considered to be a denial of the essence of European added value, because they refer to the idea of "juste retour", i.e. "fair return" as the expectation of a certain adequacy between the amounts paid and the funds received from the EU budget. The fear of excessive "crediting" to other members has prompted some countries to negotiate a number of correction mechanisms allowing them to reduce the amount of revenue they transfer to the EU budget (Stabryła-Chudzio, 2022).

Financial correction mechanisms include special discounts (rebates, reductions, abatements) relating to the amount of the contribution to the European Union budget (table 1). These rebates are on the revenue side of the EU budget, although they contribute to reducing the contribution rate. From a historical point of view, an attempt to introduce the first correction mechanism appeared in the 1970s, with the beginning of Great Britain's functioning in the European Communities. Subsequent discounts were introduced successively along with requests from selected net payers to reduce payments to the community budget. So far, Great Britain, Germany, Austria, the Netherlands, Sweden and Denmark have benefited from the discounts, but the amount of the discounts and their mechanism have changed over time.

Table 1. Corrective mechanisms	in the	history	of the	European	Communities
and the European Union					

Before 2000					
United Kingdom – British rebate (abatement, reduction)					
Germany - the so-called rebate on the British rebate, i.e. a 33% reduced payment to Great					
Britain					
2000-2006					
United Kingdom– British rebate					
Austria, Germany, Sweden, the Netherlands - the so-called rebate on the British rebate,					
i.e. a 75% reduced payment to Great Britain					
2007-2013					
United Kingdom – British rebate					
Austria, Germany, Sweden, the Netherlands - the so-called rebate on the British rebate,					
i.e. a 75% reduced payment to Great Britain					
Austria - reduced VAT rate (0.225%)					
Germany - reduced VAT rate (0.15%)					
Netherlands and Sweden - reduced VAT rate (010%); A flat-rate reduction in your					
GNI-based contribution					
2014-2020					
United Kingdom – British rebate					
Austria, Germany, Sweden, the Netherlands - the so-called rebate on the British rebate,					
i.e. a 75% reduced payment to Great Britain					
Austria – three-year flat-rate reduction in GNI-based contributions					
Denmark - flat-rate reduction of the GNI-based contribution					
Germany - reduced VAT rate (015%)					
Netherlands and Sweden - reduced VAT rate (015%); a flat-rate reduction in your					
GNI-based contribution					
2021-2027					
Austria, Denmark, Germany, the Netherlands and Sweden - flat-rate reduction					
in GNI-based contributions					

Source: Asatryan et al. (2020a); Benedetto (2017, pp. 615-633).

It should be noted that the rebates apply to countries that pay more than they receive from the EU budget and therefore constitute a form of financial relief for the largest net contributors. As a result, correction mechanisms are associated with the concept of the so-called national budget balance, i.e. the relationship between the funds received from the EU budget by a given country and the contribution it pays.

From 2021, one official form of discount from the previously existing ones has been left, i.e. lump-sum corrections on the basis of the annual GNI-based contribution of Denmark, the Netherlands, Austria, Sweden, and Germany (table 2). The gross reductions is financed by all other member states, according to their GNI. Every year amounts are indexed based on the GDP deflator.

Table 2. Rebates pe	r year in Multiannual Financial Framework 2021-2022 (r	n EUR)
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Denmark	377
Germany	3 671
The Netherlands	1 921
Austria	565
Sweden	1 069

Source: https://commission.europa.eu/strategy-and-policy/eu-budget/long-term-eu-budget/2021-2027/revenue/rebates_en (retrieved June 18, 2023).

As Darvas (2019a) rightly notes it is also possible to distinguish a "hidden rebate" related to retaining a certain part of customs revenues as "collection costs", which benefits countries with an external EU border. A partially hidden rebate can also be called flat-rate payment limitations in some member states due to the collection of non-recyclable plastic packaging waste. However, there is a justification here in order to avoid excessive regressive impact on the contributions of member states whose GNI per capita in 2017 was lower than the EU average. In accordance with the EU Council Decision on the system of own resources of the European Union (Council of the European Union, 2020) this reduction corresponds to the value of 3.8 kilograms of non-recyclable plastic packaging waste multiplied by the population of the member state concerned in 2017³.

3. Methodology and research results

This article uses the author's proposal to calculate operating balances in the context of actual payments and funds from the EU budget to member states, taking into account the European Commission's arguments regarding the omission of EU administration expenses and traditional own revenues

³ The uniform call rate is EUR 0.80 per kilogram.

from the calculations. Consequently, the formula for the modified budget balance will be:

$$MOBB_i = (TAE_i - AE_i) - (TNC_i - TOR_i)$$
⁽²⁾

where:

 $MOBB_i$ – modified operating budgetary balance of member state *i*, where i = 27 or 28⁴;

TAE_i - total allocated expenditure of member state *i*, where i = 27 or 28; AE_i - administrative expenditures allocated to member state *i*, where i = 27 or 28; or 28;

 TNC_i - total national contribution of member state *i* , with i = 27 or 28.

 TOR_i – traditional own resources of member state *i*, with i = 27 or 28.

By total national contribution is understood:

- for multiannual financial framework 2014-2020 revenue based on GNI, value added tax and traditional own resources,
- for multiannual financial framework 2021-2027 revenue based on GNI, value added tax, revenue form non-recycled plastic packaging waste and traditional own resources.

In addition to the above-mentioned arguments questioning the reliability of operational budget balances, it should also be noted that data on operational budgetary balances for a given member state vary over time and also present a different picture when presented in relative values (e.g. in relation to GDP or per capita) and absolute (figure 1).

⁴ Number of member states before or after British withdrawal from the European Union.





Source: own study based on European Commission data (retrieved July 1, 2023 from: https://commission.europa.eu/strategy-and-policy/eubudget/long-term-eu-budget/2021-2027/spending-and-revenue_en).

From the chart above, it can be seen that in 2022, where Germany, France and the Netherlands were the largest net payers in EUR million, while in relation to GDP and per capita - Germany, Sweden and the Netherlands. In 2022, Poland, Romania and Hungary were the largest net beneficiaries in absolute terms, while in relation to GDP they were Latvia, Hungary and Lithuania, and per capita - Luxembourg, Estonia and Lithuania.

In 2022, net beneficiaries received EUR 50.4 billion more than they paid in, representing 0.32% of EU GDP. The increase in this amount compared to the average of the years 2014-2020 may result from the limitation of correction mechanisms. The number of net beneficiaries remained the same as in 2019 (18 countries), with Ireland becoming a net payer in 2022 and Belgium becoming a net recipient.

These differences confirm the difficulty in drawing clear conclusions about the balance of payments and withdrawals from the EU budget. However, it should be emphasized that 2022 was an exceptional year because it was the penultimate year of using funds from the 2014-2020 period, which was associated with increased expenditure from the EU budget, and at the same time, not all countries started spending funds from the new multiannual financial framework for 2021-2027. Moreover, for the 2021-2027 financial framework, a new source of financing was introduced in the form of revenue based on non-recycled plastic packaging waste. Apart from Ireland, which became a net payer in 2022 compared to 2019 in absolute terms, Germany, France, the Netherlands, Austria, Finland and Sweden also recorded a deterioration in negative balances (figure 2). A deterioration of the positive balance was observed for Bulgaria, the Czech Republic, Croatia, Latvia, Hungary, Malta and Slovenia, while the positive balance of Luxembourg increased by over 1,228% and Belgium became a net beneficiary in 2022. The introduction of rebates improves the balance situation in 2022 in absolute terms for the beneficiaries of these mechanisms, i.e. Germany, Austria, Denmark, the Netherlands and Sweden.



Figure 2. The amount of modified operating budgetary balances in 2019 and 2022

Source: own study based on European Commission data (retrieved July 1, 2023 from: https://commission.europa.eu/strategy-and-policy/eubudget/long-term-eu-budget/2021-2027/spending-and-revenue_en). Comparing the balances with the recognition of rebates in 2022 (figure 3), the balance of Bulgaria, the Czech Republic, Germany, Ireland, France, Croatia, Latvia, Hungary, Malta, Slovenia, Finland and Sweden deteriorated compared to 2019. The reasons could be threefold: firstly, the emergence of a new source of revenue from unrecycled plastic, or secondly, larger payments to rebate beneficiaries, or finally, thirdly, the deterioration of the budget balance itself.



Figure 3. The amount of the correction mechanisms (R) in 2019 and 2022 Source: own study based on European Commission data (retrieved July 1, 2023 from: https://commission.europa.eu/strategy-and-policy/eu-budget/long-term-eubudget/2021-2027/spending-and-revenue_en).

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Therefore, a year-to-year comparison of operating balances will not provide the basis for drawing far-reaching conclusions, since the level of expenditure from the EU budget is significantly influenced by the level of advancement of investments co-financed from EU funds.

Darvas emphasizes (2019a, 2019b), that the desire of some countries to reduce their contributions to the EU budget is not due to the low level of wealth of the country in relation to the EU average, but from the desire to improve the net balance.



Figure 4. GNI per capita and modified operating budgetary balances in 2022 Source: own study, comp. Darvas (2019a, pp. 6-7).

Based on the conducted considerations, it can be concluded that there is an inverse relationship between the amount of modified operating balances and the wealth of countries, i.e. as the gross national income of a given country increases, its modified operating balance decreases. However, the relationship is not linear (figure 4), because the chart shows some exceptions, including: Luxembourg and Ireland as the wealthiest countries and at the same time not recording the lowest operating balances, and on the other hand Hungary, Latvia, Lithuania and Estonia with the highest positive balances in 2022 and at the same time not being among the least wealthy. Therefore, the effect of redistribution of funds from the EU budget is still dominant, although it relates mainly to cohesion policy and, to a large extent, to the common agricultural policy. The remaining directions of spending do not refer to national divisions, but to achieving functions of public finances other than redistribution, i.e. allocation and stabilization, also in the context of sustainable development.

4. Discussion

It can be noted that the role of budget balances in discussions on changing the structure of the EU budget is still alive, which results from great difficulties in measuring European added value. European added value, which translates into many areas, is also the core of considerations on the importance of the EU budget. However, problems in assessing the effectiveness of EU programs, both in terms of finding appropriate measurement tools and in the time needed to learn the final results of their implementation, cause EAV to become an opaque and complicated concept, and thus give rise to further use of the idea of "juste retour" (Schout & van Riel, 2023).

As Schout, Molthof and Hollander (2023) point out, leaving EU budget main revenue based on gross national income is the best solution in the current situation because it takes into account primarily the level of wealth of the member states in the contribution to the EU budget. Moreover, the calculation mechanism is understandable and transparent, although it requires adjustments after the final determination of the GNI amount for a given year. Nevertheless, it would also be necessary to abandon the correction mechanisms that complicate the relatively simple assumptions of GNI-based own resources.

It should be noted, however, that the gradual introduction of new sources of the European Union's own revenues without a direct national reference may in the distant future reduce the interest of member states in calculating net balances, but such a change in attitude would also have to be the result of a change in attitude regarding the shape of the European Union. For now, it seems impossible for the pro-federal direction to gain wider recognition among politicians and thus change the attitude from the national interest to the EU interest.

Moreover, the attempt to move away from the net balance approach solely by introducing new tax-based own resources of the EU budget is, for now, too small steps to draw far-reaching conclusions (Benedetto, Heinemann & Zuleeg, 2020). Additionally, the more expenditure categories will serve to achieve objectives at the EU level, and therefore the more expenditure will be related to achieving European added value, the less important the reference to the budget balance will be. The debate on the importance of operational balances leads to the conclusion that as long as a significant part of the EU budget expenditure is based on the redistributive function, i.e. on the common agricultural policy and cohesion policy, member states will pay attention to the amount of the described balance. Only the transfer of the burden of spending to European public goods and the actual introduction of taxes of supranational importance can change the approach of member states.

To summarize this study, operating balances resulting from political bargaining can lead to distorted spending decisions (Santos & Neheider, 2009). Monti et al. (2016) are also negative about the perception of the EU budget as a zero-sum game. Oettinger and Crețu (2017) are in favor of abolishing all rebates, especially if this would result in real added value.

Conclusions

On the basis of the author's modified budget operating balance and the author's calculations of correction mechanisms, the significance of financial flows between the European Union budget and the member states was assessed. Referring to the hypotheses formulated at the beginning of the article, it should be stated that there are no grounds to reject them. Correction mechanisms on the revenue side of the European Union budget affect the operating balance of a given country, although they do not have to cause a change in the operating balance from negative to positive or vice versa.

Operating balances are considered to have a certain 'political appeal' (Heinemann, Pilati & Zuleeg, 2020) used for the needs of current national policy, thus shifting to the background European Union activities that are not the result of a top-down negotiated national division (so-called national envelopes). As a result, as the history of European integration shows, negotiations on changes in the structure of the EU budget are extremely complicated long and rarely lead to spectacular solutions (Stabryła-Chudzio, 2022).

Operating budgetary balances do not provide a true picture of the benefits and costs of European integration. Determining the benefits and costs of integration based on data relating to budget operating balances can be misleading and lead to incorrect conclusions. This tool is used in a purely accounting aspect and therefore cannot be treated as an assessment of the role played by the European Union budget (Asatryan et al., 2020c; Sapała, 2020). Therefore, it is necessary to consider the advisability of presenting operating balances.

Part of the answer can be found in an attempt to explain the existence of correction mechanisms in the EU budget. Net payers to the EU budget through revenue reductions are trying to look for ways to reduce their contributions, which means that the EU's revenue system has become complex and often incomprehensible to the public (Darvas, 2019a). It can, of course, be noted that after United Kingdom left the European Union, the rebate system was simplified somewhat automatically, i.e. the correction mechanism for Great Britain and the so-called rebate on the rebate, i.e. special discounts in payments towards the British rebate for selected countries while increasing the payments of other EU members. Moreover, it may also be a contribution to examining the evolution of the structure of revenue and expenditure of the EU budget, although not the only one and insufficient.

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ARTICLES

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THE IMPACT OF THE WAR ON BANKING IN UKRAINE

Abstract: The article is devoted to the study of the operation of the banking system of Ukraine during the war period. The key indicators of the banking sector have been analyzed, in particular, the number of banking institutions and the dynamics of assets and liabilities. The key financial results of the banking sector, namely net profit and loss, return on assets and capital have been analyzed. It is revealed that maintenance of operational efficiency and effective measures taken by the National Bank of Ukraine allowed the banking sector to adapt to the crisis conditions and make a profit under martial law.

Keywords: russian-Ukrainian war, martial law, banking, National Bank of Ukraine.

JEL Classification: E44, E58, G21

1. Introduction

In recent years, Ukraine's financial sector has been developing under difficult conditions. One of the last most painful crises, which, unfortunately, is still ongoing, began back in the year 2014 during the deployment of the «hybrid war» of the Russian Federation against the integrity of Ukraine in the East of Ukraine and the annexation of the Autonomous Republic of Crimea. The war provoked by the russian federation against Ukraine back in 2014 generated significant risks for the operation of the national banking system, which have significantly increased after the full-scale aggression

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in February 2022. The banking sector is highly sensitive to political, economic and regulatory fluctuations. During 2014-2022, the war significantly changed and restricted the banking sector's operating environment, affecting the lending, discount rate, foreign exchange transactions, deposit rates, and the stability of banks, as a result of which their number in Ukraine was reduced.

In recent years, Ukrainian researchers have increasingly focused on the issues of banks' operation in wartime. In particular, the article (Prokopenko et al, 2022) is devoted to determining the basic principles of the functioning of the banking system of Ukraine under martial law. The publication (Zabchuk & Ivashchuk, 2022) discusses the peculiarities of credit, market, currency, and liquidity risks to the operation of the banking system of Ukraine under martial law. The study (Tymoshyk et al, 2023) identifies the problems of the banking sector of Ukraine that were generated by a full-scale military invasion of the country, analyzes trends in the industry's indicators, and develops proposals for measures to stabilize the situation. The purpose of the article (Rats, 2023) is to study the efficiency of the domestic banking sector under martial law. In addition to these publications, the following studies are also noteworthy (Kovalenko, 2022; Pravdykovska & Doroshenko, 2022; Drugov & Drugova, 2022; Shkolnyk et al, 2022; Sytnyk & Pritsak, 2023; Nakonechna, 2023).

The problem of the impact of the russian-Ukrainian war on the development of the economy and the financial sector is the subject of research not only by Ukrainian scholars, but also by foreign ones. In particular, it is worth highlighting the publications (Deng & Li, 2023), (Batten et al, 2023), (Taera et al, 2023), (Zhou & Lu, 2023), (Guénette et al, 2022). This suggests that the war in Ukraine not only has led to changes within the country, but also affects the global economy. In particular, according to some researchers (Taera et al, 2023), the russian-Ukrainian war causes a decline in global growth from 5.7% in 2021 to 2.9% in 2022, with a projected average 3% slowdown in 2023-2024, and GDP is projected to be at least USD 2.8 trillion lower in 2023.

The purpose of this publication is to study the key changes in the banking sector of Ukraine in 2014-2022, caused by the impact of the russian invasion.

Statistical methods, methods of feasibility and financial analysis and observation were used to study the development trends and the current status of the banking system of Ukraine. Statistical and graphical methods were used to process and summarize statistical data and display them in tables and figures. The statistical data of the National Bank of Ukraine were used to write this article.

2. Analysis of the key indicators of banking activity in Ukraine during the war period

Today, all areas of business, including illegal ones, depend on the stable operation of the banking system, which is the basis of production and operational processes. Since the beginning of the war in Ukraine, not only businesses but also ordinary citizens have felt dependent on it. In the first days of the full-scale invasion, the payment system was on the verge of shutting down. Because employees could not go to work, a large number of bank branches closed. A massive attempt to withdraw cash from ATMs also hit the Ukrainian banking system.

Despite a number of challenges, the banking system continues to operate. Banks are trying to ensure uninterrupted operation of their branches in regions where there is no threat to the life and health of the population.

In the context of the war with russia, the Ukrainian banking system operates under the restrictions established by the Resolution of the Board of the National Bank of Ukraine No. 18 dated 24.02.2022 on the Operation of the Banking System During the Period of Martial Law. These restrictions are related to cash withdrawal from customers' accounts, cash disbursement in foreign currency, the foreign exchange market, the official foreign exchange rate, etc. At the same time, the Resolution lifted restrictions on non-cash payments, ATM replenishment, access to safe deposit boxes and governmental payments. Regulatory measures taken by the National Bank of Ukraine help to withstand the martial law. Thanks to this, as well as new approaches, principles, and measures that the banking system of Ukraine has invented, the country has maintained the relative stability of the national currency and ensured business activity (Prokopenko et al, 2022).

Between 2014 and 2022, the number of banks in Ukraine decreased by almost 100 institutions, from 163 in 2014 to 67 in 2022 (Table 1):

Parameter	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of	163	117	96	82	77	75	73	71	67
operating banks									
including those	51	41	38	38	37	35	33	33	30
capital									
including those with 100% foreign capital	19	17	17	18	23	23	23	23	22

 Table 1. Number of banks in Ukraine in 2014-2022

Source: The author's own research on the basis of National Bank of Ukraine

The largest reduction in the number of banking institutions over the analyzed period was observed in 2015, i.e. 46 institutions, which is explained by the revocation of licenses by the National Bank of Ukraine (NBU) in connection with the annexation of Crimea and the deterioration of banks' solvency, which resulted in a decision to liquidate them. The year of 2014 has become a turning point, when Ukraine faced one of the worst crises in its history. It was then that the NBU decided to increase the minimum capital requirements for banking institutions in order to improve the banking system, which in turn led to the liquidation of low-guality and financially non-transparent banks. The fact that despite the reduction in the number of banks, lending volumes in Ukraine remained almost unchanged is evidence of the banking sector's cleanup. It is noteworthy that the reduction in the number of commercial banks was primarily due to the liquidation of banks with private capital. The main reasons for foreign banks to leave the market were political and economic instability, as well as the government's revocation of the licenses of banks with russian capital.

According to statistics, the leading banks with foreign capital in Ukraine are represented by such developed European countries as Austria, France, Britain, Poland, Germany, Turkey, etc. The consequences of the presence of a significant share of banks with foreign capital in the domestic market are rather ambiguous: on the one hand, they contribute to the financial development of the country, and on the other hand, they conceal certain threats. The study (Khoma & Papirnyk, 2022) shows that banks of foreign banking groups generate about a third of the total assets, equity, liabilities, and net profit of the banking system, while following the so-called "creamcollecting" strategy, which implies lending predominantly to legal entities, in particular large companies. Further to that, the high profitability of foreign banks and their compliance with the economic standards set by the NBU during the study period indicate that these institutions played a significant role in maintaining the resilience of the Ukrainian banking system during the 2014 crisis.

In 2022, banks were forced to close every fifth branch in Ukraine. Most branches were closed by foreign and state-owned banks. Branches were closed and staff dismissed mostly in the regions where active hostilities were or are currently taking place, and thus the demand for banking services is lower. The most massive cuts occurred in Kharkiv and Donetsk regions, as well as in the city of Kyiv and Kherson region. At the same time, banking services are not currently available in all settlements. State-owned banks ensure inclusion of these settlements through mobile branches.

Despite the decline in the number of banks in Ukraine, there has been an increase in assets in 2014-2022 (Figure 1):



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Investments in securities and long-term investments, UAH million

Figure 1. Dynamics of Ukrainian banks' assets in 2014-2022

Source: The author's own research on the basis of National Bank of Ukraine

This trend is positive, as banking assets form the income of banking institutions. During 2014-2022, the value of assets increased from UAH 1,316,852 million to UAH 2,351,678 million, and their growth during this period was about 80%.

In 2014-2018, asset growth was generally driven by the growth of the banks' loan portfolio. During this period, the share of loans in banks' assets was about 80%. However, since 2019, there has been a decline in bank loans, and their share in assets amounted to 44% at the end of 2022. At the same time, there has been an increase in investments in securities and long-term investments. Between 2014 and 2022, their share in assets increased from 13% to 43%.

According to the National Bank of Ukraine, from the beginning of the fullscale war until December 31, 2022, the government of Ukraine raised UAH 152,390.6 million, USD 1,929.0 million, and EUR 977.3 million from the placement of domestic government bonds at auctions. Over the same period, UAH 213,337.7 million, USD 2,793.3 million, and EUR 662.3 million were allocated for repayment on domestic debt securities. During the martial law period, the Ministry of Finance of Ukraine raised interest rates on a number of hryvnia-denominated domestic government bonds (with the maximum rate of 19.5% per annum), as well as on dollar-denominated domestic government bonds (with the maximum rate of 4.5% per annum) and on euro-denominated military bonds (with the maximum rate of 3% per annum). The largest volume of these securities is concentrated by primary dealer banks.

After the outbreak of the full-scale war, the demand for loans declined. Due to the war, credit risk has become one of the biggest risks, the final amount of losses from which can only be calculated over time, as a large part of Ukraine's territories is occupied, businesses are not operating, many people have gone abroad, and many are unemployed, unable to pay loans and interest on them (Kovalenko, 2022; Pravdykovska & Doroshenko, 2022).

In 2017-2021, Ukraine saw a downward trend in the share of NPLs. In particular, their share decreased threefold during this period, from 53.51% to 16.86%. However, in 2022, it almost doubled and amounted to 30.44% (Fig. 2). This growth was driven by an increase in NPLs of both the corporate sector and individuals. As of the end of 2022, they amounted to 42.87% and 38.12%, respectively.





Source: The author's own research on the basis of National Bank of Ukraine

A bank loan is considered non-performing by the European Central Bank if the borrower failed to pay the agreed installments or interest for more than 90 days. At the beginning of the war, repayment holidays were introduced and credit card limits were reduced. During the repayment holidays, banks offered the following concessions: waiver of mandatory payments for a period of one to three months; temporary halving of interest rates or more; and waiver of late payment fees.

Repayment holidays are effective in the short term because they reduce the debt burden on customers and increase customer confidence in the institution. However, over time, banks need to move away from large-scale repayment holidays to be able to finance their expenses.

The NBU emphasized the high risks of unsecured consumer lending due to the dependence on borrowers' solvency. During the repayment holidays, the banks' losses were not noticeable. However, these risks will be realized as the repayment holidays gradually end and the banks return to their normal payment schedules. The normal resumption of retail lending requires stabilization of household incomes and the economic situation in the country, which will be only possible after Russia's military aggression against Ukraine ends. Therefore, banks are now trying to adapt and fulfill their functions in the conditions prevailing in the country. Since June 1, 2022, the repayment holidays have been terminated by many Ukrainian banks. Each bank decides on benefits it provides to the borrowers who are still repaying their loans at its sole discretion. The problem is that the volume of bank loans to the corporate sector is much higher than the volume of loans to individuals in Ukraine (Figure 3):





The volume of bank loans to legal entities exceeded the volume of loans to individuals by almost four times during 2014-2022. In 2022, the value of loans to business entities increased from UAH 835,658 million to UAH 847,586 million, while loans to individuals decreased from UAH 256,291 million to UAH 224,260 million. This situation can be explained by the government's support and incentives for commercial banks to intensify lending to the real sector during the war. In this case, the state is assuming more and more obligations to compensate for loan rates for businesses. On March 18, 2022, the government decided to launch Interest-Free Business Lending during the wartime. For the duration of martial law and for another month after its end, the interest rate on loans will be 0%. The state will pay interest for those who want to do business. After martial law, the interest rate under this program will not exceed 5%. The maximum loan amount has been increased to UAH 60 million.

According to the Ministry of Finance of Ukraine, as of the beginning of 2023, 19,738 loan agreements totaling UAH 81.61 billion were concluded under the state program Affordable Loans 5-7-9% during the period of martial

law (including 14,708 loan agreements worth UAH 42.44 billion concluded by public sector banks), of which:

- UAH 0.83 billion for investment purposes;
- UAH 6.69 billion as anti-crisis loans;
- UAH 4.36 billion as refinancing of previously obtained loans;
- UAH 25.86 billion of loans to agricultural producers;
- UAH 43.85 billion for anti-war purposes.

This policy of the state through the mediation of commercial banks is aimed primarily at supporting Ukrainian enterprises engaged in the production of weapons and military equipment and energy companies that need to be restored. Further to that, the government is actively seeking ways to resume mortgage lending under martial law. To this end, the government program Affordable Mortgage 7% has been developed. Its essence is that military personnel, doctors, IDPs, teachers and researchers will be offered mortgages at 3% to 7% per annum.

During 2014-2022, the bank's liabilities increased from UAH 1,168,829 million to UAH 2,135,838 million (Table 2). This growth was due to an increase in funds of business entities and individuals, whose share in 2014 was 58%, and at the end of 2022 – more than 85% of the banks' liabilities.

Years	Banks' liabilities	Liabilities in foreign currencies	Fixed- term deposits and loans from the other banks	Due to business entities	Due to individuals	Due to non- bank financial institutions
2014	1,168,829	Х	Х	261,372	416,371	Х
2015	1,150,672	667,246	122,592	318,568	402,137	30,474
2016	1,132,515	644,223	73,938	369,913	437,152	42,813
2017	1,172,723	613,681	50,240	403,955	478,100	22,907
2018	1,204,743	587,940	42,178	406,367	508,457	23,794
2019	1,293,377	568,621	23,912	498,157	552,115	26,885
2020	1,613,381	648,020	24,235	646,491	681,892	34,704
2021	1,797,718	613,334	24,948	758,434	726,898	41,410
2022	2,135,838	799,056	6,457	889,526	933,240	53,188

 Table 2. Dynamics of Ukrainian commercial banks' liabilities in 2014-2022

 (UAH million)

X – no data available

Source: The author's own research on the basis of National Bank of Ukraine

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It is noteworthy that despite martial law, 2022 witness an increase in the amount of funds held by business entities and households in commercial banks. This growth occurred mainly in foreign currency. This was facilitated by an increase in interest rates on deposits due to the NBU's increase in the key policy rate to 25%. This resulted in an acceleration in the growth of fixed-term deposits in UAH. The NBU's permission to purchase foreign currency online for placement on deposits also contributed to the growth in the liquidity of banking institutions, which helped to increase the volume of individuals' fixed-term deposits in foreign currency. Thus, the increase in deposits in NBU certificates of deposit, funds on accounts with other banks, deposits of individuals and legal entities, and, ultimately, the deposit portfolio, demonstrates the adaptation of the banking business to martial law conditions, as well as the effectiveness of the NBU's measures intended to stabilize the banking system.

3. Analysis of the performance of Ukrainian banks in 2014-2022 In 2014-2017, the Ukrainian banking sector was unprofitable (Figure 4):



Banks' revenues, UAH million

Figure 4. Dynamics of income and expenses of commercial banks in Ukraine in 2014-2022

Source: The author's own research on the basis of National Bank of Ukraine

In 2016, the Ukrainian banking system suffered a historically high loss of UAH 159 billion, of which about UAH 136 billion was the loss of the largest systemic state-owned bank, Privatbank, due to the loan portfolio provisions at the end of the year.

The main reasons for the unprofitability of the Ukrainian banking system in 2014-2017 were (Chaikovskyi et al, 2022) a significant drop in business activity in the economy caused by the armed conflict in the east of the country and the loss of government control over a part of the country's territory, devaluation of the hryvnia, rising inflation, which, in turn, provoked a reduction in bank deposits of the individuals, a drop in solvency and payment discipline of borrowers, unsatisfactory dynamics of industrial production, and other adverse phenomena. In general, this led to a reduction in interest income due to poor servicing of loans by borrowers and an increase in bank expenses due to the need to form insurance reserves for bad debts.

Since 2018, commercial banks' revenues began to exceed their expenses. The banking sector received UAH 24,716 million in net profit in 2022: 46 of 67 solvent banks were profitable. The decrease in net profit in the banking sector overall amounted to UAH 52,660 million, or 68.05%. The positive financial result was achieved by maintaining high operational efficiency. According to the NBU, the structure of banks' income grew in interest income (by 28.59%) and the result from revaluation and from purchase and sale transactions (more than 5 times). Among the expenses, provisioning had the highest growth rate; in 2022 vs 2021 it increased by 3,345.73% or 34.46 times.

The return on equity (ROE) and return on assets (ROA) of commercial banks in Ukraine were also negative in 2014-2017, which is explained by the banking sector's loss-making performance over this period (Figure 5):



Figure 5. Dynamics of return on assets and capital of Ukrainian commercial banks in 2014-2022

Source: The author's own research on the basis of National Bank of Ukraine

During 2018-2021, the ROE increased from 14.67% to 35.08%, and the ROA increased from 1.69% to 4.09%, respectively. However, at the end of 2022, these indicators decreased to 9.68% and 1.04%, respectively, due to rising bank costs and, as a result, lower profits.

In the context of large-scale armed aggression and the introduction of martial law in Ukraine, ensuring the reliable and stable operation of the country's banking and financial system, as well as maximizing the needs of Ukraine's defense, the smooth operation of the public finance system, and critical infrastructure facilities are of paramount importance. In accordance with the Monetary Policy Guidelines for the period of martial law, the NBU will provide further support and take urgent measures to ensure financial stability. Given the structural liquidity position of the banking system (surplus or deficit) and its volumes, the NBU will, if required, adapt the operational design of its monetary policy flexibly to promote an optimal balance between ensuring an adequate level of liquidity in the banking system to respond to eventual turbulence in financial markets and strengthening the interest rate channel of monetary transmission. If risks to the banking system's liquidity decline, the NBU will wind down its emergency support measures for banks.

4. Conclusions.

With the beginning of hostilities, despite the reduction in the number of banking institutions, the banking sector began to adapt to unfavorable operating conditions. During 2014-2022, Ukraine saw a significant reduction in banking institutions, primarily due to the liquidation of banks with private capital and the exit of foreign banks from the market, which was caused by political and economic instability, as well as the government's revocation of the licenses of banks with russian capital. In 2022, due to the full-scale war, banks were forced to close every fifth branch in Ukraine.

Despite the closure of banking institutions in Ukraine, the volume of bank assets is growing, but their structure is changing. In particular, the share of lending is decreasing, while the share of banks' investments in securities and long-term investments is growing. This policy of the state through the mediation of commercial banks is aimed primarily at supporting Ukrainian enterprises engaged in the production of weapons and military equipment and energy companies that need to be restored. Further to that, the government is actively seeking ways to resume mortgage lending under martial law.

The active adaptation of banks' business models to the unfavorable conditions of martial law and the use of effective NBU instruments allowed the banks to achieve an overall positive financial result and profitability in 2022. There are still many risks and problems that are difficult for banks to cope with in the conditions of the full-scale war, so actions to ensure balance in the money market should be comprehensive and systemic. The further development of Ukraine's banking sector depends on maintaining its resilience, justifying customers' trust, and effective measures taken by the central bank.

The practical significance of the study lies in the possibility of applying the proposed recovery measures by other countries in crisis situations arising in the economic and political environment.

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ARTICLES

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THE CUSTOMS SYSTEM OF THE EUROPEAN UNION IN THE FACE OF THE CURRENT CHALLENGES OF CUSTOMS HANDLING IN SUPPLY CHAINS²

Abstract

The global environment, with its dynamic and varied changes, creates unstable and demanding conditions for the customs system of the European Union to cope with. The article aims to identify and describe the most pressing challenges to the EU customs system in the context of the customs handling of supply chain actors. The hypothesis for verification is that the EU system is not static in the face of the volatility, uncertainty and ambiguity of the environment; instead, it responds to all challenges arising, so as to ensure guarantee professional customs handling to participants in supply chains. The article is composed of two parts followed by a summary. The first part addresses the role of customs in supply chains; the second part presents the most important challenges to the EU's customs system directly related to the customs handling of participants in international supply chains. The summary concludes the issues raised in the investigation. The study relies on traditional research methods: deductive reasoning and comparative analysis.

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Keywords: customs system, customs handling, European Union, supply chain.

JEL: F10, F15, M10, M21.

Introduction

The customs system of the European Union (EU) is an architecture composed of multiple and strongly interrelated elements, performing multi-faceted tasks resulting from the current trends and customs policy challenges. The EU customs system is constantly challenged by the changing environment of the European Union. The environment encompasses actors in supply chains, i.e. businesses involved at various stages of trade, related to customs authorities by participating in customs operations. Those participants primarily expect solutions resulting in the simplification of customs procedures applicable to imported and exported goods as well as ensuring their efficient and safe movement. Introducing such solutions requires the coordination of the main components of the customs system, incorporating legal aspects (i.e. regulations governing trade in goods), organisational structures (action and measures taken by EU institutions shaping the customs system as well as by the customs administrations of the Member States) and economic activities (the collection of customs duties and taxes). From the point of view of supply chain actors, the customs system should quickly respond to changing economic, technological, environmental, safety or security conditions. The volatility, uncertainty and ambiguity of the environment having arisen in connection with Brexit, the COVID-19 pandemic and, subsequently, the war in Ukraine have all placed new burdens on the customs system with regard to flexible crisis management. In practice, those challenges have been primarily faced by the Member States' customs administrations as the authorities fully competent for the supervision and control of all goods crossing customs frontiers, securing and facilitating their movements in supply chains. It is of utmost importance customs handling of participants since the in supply chains is an inseparable stage of international market transactions. Given the above, the article aims to identify and describe the most pressing challenges to the EU customs system in the context of the customs handling of supply chain actors. In order to achieve that objective, the following hypothesis is put forward for verification: the EU system is not static towards the volatility, uncertainty and ambiguity of the environment; rather, it responds to all challenges so as to ensure the guarantee comprehensive customs handling to participants in supply chains. The approach adopted encompasses the application of the following

traditional research methods: deductive reasoning and comparative analysis.

The subject is a topical problem from the perspective of the development of the EU's customs union. The challenges facing the customs system involve a wide range of regulations and solutions applied in the legal, organisational and economic dimensions of the European customs union. The paper addresses a selection of issues directly related to the customs handling of international supply chain actors. The role of customs quality remains underestimated by the mainstream scientific studies of the functioning of modern supply chains. The conclusions presented mostly have cognitive values, thus constituting added value. However, bearing in mind the volatility of the environment, one must treat them as the starting point for further discussion and analysis.

1. The role of customs in the international supply chain

The functioning of the EU, as a major global trade actor, depends on efficient movement of goods from and to the territory of the customs union as well as on the free movement of goods within the single market. The purpose of any supply chain is to ensure smooth flows of materials, products and services, from their respective places of origin to final customers [Świerczek, 2009]. The term supply chain should be understood as a network of connected and interdependent organisations engaged in mutual cooperation in order to control, manage and improve material and information flows from suppliers to end users [Christopher, 2000]. As noted by J.B. Ayers [2002], a supply chain comprises organisations and processes related to purchasing, storing, selling raw materials, semi-finished products and finished goods. The movement of products through such a supply chain is connected with information and financial flows. In a broad sense, a supply chain can be seen as interrelationships between economic operators responding to customer demand and efficient movement contributing to of goods, services, capital and information accompanied by the circulation of documents with back-tracking (from the shop shelf), in order to optimally meet the needs of final consumers, while maximising business efficiency and productivity of the whole process [Czyżowicz, 2011]. A supply chain can also be perceived in philosophical terms - as an integrating management philosophy for all flows over a distribution channel from the supplier to the end customer [Cox, Blackstone, Spencer, 1995], or as a series of operations performed by various enterprises: a sequence of processes adding value to the product during its movement and processing, from raw materials through all intermediate stages to the form required by the final customer [European Committee for Standardisation, Logistics, 1997]. As an extension of national supply chains, an international supply chain is a composition of multiple elements working together: undertakings, streams of products, information and funds flowing between them, functioning in a complex array of international conditions and factors. For a supply chain to be considered international, at least one of the three business processes - sourcing, production or distribution - must be internationalised [Rutkowski, Ocieka, 2011]. From the point of view of customs authorities, an international end-to-end supply chain is a process involving, for example, the manufacturing of goods for export until their delivery to another customs territory. It is not an identifiable entity; instead, it represents a series of ad hoc elements, i.e. traders operating in various industry segments. Sometimes, all the enterprises are known and may cooperate under long-term relationships; in other cases, undertakings may often change or only be contracted for a single [European Commission, 2016]. transaction Supply chain actors of relevance to customs operations include manufacturers, exporters, freight forwarders, warehouse keepers and other storage facility operators, customs agents/representatives, carriers, importers. Those participants operate in different countries, which results in various barriers such as geographical distances, local economic, technological, legal, social and cultural conditions. Therefore, the three main dimensions of the EU customs system, i.e. its legal, organisational and economic aspects, must be effectively coordinated. The EU customs system constitutes a complex array of customs institutions functioning in public and market areas of the EU, strongly interrelated, performing multi-faceted tasks arising current customs policy challenges [Świerczyńska, from 2017a]. Its foundation is the customs union formed by the EU Member States. The development of the customs union is correlated with changes in international economic relations and the EU's plans for the role of customs duties and the customs system. The international framework of the customs system is composed of the customs administration or, more specifically, the competent customs administrations of the Member States [Table 1].

COUNTRY	Name of customs administration	Type of organisation	Number of customs staff (approximate)
Austria	Customs Department, Ministry of Finance	Ministry department	1,700
Belgium	General Administration of Customs and Excise, Federal Public Service of Finance	Ministry department	3,233
Bulgaria	National Customs Agency	Customs agency	3,174
Croatia	Customs Administration, Ministry of Finance	Ministry department	2,587
Cyprus	Department of Customs and Excise, Ministry of Finance	Ministry department	456
Czech Republic	The Customs Administration of the Czech Republic	Customs agency	5,535
Denmark	Danish Customs Agency	Customs agency	960
Estonia	Estonian Tax and Customs Board	Revenue authority	537
Finland	Finnish Customs	Customs agency	2,028
France	Direction Générale des Douanes et des Droits Indirects	Customs agency	16,748
Germany	Central Customs Authority	Customs agency	42,153
Greece	General Directorate for Customs and Excise/ Independent Authority for Public Revenue	Revenue authority	1,192
Hungary	National Tax and Customs Administration	Revenue authority	4,247
Ireland	Office of the Revenue Commissioners, Irish Tax and Customs	Revenue authority	1,267
Italy	Customs and Monopolies Agency	Customs agency	9,607
Latvia	National Customs Board of the State Revenue Service	Revenue authority	482
Lithuania	Customs Department under the Ministry of Finance of the Republic of Lithuania	Ministry department	1,958
Luxembourg	Administration des Douanes et Accises	Customs agency	450
Malta	Customs Department, Ministry for Finance and Employment	Ministry department	420
Netherlands	Customs Policy and Legislation Department, Ministry of Finance	Ministry department	5,809
Poland	National Revenue Administration	Revenue authority	11,274
Portugal	Tax and Customs Authority	Ministry department	1,329
Romania	Romanian Customs Authority	Customs agency	3,021
Slovakia	Financial Administration, Slovak Republic	Revenue authority	2,887
Slovenia	Financial Administration of Republic of Slovenia, Customs Department	Revenue authority	455
Spain	Departamento de Aduanas e Impuestos Especiales. Agencia Estatal de Administración Tributaria (AEAT)	Revenue authority	4,084
Sweden	Swedish Customs	Customs agency	2,457

Table 1. Customs administrations of the European Union Member States

Source: prepared by the author on the basis of [WCO, 2023].

Customs administrations are primarily responsible for the supervision of the Union's international trade, the implementation of external aspects of the internal market, of the common trade policy and of the other common Union policies of relevance to trade as well as overall supply chain security [Regulation (EU) 952/2013]. Customs administrations put in place measures aimed, in particular, at the following: protecting the financial interests of the Union and its Member States; protecting the Union from unfair and illegal trade while supporting legitimate business activity; ensuring the security and safety of the Union and its residents, and the protection of the environment, where appropriate in close cooperation with other authorities; and maintaining a proper balance between customs controls and facilitation of legitimate trade [Regulation (EU) 952/2013]. Customs supervise all goods entering or leaving the territory of the EU's customs union, 24 hours a day, 365 days a year. To that end, they identify any threats or risks based on intelligence information regarding trade and security and carry out controls to ensure enforcement of the applicable rules. In 2022, the amount of duties collected in all the Member States was EUR 33.6 billion, with 75%, i.e. EUR 25.2 billion, transferred to the budget [European Commission, 2023b]. Moreover, FU customs administrations detected 508.9 tonnes of illegal drugs as well as 3.7 billion pieces of illicit tobacco and cigarettes. EU customs also seized 1,959 pieces of firearms, an enormous amount of over 5.8 million pieces of ammunitions and more than 205,000 pieces of explosives in the Products suspected of violating intellectual property rights EU. were intercepted by the EU's customs on almost 73,000 occasions. In 2022, customs administrations in the EU detected 34,694 cases of goods posing various health-related risks to consumers (in terms of sanitary, phytosanitary or veterinary technical standards) [European Commission, 2023bl.

International supply chain actors need to deal with customs authorities nearly on a daily basis – every undertaking (whereas an importer or an exporter) must meet certain formal requirements and undergo customs procedures in their transactions. The wide variety of supply chain links (manufacturers, exporters, importers, freight forwarders, carriers; small, medium-sized and large enterprises; new entrants and experienced traders; a varying number of customs checks and amounts of customs duties and taxes paid, etc.) requires customs authorities to adopt different approaches while maintaining equal treatment in all the Member States. In 2022, 1,870 customs offices employing 82,431 customs officials handled the import, export and transit of around 1,110 million items (Table 2). According to the European Commission data [2023b], 95% of import declarations and 93.5% of export declarations were cleared by customs within 60 minutes.

COUNTRY	Import	Transit	Export
Austria	3,726,035	2,443,771	768,149
Belgium	10,498,874	9,091,975	15,114,863
Bulgaria	493,411	465,129	406,751
Croatia	341,298	281,077	321,496
Cyprus	203,096	1,640	44,016
Czech Republic	1,653,433	699,952	1,603,494
Estonia	531,633	158,568	153,236
Finland	663,316	73,800	1,103,650
France	4,614,459	-	6,817,725
Germany	149,300,000	7,800,000	234,200,000
Greece	521,542	145,312	677,107
Hungary	149,728	1,470,615	22,475
Ireland	22,311,429	-	2,468,979
Italy	28,521,270	1,296,302	21,611,676
Latvia	201,307	291,876	226,910
Lithuania	317,523	468,233	558,113
Luxembourg	68,021	104,178	87,398
Malta	880,325	253	23,626
Netherlands	152,914,525	3,731,342	32,898,771
Poland	7,211,046	488,320	16,660,466
Portugal	712,495	64,104	1,458,491
Romania	944,936	476,979	692,169
Slovakia	514,392	169,781	525,789
Slovenia	523,695	-	503,450
Spain	6,185,028	572,131	14,115,956
Sweden	6,627,547	459,959	5,988,107

Table 2. Number of customs declarations in 2022

Source: prepared by the author on the basis of [WCO, 2023].

Bearing in mind the importance of customs quality to smooth movement of goods in international supply chains, one can presume that customs handling represents a process comprising a wide range of specialised operations related to planning, organising, implementing and controlling movements of goods and services between various supply chain links located in different customs territories, from the manufacturer through all the intermediate stages of distribution, for the purpose of meeting the final consumer's needs [Witkowski, 2018]. Therefore, customs (and customs handling in particular) encompasses all customs formalities associated with business transactions in international trade in goods, carried out before customs authorities in accordance with the applicable law. The catalogue of customs services provided by the EU Member States' customs administrations is very extensive and gradually increasing. Those are related to the implementation of customs policy measures arising from participation in the European customs union; contribution to revenue by collecting import and export duties, taxes and other charges; placing goods under various customs procedures and regularising the situation of imported and exported goods; recognising, detecting, combating and preventing crime, various serious criminal and petty offences concerning goods subject to prohibitions or restrictions on trade. With regard to customs quality, the top priorities for supply chain actors include the customs handling time and cost of transactions, service utility, easy access to information and uniform customs handling in every Member State.

2. The customs system in the face of supply chain challenges

As shown by more than half a century of the operation of the EU's customs system, the European customs union has endeavoured to perform its functions, adjusting the customs system to new tasks as well as to growing needs and demands from supply chains. In recent years, the customs system has been facing serious challenges: during the COVID-19 pandemic, customs administrations took measures to ensure border surveillance and effective border control, of extreme importance due to the role of filtering the movement of persons played by the EU's external borders, thus mitigating pandemic-related consequences. In addition, customs authorities performed a vital function of monitoring the carriage of vaccines and medical equipment, simultaneously adapting to disrupted and unstable supply chains. It also coincided with the expiry of the transition period related to the United Kingdom's withdrawal from the EU's single market, which changed the boundaries of the customs union in 2021. Subsequently, Russia's invasion of Ukraine forced customs to carry out a number of tasks: from enforcing prohibitions on exports through import control to providing assistance in the form of relief from customs duties. The consequences of those events put the resilience of global supply chains to the test. Supply chain resilience is defined as the ability of a supply chain to prepare responses to unexpected risk events and to recover from disruptions, restoring its potential to the original situation or moving to a more desirable state [Hohenstein, Feisel, Hartmann, Giunipero, 2015]. The risks of disrupted transport processes, suppliers' being unable to execute orders or broken transport links with other members of supply chains all accentuated the necessity for the customs system to respond and adapt, e.g. through flexible customs. In that context, one must point to related efforts by the European Commission; on 17 May 2023, the European Commission [2023a] presented its reform proposals for the customs union, with a time frame of 2028 to 2038. With regard to supply chains, the Communication
indicated that the customs union must be agile, future-proof and adapt flexibly to changes in supply chains, whether those related to the twin – green and digital – transitions in the ongoing decade or future developments of relevance to supply chain management [European Commission, 2023a].

The changes of the EU customs system, which have been occurring since the beginning of the 21st century, aim to pursue twin goals, i.e. facilitating and boosting trade in goods as a result of reducing customs clearance formalities and introducing simpler ones, as well as ensuring the security of commercial transactions and trade at the same time [Czermińska, 2016]. The challenges related to customs processes in supply chains concern various areas, particularly customs risk, e-commerce, customs legislation, supply chain partnerships and sustainable development.

2.1. Customs risk management in supply chains

The term (customs) risk was first introduced to the EU's customs legislation in 2005, as an amendment to the Community Customs Code [Regulation (EC) 648/2005]; it means the likelihood and the impact of an event occurring, with regard to the entry, exit, transit, movement or end-use of goods moved between the customs territory of the Union and countries or territories outside that territory and to the presence within the customs territory of the Union of non-Union goods, which would: prevent the correct application of Union or national measures; compromise the financial interests of the Union and its Member States; or pose a threat to the security and safety of the Union and its residents, to human, animal or plant health, to the environment or to consumers [Regulation (EU) 952/2013]. There is virtually no limit to supply chain areas where customs risk might arise, with multi-faceted origins. The various sources of threats to smooth flows of goods in supply chains in the customs aspect include behaviour or conduct inconsistent with the applicable legislation, legal requirements, accepted norms and adopted customs standards (incorrect classification of goods; erroneous customs tariff code, miscalculated customs value; false or incomplete particulars in customs declarations; the origin of goods inaccurately described), improper use of the IT system of an economic operator compromising supply chain continuity; no or incorrect control of the movement of goods; the lack of appropriate tools for business partner identification resulting in insufficient, false or no knowledge on the other supply chain links. Since any response to a significant risk tends to be active, it is necessary to appropriately manage such responses. The essence of risk management is the systematic identification of risk and the implementation of all measures necessary for limiting exposure to risk [Regulation (EU) 952/2013]. For a supply chain, it requires the capacity to identify, evaluate and analyse the full range of threats and risks associated with goods and their movements as well as, should such threats materialise, taking account of their impact and consequences to undertake appropriate measures [European Commission, 2014]. Risk management allows customs authorities to more effectively identify and target those consignments that present a risk, thus to address those risks at the best moment in the supply chain [European Commission, 2021a]. Although risk management complementarity at the Union and national levels is of major importance, it is not always the case. The Member States have no common (EU-wide) regime for the supervision of supply chain consignments; customs authorities use their respective national systems and, in practice, each Member State adopts its own approach to the application of controls. Seizing opportunities for fraud or unfair practices, rogue traders may target the weakest link of the EU's external border to allow illicit or dangerous products to enter the EU market.

In the future, customs measures should focus on developing a high quality, multi-layered, effective and efficient common approach to risk management. It is necessary to adopt such a flexible approach as customs controls increasingly rely on digitisation and data flows. Risk analysis remains a key component of efficient customs controls enabling customs authorities to target controls in situations of the growing volume and pace of trade, putting an increasing pressure towards a more selective and targeted approach [European Commission, 2021a]. According to the planned reform of the customs union, risk management will be based on common priority setting while balancing centralised and country-specific rules.

2.2. E-commerce management in a customs environment

The growing role and complexity of supply chains give rise to new expectations towards the customs system which must be met for economic operators to seize opportunities offered by cross-border e-commerce. As defined by Eurostat and the OECD, e-commerce is the sale or purchase of goods or services by businesses, households, individuals or private organisations through electronic transactions conducted via the Internet or other computer-mediated (online communication) networks [European Court of Auditors, 2019]. According to the World Customs Organisation, it consists in pursuing economic activities with the use of ICT and computer technologies for electronic data interchange between independent computerised information systems for transacting business [Wawszczyk, 2003]. The cross-border aspect of e-commerce means that the actual (geographical) place of purchase is basically irrelevant to purchasing decisions; the option to buy the product concerned is accessible to the customer regardless of their country of physical presence or of the time of the transaction. The rapid growth in the volume of e-commerce,

particularly during the COVID-19 pandemic, due to increased fraud risk, required changes in conducting transactions. On 1 July 2021, the VAT e-commerce package entered into application; under that legislation, VAT must be levied by customs authorities on all goods upon their entry into the EU, unless the seller already charged the EU VAT on purchase under the Import One-Stop Shop scheme. Consequently, all imported products, also those of an intrinsic value not exceeding EUR 150 (for which no customs duties are due), are subject to VAT. As a result, the number of standard customs declarations increased from 376.8 million in 2019 to 691.5 million in 2021 [European Commission, 2021a]. The VAT e-commerce package enabled customs authorities to better supervise supply chains, but it did not eliminate the risk of abusing the above-mentioned threshold through undervaluing consignments. It will only be possible after removing the EUR 150 customs duty exemption, as indicated in the planned reform of the customs union.

Virtual reality will continue to develop rapidly; therefore, e-commerce procedures will require constant analysis and review, particularly with regard to the protection role played by the customs system: protecting societies from abuse of e-commerce for criminal activity, as well as to the performance of the fiscal function: fair and efficient charging, levying and collecting customs duties and taxes, especially in the case of low-value consignments. In addition, customs quality must keep up with the rising number of transactions and risk management requirements in conditions of limited knowledge on occasional e-buyers and supply chains.

2.3. The customs legislation - tasks and challenges facing customs administration in the light of international supply chains

A major challenge facing the customs system is taking action aimed at improving and facilitating compliance with the customs laws and regulations on the part of supply chain actors. The EU customs legislation comprises all legal rules, regulations, norms and instruments concerning trade in goods and services as well as procedures, mechanisms and institutions associated with those processes and relating to merchandise between the EU and third countries [Czyżowicz, trade 2002]. More precisely, the EU customs legislation encompasses all legal acts, including: the Union Customs Code (UCC) and the provisions supplementing or implementing it adopted at Union or national level; the Common Customs Tariff; the legislation setting up a Union system of reliefs from customs duty; international agreements containing customs provisions, insofar as they are applicable in the Union [Regulation (EU) 952/2013]. The volume of rules adopted by the EU in recent years is significant, e.g. with regard to environmental, safety and security, health, digital standards; at present, goods need to comply with and customs must enforce more than 370 legal acts of the EU. Those ever-increasing tasks related to the enforcement of the EU legislation on prohibitions and restrictions have been placing significant pressure on customs [European Commission, 2023a]. Underpinning international movements of goods, the customs legislation contributes to ensuring smooth functioning of supply chains. Therefore, it should be clear, transparent and accessible to all actors. Systematic evaluations of the applicable regulations, with a view to verifying whether they still correspond to the actual international trading conditions and ensure business-friendly customs procedures, should become standard practice. Such reviews are also necessary on account of the functioning of the COVID-19 pandemic experience, such development may result in disrupted or interrupted supply chains.

Another challenge to the Union customs system concerns the interpretation of the customs legislation, to be implemented and enforced by the Member States. To date, even though the EU customs legislation is applicable in all the Member States, its interpretations happen to differ. An important step was the announcement of establishing the EU Customs Authority, as part of the planned reform [European Commission, 2023a]. The new institution will be tasked with steering, coordinating and supporting national customs authorities for a more harmonised application of customs processes. It will enable customs authorities at the EU and national levels to 'act as one' with regard to controlling the EU's external border for goods, thus strengthening the supervision of supply chains [European Commission, 2023a]. It is worth highlighting that there is no single EU customs administration at present; instead, traders must deal with 27 national customs administrations which should act in a fully coordinated manner, which is, unfortunately, not always practical. Moreover, the Customs Authority will be tasked with preserving the integrity of the single market, in particular by drawing up guidelines on acts and omissions infringing customs regulations and preparing a single package of non-criminal sanctions for such infringements for all the Member States [European Commission, 2023a]. It is extremely crucial to establish a single legal framework for customs infringements as the existing differences leave the door open for fraud and abuse of rules. Another pivotal element is to ensure equal treatment of traders, irrespective of the place where goods are brought into or taken out of the customs territory of the EU. So far, efforts made by the European Commission to develop a single classification of infringements of customs law and sanctions have not resulted in a satisfactory conclusion. Therefore, the above-mentioned issue remains to be resolved in the near future. At this point, it is worth emphasising that members of supply chains only enjoy a level playing field when the customs legislation is applied and enforced in a uniform manner.

The absence of a common legal framework for the treatment of customs infringements and sanctions results in the lack of legal certainty for economic operators as well as in potential supply chain disruptions. Supply chains must be supported by clear, stable, coherent, predictable and practical customs legislation.

2.4. Partnership in supply chains - AEO status as an important way of building trust between business partners in supply chains

Partnerships determine the shape and nature of cooperation in business; the risk of a collapse of cooperation and a loss of trust between supply chain actors may arise at any time. Therefore, it is essential to even more effectively reinforce the role and status of Authorised Economic Operator (AEO). Introduced to the EU legal order in 2005 [Regulation (EC) 648/2005], the AEO programme has functioned in practice since 1 January 2008 [Commission Regulation (EC) 1875/2006]. The status of Authorised Economic Operator (AEO) is granted to an economic operator who is deemed reliable, trustworthy and financially solvent in the context of their customs-related operations; whose organisation, infrastructure and safeguards for IT systems and facilities for the storage of goods provide an adequate protection of areas and goods and against unauthorised access to the goods [Świerczyńska, 2017b]. The participation in supply chains of economic operators seen by customs authorities as reliable, trustworthy and financially solvent makes it easier to build partnerships and trust. But due to stringent requirements for traders applying for an AEO authorisation (AEO certificate) and varying customs approaches adopted in particular Member States during audits, despite the various benefits in the form of facilitations granted (fewer controls; priority treatment of consignments if selected for control; choice of the place of controls, e.g. different from the place of the customs office involved; prior notification; self-assessment, centralised clearance) or indirect benefits (reduced theft and losses; fewer delayed shipments; improved planning; improved customer service; improved confidence, thus customer loyalty; improved inventory management; improved employee commitment; reduced security and safety incidents; lower inspection costs of suppliers; improved communication between supply chain partners) [European Commission, 2016], the solution attracts varying interest from businesses in individual Member States. It is very important to effectively encourage economic operators to participate in the Programme; the more links in an international supply chain hold AEO authorisations, the more benefits will be available for the supply chain as a whole. In a situation where all supply chain links are not holders of AEO authorisation, customs administrations may not assess the risk as low enough to be reflected in reduced customs controls of consignments shipped in the supply chain

in question, significantly speeding up the movement of goods. The new concept of 'Trust and Check traders' (modified and upgraded AEOs) included in the customs reform seems to be a step in the right direction; the underlying idea is that the most trustworthy economic operators should be able to place their goods on the EU market (for free circulation) without formal customs interaction [European Commission, 2023a].

2.5. Sustainable supply chains - the role of customs authorities and customs services

Supply chain strategies are increasingly built on the basis of modern concepts of sustainable development. The objective of supply chain sustainability is to create, protect and increase long-term value for all stakeholders involved in bringing products and services to the market [Sisco, Chorn, Pruzan-Jorgensen, 2012]. The application of sustainable development principles in supply chains contributes to long-term business viability in agreement with all participants. Sustainable supply chain management is the control of supply chain operations, resources and logistic streams to maximise supply chain profitability while reducing negative environmental impact and maximising social well-being [Hassini, Surti, Starcy, 2012]. The sustainability concept is consistent with tapping the potential of digital tools in the implementation of customs administration. It has become a priority for the customs system to rely on IT systems wherever possible, according to the principle of a 'paperless environment'. The ICT solutions adopted in customs are based on the regulations of the Decision of the European Parliament and of the Council on the introduction of an EU-wide electronic customs system [Decision 70/2008/EC] as well as on the UCC provisions. Although some of the work associated with extending and upgrading a total of 17 IT systems was completed in 2020, ensuring a complete and fully integrated structure across all the Member States is planned to continue up to 2025 [European Commission, 2018].

The implementation of modern IT solutions in customs speeds up the movement of goods in supply chains, which contributes to achieving one of the main objectives of any supply chain, i.e. ensuring smooth and efficient flows of materials, products and services, from their place of origin to the final customer. Nowadays, tapping the potential of digital tools in the provision of customs services is indispensable to supply chain sustainability. Therefore, it is vital for ICT systems to offer uniform solutions to all supply chain actors in all the Member States. The goal to be achieved in the implementation of customs systems is reaching the highest possible level of integration, which undoubtedly is and will remain challenging to customs, given the ongoing and fast technological changes. For the coming years, it is essential that the development of e-services offered by electronic customs should continue. At the same time, e-customs should be subject to constant monitoring for the quality of customs operations. Making supply chains more sustainable, in particular by promoting sustainability standards across global value chains, should be a priority. Experience has shown that more sustainable supply chains tend to be more resilient. Trade policy can also contribute to that objective by promoting responsible business conduct as well as greater transparency and traceability in supply chains [European Commission, 2021b].

Summary

The EU system is not static in the face of the volatility, uncertainty and ambiguity of the environment; instead, it responds to all challenges arising, so as to ensure the guarantee professional customs handling to participants in supply chains. In the author's opinion, measures taken so far allow a positive assessment of customs activities. In both legal and organisational aspects, the customs system efficiently and smoothly adapts to new tasks and ever-increasing demands of changing international trade conditions. High quality customs is a major source of supply chain benefits and profits. The role played by customs administrations towards supply chain actors is not confined to their traditional dimension, consisting in the collection of customs duties and taxes; rather, it is constant and consistent support for economic activity. Customs quality should be seen as a commitment that the customs system should fully meet expectations from members of supply chains by providing professional services adapted to the actual conditions. An important determinant of customs quality is clear, transparent customs legislation as well as the rights and of economic operators arising from customs obligations rules and regulations. Much has been done in that regard, with positive customs reform developments, considering the planned time frame for the implementation of the reform (2028-2038). Until the full implementation of the reform, the regulations should be monitored for relevance to changing business conditions, for the legal environment to support and promote supply chain operations. Innovative solutions and facilitations introduced to the customs system are largely based on the electronic environment, which is perfectly consistent with the sustainability principle, for individual enterprises and the EU economy as a whole. Therefore, it is vital for ICT systems to offer uniform solutions and options to all supply chain actors in all the Member States. According to the Author, the most important for customs services in supply chains will be activities aimed at enhancing effective controls at the optimal point of the supply chain, based on maximal automation and electronisation,

To recapitulate, the global environment, with its dynamic and varied changes, creates unstable and demanding conditions for the functioning

of modern supply chains, thus giving rise to ever new challenges to the EU customs system. The EU system must be forward-looking, taking account of global trends and challenges; customs administrations must display constant innovation and preparedness for action. A stronger customs system requires standardised internal and external measures in a number of areas as well as adapting and using all the tools necessary to support members of supply chains.

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